15. Spacecraft Support Ground System

The GOES-NOP spacecraft support ground system (SSGS)

- Generates spacecraft commands for uplink
- Processes telemetry downlinks, instrument data downlinks, and multi-use data link (MDL) data
- Generates the GOES variable (GVAR) data uplink to the spacecraft
- Determines the spacecraft orbit and attitude using star look, range, and landmark data
- Provides stationkeeping maneuver planning tools
- Monitors GVAR data broadcast quality.

The SSGS comprises seven elements:

- NOP telemetry acquisition and command transmission system (NTACTS)
- GOES-NOP telemetry and command system (GTACS)
- Orbit and attitude tracking system (OATS)
- MDL receive system and server (MRS&S)
- Dynamic interaction diagnostic (DID)
- Sensor processing system (SPS)
- Product monitor (PM).

As shown in Figures 15-1 and 15-2, the GOES SSGS equipment resides at National Oceanic and Atmospheric Administration (NOAA) facilities at the locations below:

- Satellite Operations Control Center (SOCC) in Suitland, MD
- Wallops Command and Data Acquisition Station (WCDAS) in Wallops, VA
- Fairbanks Command and Data Acquisition Station (FCDAS) in Fairbanks, AK, capable of supporting one GOES-NOP satellite West of 100° West longitude

- Wallops Backup (WBU) at the Goddard Space Flight Center (GSFC) in Greenbelt, MD, capable of supporting one GOES-NOP satellite
- Space Weather Prediction Center (SWPC) in Boulder, CO, capable of receiving the MDL signal from three GOES-NOP satellites.

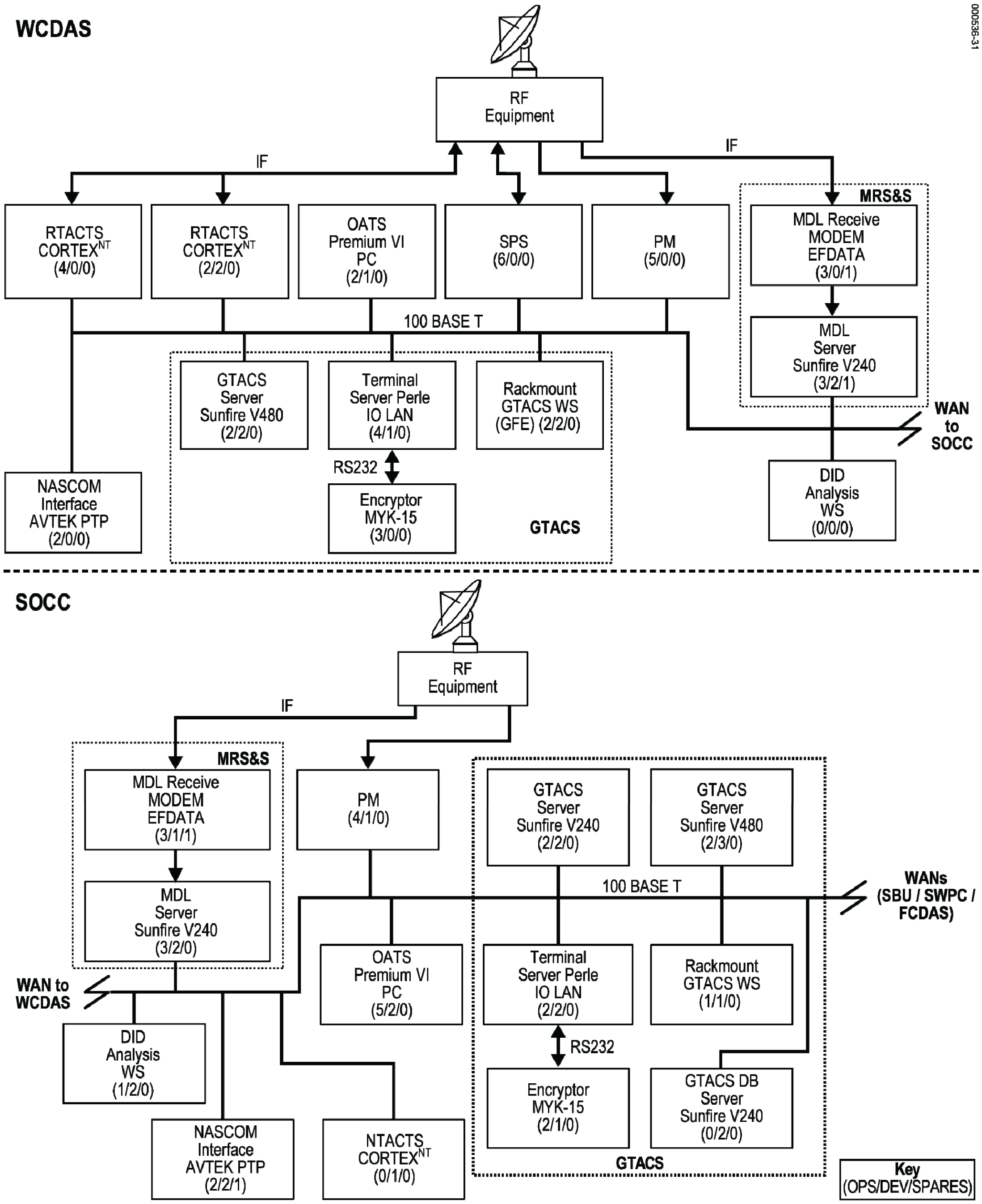

Figure 15-1. GOES-NOP SSGS Elements at the WCDAS and SOCC

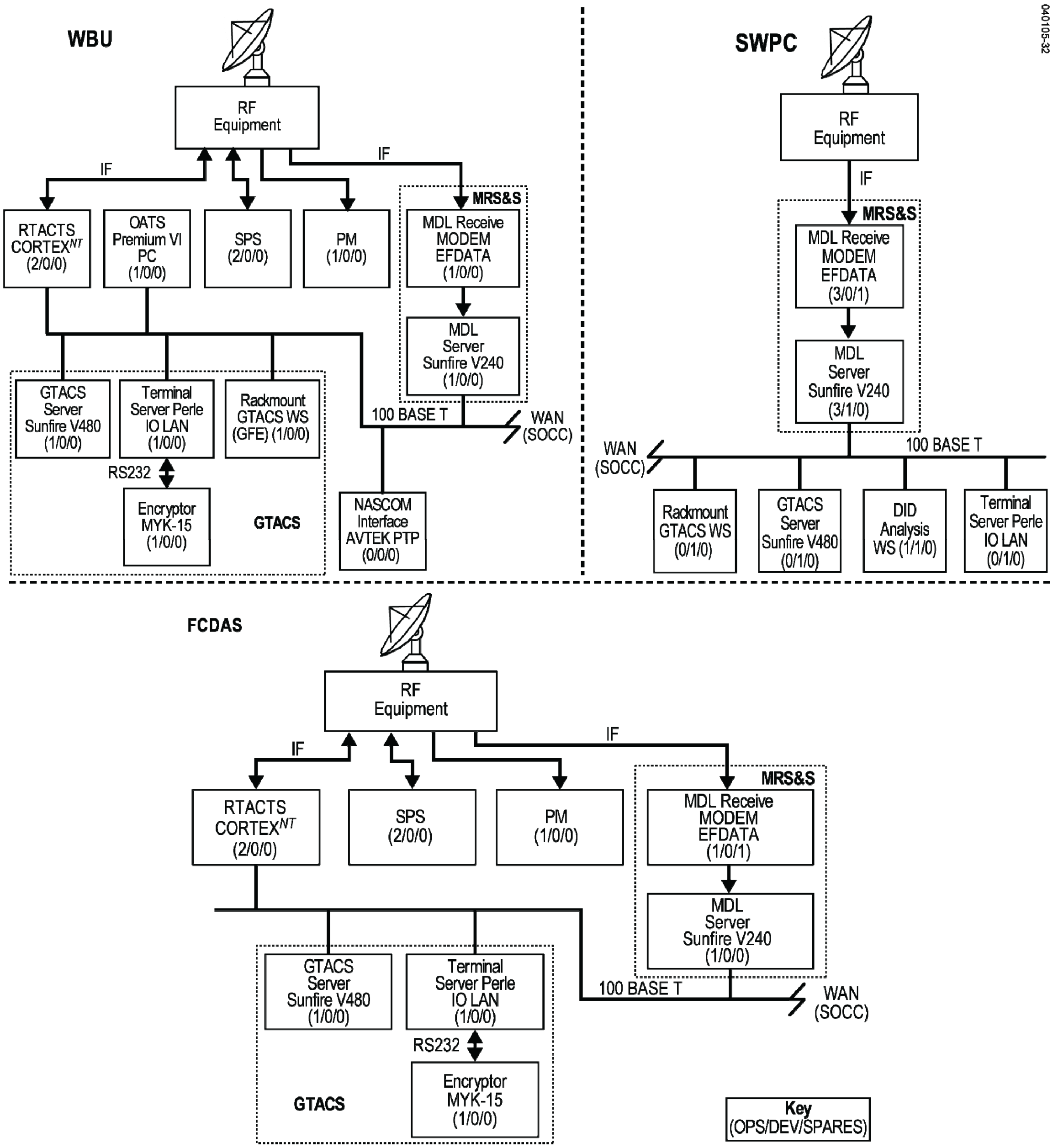

Figure 15-2. GOES-NOP SSGS Elements at the WBU, FCDAS, and SWPC

Figure 15-2. GOES N-P SSGS Elements at the WBU, FCDAS, and SWPC

The CDASes provides RF transmit and receive interface with the spacecraft for all functions; the SOCC receives only the GVAR and MDL signals. Primary GOES command, control, scheduling, and engineering operations activities are hosted at the SOCC, with a complete backup capability at the WCDAS.

The SSGS receives several independent data streams from each spacecraft and processes the following data:

- Raw Imager and Sounder data is received at the NOAA CDASes and processed in the SPS resulting in highly accurate, earth-located, calibrated imagery and sounding data in near real time; star sense data, which is directed to OATS for use in attitude determination; and instrument health and safety data, which is directed to GTACS. This data is formatted as GVAR data and transmitted to its corresponding spacecraft for relay to principal users.
- GVAR data is received at the SOCC, the WCDAS, the FCDAS, and the WBU and processed by the PM and the SPS. The PM monitors the quality of the processed data and registers landmarks, and the SPS performs spacecraft ranging. These observation data are then used by OATS as part of the orbit and attitude determination process.
- MDL data is received at the WCDAS, the FCDAS, the SOCC, the WBU, and the SWPC, and processed by the MRS&S. The MDL stream includes Imager and Sounder servo error data, Imager image motion compensation (IMC) data, angular velocity sensor data, Solar X-ray Imager (SXI) data, and both spacecraft spacecraft pulse code modulated (PCM) telemetry streams. The MRS&S makes this data available to the DID for diagnosing dynamic interactions among the instruments and the spacecraft. The MRS&S also supports a custom client interface to extract specific contents from the MDL stream. SWPC, for example, uses custom clients to extract SXI and SEM data.
- Two streams of PCM data are received at the WCDAS, the FCDAS, and the WBU. The NTACTS provides bit and frame synchronization and passes the data on to GTACS for further processing. These streams contain spacecraft health and safety data used in monitoring spacecraft commanding performed on the ground or from stored commands on the spacecraft. The SWPC derives SXI and space environment monitor (SEM) instrument data from the MDL stream for use in solar environment forecasting.

Spacecraft commanding is generated within GTACS, which generates bit-level, encrypted commands. GTACS transfers the commands to NTACTS, which interfaces with CDAS RF system for uplink to the spacecraft..

The SOCC has physically a physically diverse landline circuits to each of the other four sites. Operations voice circuits are also provided via the landline WANs. The interconnectivity allows the exchange of both spacecraft operations data and status data among SSGS elements. The data exchange between GTACS and all other SSGS elements use the TCP/IP socket protocol. The SSGS comprises separate operational and development configurations, each on its own local area network. The operational network includes equipment strings at all five sites, while the development network comprises equipment at the SOCC, the WCDAS and SWPC. Figures 15-1 through 15-5 show the equipment configuration at each site

NTACTS

NTACTS provides an interface between GTACS and the GFE RF systems at the Wallops CDAS and WBU for PCM telemetry receipt and spacecraft command transmission, and can be used for spacecraft ranging. Each NTACTS services a single GOES-NOP spacecraft and is able to receive two PCM telemetry streams as IF signals. NTACTS bit synchronizes, frame synchronizes, time tags, and formats the minor frame data for each stream for transmission to GTACS. NTACTS receives commands from GTACS in a form ready to uplink (encryption is already applied) and modulates an IF command signal that is passed to the GFE ground station RF equipment for transmission to the spacecraft. In support of the command link, NTACTS sweeps the carrier to establish carrier lock with the spacecraft at initiation of contact and transmits an idle pattern between commands to maintain lock. Each NTACTS can send telemetry data to multiple GTACS to provide receipt redundancy, but can establish a commanding connection to only one GTACS at a time. NTACTS can also be connected to the spacecraft emulators for commanding and telemetry.

There are four NTACTS at the Wallops CDAS and one at the SOCC (used for testing). There are also four GOES I-M RTACTS at the WCDAS that can be moved to the SSGS network for use as NTACTSs

At the FCDAS and the WBU there are no NTACTSs. The two RTACTS at each of the sites are switchable between the I-M and N-P networks.

GTACS

GTACS performs tasks similar to those performed by the GOES I-M telemetry and command system (GIMTACS) for the GOES-NOP satellites using a distributed system of servers and user workstations located at the SOCC, WCDAS, FCDAS, WBU, and SWPC. GTACS processes all real-time and non-real-time spacecraft telemetry data, generates spacecraft commands, provides command schedule generation and upload capabilities, and performs ground system monitoring and control functions, and configures the NTACTS for spacecraft ranging.

GTACS consists of two servers at the SOCC (plus three development machines), two servers at the WCDAS (plus two development machines), and one server each at the WBU and the FCDAS, and one development machine at the SWPC. GTACS servers receive data streams from NTACTS (raw PCM minor frames), MRS&S (SXI housekeeping data, memory dump and image summary data, and PCM), SPS (Imager and Sounder housekeeping data), and spacecraft emulators. The servers archive the raw data, decommutate and convert values to engineering units and check database limits, and provide the resulting parameter values to other processes such as user display, and interface the NOAA GOES Archive System (GAS), which provides long-term storage and supports the trending analysis function. Programmable Telemetry Processors (PTPs) provide the interface between GTACS and Nascom and the USN for launch and early orbit telemetry, tracking, and commanding (TT&C).

Each GTACS server can concurrently support multiple spacecraft, and the entire GTACS element can support up to eight spacecraft (including real and simulated spacecraft). The GTACS servers also support command generation and real time schedule execution (if schedule commanding is from the ground) and monitor the execution of onboard schedules. Binary commands nominally are encrypted using commercial encryption devices before transmission to NTACTS for uplink.

More than one server can be configured to receive data from a spacecraft, providing redundancy in case of a server or network failure. If multiple servers are configured to support one spacecraft, one server is configured as prime, with the other servers configured as backups. Only the prime server can generate spacecraft commands, and only one user on the prime has authority to issue commands. In a redundant configuration, servers at the WCDAS and SOCC can support the same spacecraft. Nominally, the server at the WCDAS will be configured as prime, enabling schedule related processing to continue uninterrupted in case of network failure between the SOCC and the WCDAS. Users at the SOCC can connect to either the WCDAS or SOCC server for data service. Users at the WCDAS will connect only to collocated servers.

Users interact with the system on GFE Intel-based workstations. A pool of GFE workstations can be used to support different missions and different aspects of those missions. The assigned user privileges and the corresponding software applications currently in use determine the functions which can be performed on that workstation. These workstations support three categories of user operations.

- First, a workstation can be configured to provide real time T&C operations for a specific spacecraft using data received from a GTACS server. Telemetry and system data points can be monitored using parameter text displays and plots. Users can also create and run procedures that make use of telemetry or other GTACS element data. Users can also monitor the status of SSGS elements and configure aspects of these elements.

- Second, a workstation can be configured to analyze non-real-time data. Using this capability, a user can perform trending analysis, recall archived data, export data, and use additional analysis tools not applicable to real-time data.

- Third, a workstation can be configured to generate schedules. In this mode, a user can start with schedule building blocks and create a set of schedules for daily operations to be commanded either from the ground or from the spacecraft. These schedules are then distributed to other functions within GTACS for execution or upload to the spacecraft. Schedules are nominally generated at the SOCC.

The GTACS support available at the WBU and the FCDAS is similar to that at the WCDAS, except that only one GOES antenna system is available at each. Workstations at the SOCC can be configured to use the WBU or FCDAS server for real time T&C service, as can workstations within the WBU and FCDAS facilities. However, workstations at the WCDAS, the FCDAS, or the WBU will not nominally use a server at the other facility.

OATS

The OATS performs three major functions in support of mission operations using telemetry and status data obtained from GTACS, star sense and range data provided by the SPSs, and landmark and IMC data obtained from the PMs. The primary function is to provide daily computational support for implementing the orbit and attitude determination (OAD) and image navigation and registration (INR) processes. This support consists of a closed-loop sequence that:

- Ingests star, range, and landmark observations from SPS and PM
- Determines spacecraft orbit and Imager and Sounder attitudes
- Determines station radio frequency interference (RFI), and solar and lunar intrusions into the Imager and Sounder
- Predicts eclipses
- Computes image motion compensation
- Determines star observation coordinates.

This daily support is performed both for normal operations and special operations such as during eclipses and yaw-flip maneuvers.

The second major function of OATS is to plan, generate command data, and evaluate maneuvers such as daily momentum dumping, periodic stationkeeping, and repositioning maneuvers. The evaluation includes estimates of the remaining onboard propellant and calibration of the propulsion system.

Finally, OATS requests, accepts, and processes telemetry data such as evaluating thruster firing data and attitude control electronics (ACE) data to verify and calibrate IMC, stationkeeping, and reacquisition support. The OATS also supports the GTACS command-level schedule generation process, generating instrument commands for image frame coordinates and definitions and scheduling star looks.

OATS generates output such as:

- Orbit and Imager/Sounder attitude coefficients for the SPS
- IMC coefficients uplinked to the spacecraft via GTACS
- Star view command data to support Imager and Sounder star sense and sequence operation
- Maneuver planning information and spacecraft stationkeeping command data
- Commands required for daily reaction wheel momentum dumping

- Estimates of onboard propellant remaining
- Propulsion calibration parameters
- Orbit and station events prediction
- Sensor intrusion predictions
- Star tracker intrusion predictions during yaw-flip maneuvers
- Scan frame coordinates conversion
- IMC calibration factors
- Transformation between the IMC set J2000 and the star catalog true-of-date coordinates.

OATS functions are performed on primary and backup systems at the SOCC (five OATS total), with additional backup systems installed at the WCDAS (two OATS total) and the WBU (one OATS). The backup systems are maintained with the most current data so that transfer to the backup OATS (either forced due to primary failure or orderly) may occur with little operational interruption. OATS also archives data for later analysis.

OATS exchanges data with other SSGS elements. OATS communicates with GTACS and other OATS over an Ethernet LAN. OATS provides orbit and attitude related data to GTACS for schedule creation and for maneuver commanding. GTACS provides attitude-related data to OATS, as well as star sense data from SPS with acquisition times added. OATS also exchanges data with the PM and SPS via a gateway that handles protocol translation. These messages include data for spacecraft ranging, landmarks and image correction calibration data.

OATS also has functionality to compute a spacecraft orbit from NTACTS ranging measurements. This functionality replaces/complements the ranging function previously performed through the DSN and is used when the spacecraft is in storage mode.

MRS&S

An MRS&S consists of a server and a demodulator that ingests the MDL signal received from the RF system at an intermediate frequency (IF) of 64.1 MHz for one satellite. The data contained in the MDL stream include Imager and Sounder servo error data, Imager IMC data, and angular displacement sensor data. These data complement instrument telemetry data received by the SPS. In addition to these data, the MDL telemetry stream also contains three other embedded telemetry streams: two PCM telemetry streams (replications of the independently downlinked PCM telemetry streams), and the SXI telemetry stream (100 kbps was allocated to instruments of opportunity (IOOs), but none are being flown on either GOES-N or GOES-O). The MDL stream format has a frame format consisting of 128 29-bit packets, with each 29-bit packet consisting of a five-bit packet header and 24 bits of data.

The MRS&S demodulates and bit synchronizes the received MDL stream, and then frame synchronizes the data to identify the MDL frames and packets. The MRS&S decommutates the dynamics data packets directly from the 29-bit MDL packets, demultiplexes the PCM and SXI streams back into independent bit streams, and then frame synchronizes each stream independently. The MRS&S archives all these data types in a circular seven-day archive mapped as data and product types. The MRS&S then provides access to MDL data in real-time and near-real-time from the archive to the DID and custom MDL clients (including GTACS) via socket interfaces.

The SOCC and the WCDAS each have three MRS&Ss (plus two development machines), while the WBU and FCDAS each have one. The Space Weather Prediction Center (SWPC) in Boulder, CO, also has three MRS&Ss (plus one development machine) that are used for receiving the SXI and PCM data streams, the latter of which contains the SEM instrument data.

DID

DID workstations, supplied by NOAA, provide a configuration controller function for monitoring and control of the MRS&Ss. They also provides a real-time plotting function for the dynamic interaction data, and a PV-Wave analysis tool for plotting dynamic interaction data, and SXI images, histograms, and HASS plots from the MRS&S archive. The analysis tools are used during initial on-orbit checkout to identify dynamic effects that produce excessive interaction and to support the development of operational scenarios that avoid or minimize such interaction, as well as to monitor SXI data quality. Diagnostic telemetry can be used at any time during subsequent spacecraft orbital operations for the same purpose. Using the DID data selection interface, the user can request parameters to be analyzed (real-time or archive data for a desired time span).

The SOCC has three DID workstations, and SWPC has two. At present NOAA has provided no DID workstation at the FCDAS and WBU, with at least one planned for the WCDAS; however, DID software can be run on the MRS&Ss themselves to provide the configuration controller user interface.

SPS

The SPSs perform all functions associated with processing Imager and Sounder instrument data from the GOES I-M and N-P spacecraft, one spacecraft per SPS. Functions provided by the SPS include data ingest, including frame synchronization, decommutation by channel, detector scan alignment, and alternate scan line reversal; visible image normalization; IR radiometric calibration; earth location and Imager gridding annotation; reformatting of instrument data into the GVAR format; computation of Imager and Sounder space look, blackbody, electronic calibration and instrument telemetry statistics for inclusion in GVAR data stream; binary phase shift keyed (BPSK) modulation of the GVAR data stream; and spacecraft ranging. The modulated GVAR signal is passed to the GOES RF system for uplink to the spacecraft.

To support the orbit and attitude determination function of the OATS subsystem, the SPS also performs spacecraft range measurements using the GVAR data stream round trip propagation time, performs star crossing event measurements by processing Imager and Sounder star view data, and extracts periodic IMC and servo error data from the sensor data for use in the IMC quality check function performed by OATS.

Further, SPS sends wideband telemetry data, including command register echo information extracted from the Imager and Sounder data streams and scan position to GTACS every 2 to 10 seconds, as long as valid telemetry is being processed in the SPS. The telemetry message data consists of the latest values received for the telemetry words extracted from the telemetry blocks of the Imager turnaround sequence and telemetry words extracted from the Sounder blocks.

The SPSs are provided by NOAA and are shared by the I-M and N-P satellites. There are six SPSs at the WCDAS, two at the WBU and two at the FCDAS. The spares are typically used as hot backups, but can also be used to support testing or third spacecraft operations on a limited basis.

The SPSs communicate with GTACS and OATS via an Ethernet LAN connection. The SPSs send messages containing ranging and star sense data to OATS and instrument housekeeping telemetry and SPS status data to GTACS. SPSs send text messages and data to the PMs via the GVAR broadcast. The PMs send data, such as image alignment correction factors and visible detector normalization (destriping) tables to the SPSs via the Ethernet LAN. The SPS subsystem also includes an analyst workstation capability at the SOCC, WCDAS, and WBU through which analysts can access Imager and Sounder data maintained in the SPS archive.

PM

The primary functions of the PMs are to monitor and analyze the quality of the image and nonimage data broadcast in the GVAR data stream, feeding back any required changes to the SPS, and to provide OATS with landmark registration and IMC quality check data in support of INR and attitude determination.

In support of the orbit and attitude determination function, the PM provides landmark identification by storing, displaying, and registering small areas of Imager visible and infrared data (visible Sounder as backup) defined as landmark sectors. Landmark registration is performed by a semiautomatic (an automatic capability is being implemented) correlation of selected landmark sectors to previously stored landmark sectors referred to in landmark correlation chips. Once correlated, landmark measurement data in the form of earth location coordinates are sent to the OATS. The PM also captures the IMC and servo error data included in the GVAR data by the SPS and passes it to OATS, which provides quality checks of the INR function performed onboard the spacecraft.

The PM subsystem, provided by NOAA, consists of servers and user workstations. There are five PM servers at the SOCC, five at the WCDAS, one at the FCDAS and one at the WBU. Each PM is capable of supporting one GVAR data stream at a time. One PM is normally assigned to the GOES East broadcast and the other to the GOES West broadcast. Under normal operational circumstances, the PMs at the WCDAS perform only the monitoring function while the PMs at the SOCC perform the OATS support functions as well as the monitoring functions.

GVAR

The GVAR data transmission format was developed to allow full use of the capabilities of the advanced, three-axis stabilized spacecraft while retaining as much commonality as possible with receiving equipment presently in use from earlier spin-stabilized GOES spacecraft. The GVAR format is based on the operational visible and infrared spin scan radiometer atmospheric sounder (VAS) mode AAA format, which consisted of a repeating sequence of 12 fixed-length equal size blocks. The transmission of these blocks was synchronized with the spin rate of the earlier GOES spacecraft, that is, one complete 12 block sequence per satellite rotation.

The GOES-N GVAR transmission sequence consists of 12 distinct blocks numbered 0 through 11. Blocks 0 through 10 are transmitted when an Imager scan line is completed. Block 10 is followed by a variable number of block 11s, according to what data are available for transmission (Figure 15-3).

The GOES-O and GOES-P Imagers have an eighth IR detector, one more than the GOES-13 and earlier Imagers. As a result, the GVAR format was modified to accommodate the additional detector data. Table 15-1 lists the format changes between GOES-N and GOES-O/P. Table 15-2 provides an overview of the GVAR format for GOES-O/P, and Table 15-3 provides detail on the composition of each GVAR block for GOES-O/P.

GVAR Data Block Type

	Doc-ument	IR 1	IR 2	Visible 1	Visible 2	Visible 3	Visible 4	Visible 5	Visible 6	Visible 7	Visible 8	Sounder and Auxiliary Data
GVAR Block Number	0	1	2	3	4	5	6	7	8	9	10	11
Word Size, Bits	8	10	10	10	10	10	10	10	10	10	10	6, 8, 10
Field Length, Words	8,040	68 - 21,008	51- 15,756	20 - 20,960	20 - 20,960	20 - 20,960	20 - 20,960	20 - 20,960	20 - 20,960	20 - 20,960	20 - 20,960	10,720/ 8,040/ 6,432
Number of Records	-	4/block	3/block	1/block	1/block	1/block	1/block	1/block	1/block	1block	1/block	1- 8
IR Detector Data, Words	-	5,236	1 - 5,236	4 - 20,944	4 - 20,944	4 - 20,944	4 - 20,944	4 - 20,944	4 - 20,944	4 - 20,944	4 - 20,944	-

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Each GVAR block has
- 10,032-bit synchronization code
- 720-bit header
- N-bit information field
- 16-bit cyclic redundancy check

Block Characteristics

• Period	15.25 - 104.6 ms
• Synch Length	10,032 bits
• Header Word Length	8 bits/word
• Header Length	90 words (720 bits) (Triple Redundant)

Scan Characteristics

• Period	Variable
• Block/Imager scan	11
• Bit Rate	2,111,360 b/s

- Blocks 0 and 11 have fixed length information field of 64,320 bits
- Blocks 1 through 10 have variable length information fields directly dependent on width of scan, with minimum information field of 21,440 bits
- A single Imager scan generates blocks 0 through 10 in sequence
- Blocks 0 through 10 may be followed by any number of block 11s (0-N) depending on data available; in priority order, the next block(s) transmitted will be:

1. Next Imager scan	Blocks 0 through 10
2. Imager compensation and servo errors	One block 11
3. Sounder compensation and servo errors	One block 11
4. Imager telemetry statistics	One block 11
5. Imager spacelook statistics and data	Six block 11s
6. Imager calibration coefficients and limits	One block 11
7. Imager electronic calibration statistics and data	Two block 11s
8. Imager blackbody statistics and data	Two block 11s
9. Imager visible NLUT	Two block 11s
10. Imager star sense data	Nine block 11s
11. Sounder scan data	2 to 523 block 11s
12. Sounder telemetry statistics	One block 11
13. Sounder spacelook statistics and data	Five block 11s
14. Sounder calibration coefficients and limits	Two block 11s
15. Sounder electronic calibration statistics and data	Three block 11s
16. Sounder blackbody statistics and data	Five block 11s
17. Sounder visible NLUT	Nine block 11s
18. Sounder star sense data	Nine block 11s
19. GIMTACS text messages	One to two block 11s
20. SPS text messages	One block 11
21. Auxiliary data	One to N block 11s
22. Fill data	One block 11

Figure 15-3. GOES-N Variable Data Transmission Format

Table 15-1. GVAR Format Changes for GOES-O/P

GVAR Format Changes for GOES-O/P
New Block 11 added for Imager factory coefficients including coefficients for the 8th detector Modified blocks for eighth detector: Imager Block 0: • Imager factory coefficients removed • Added data for 8th detector to existing block using spares at the end of the block Imager Block 2: • Added data for the 8th detector to the existing block using spares at the end of the block Imager Blackbody Block 11: • Added a 3rd block for the 8th detector Imager Calibration & Limits Block 11: • Added data for the 8th detector to the existing block using spares at the end of the block Imager ECAL Block 11: • Added a 3rd block to accommodate the 8th detector Imager Spacelook Block 11: • Added a 7th block to accommodate the 8th detector

Table 15-2. GOES-O/P GVAR Format Overview

DOC	IR1	IR2	VIS 1	VIS 2	VIS 3	VIS 4	VIS 5	VIS 6	VIS 7	VIS 8	SAD
0	1	2	3	4	5	6	7	8	9	10	11

– Each GVAR Block has the following:

10,032-bit Synchronization Code
720-bit Header
N-bit Information Field
16-bit CRC

– Blocks 0 and 11 have a fixed-length information field of 64,320 bits.

– Blocks 1 – 10 have variable length information fields directly dependent on frame width (scan width), with a minimum length of 21,440 bits.

– A Single Imager Scan generates Blocks 0–10 in sequence.

– Blocks 0–10 may be followed by any number of Block 11s (0–N), depending on what is available in priority order, the following Blocks transmitted are:

1. Imager Scan Blocks 0 –10
2. Imager Compensation and Servo Errors – 1 Block 11
3. Sounder Compensation and Servo Errors – 1 Block 11
4. Imager Telemetry Statistics – 1 Block 11
5. Imager Spacelook Statistics and Data – 6 Block 11s
6. Imager Calibration Coefficients and Limits – 1 Block 11
7. Imager ECAL Statistics and Data – 3 Block 11s
8. Imager BB Statistics and Data – 2 Block 11s
9. Imager Visible NLUTs – 2 Block 11s
10. Imager Star Sense Statistics and Data – 9 Block 11s
11. Sounder Documentation and Scan Data – 2-523 Block 11s
12. Sounder Telemetry Statistics – 1 Block 11
13. Sounder Spacelook Statistics and Data – 5 Block 11s
14. Sounder Calibration Coefficients and Limits – 2 Block 11s
15. Sounder ECAL Statistics and Data – 3 Block 11s
16. Sounder BB Statistics and Data – 5 Block 11s
17. Sounder Visible NLUTs – 9 Block 11s
18. Sounder Star Sense Statistics and Data – 9 Block 11s
19. GIMTACS Text Messages – 1–2 Block 11s
20. SPS Text Messages – 1 Block 11
21. Imager Factory Coefficients – 1 Block 11
22. Fill Data – 1 Block 11

Table 15-3. GOES-O/P GVAR Format Block Details

Parameter	Value
Scan	
Period Blocks per Imager Scan Line Bit Rate	Variable 11 2,111,360 bps
Block	
Period Synch Length Header Word Length Header Length (Triple Redundant)	15.25 to 104.6 msec 10,032 bits 8 bits per word 90 words (720 bits)
Data Section (by block type)	
Block 0 - Documentation Block Word Size Field Length	 8 bits 8040 words (64,320 bits)
Block 1 - Infrared Block 1 Word Size Field Length Number of Records Line Documentation IR Detector Data	 10 bits *68 to 21,008 words 4 per block 16 words 1 to 5236 words
Block 2 - Infrared Block 2 Word Size Field Length Number of Records Line Documentation IR Detector Data	 10 bits *68 to 21,008 words 4 per block 16 words 1 to 5236 words
Blocks 3 – 10 - Visible Blocks Word Size Field Length Number of Records Line Documentation IR Detector Data	 10 bits *20 to 20,960 words 1 per block 16 words 4 to 20,944 words
Block 11-Sounder Data and Imager Factory Coefficients Word Size Field Length (words) Record Types Number of Records	 6, 8, or 10 bits 10720, 8040, or 6432 7 1 to 8
CRC	16 bits

Note:
* Variable length information fields are subjected to zero packing filling to meet the 32,208-bit minimum block length and to satisfy the 16-bit bounding required for the block CRC. Maximum values denote only the data sections resulting from a 19.2 degree instrument scan.

Spacecraft Emulator

The GOES-NOP spacecraft emulator is a simulation platform that consists of the Applied Dynamics International (ADI) real time station (RTS) and computer workstations. The emulator is contained within a tower unit. It contains various spacecraft components, several compute engines including a NASA-provided Imager-Sounder Instrument Simulator, a Versa-bus Module Eurocard (VME) bus, a 1553 bus, and various software applications. The emulator provides the T&C interface, MDL interface, and Imager and Sounder messages to support SSGS integration and test. In addition, it provides high fidelity models of the spacecraft dynamics, sensors, and actuators, along with orbital and environmental models to support operational procedures development and mission and on-station operation rehearsals.

In addition, a Lockheed-Martin developed SXI Emulator (SXIE) consisting of a Programmable Telemetry Processor (PTP) front end processor and a Power PC with the same processor type used in the instrument interfaces with the spacecraft emulator RTS to allow a high fidelity simulation of the SXI instrument operation. The SXIE has an Ethernet connection to the spacecraft emulator for receipt of SXI commands and a serial output connection to the spacecraft emulator The spacecraft emulator provides a serial interface to the MRS&S (as well as one to the NTACTS) emulating the complete MDL downlink. There are four spacecraft emulators at SOCC and one SXIE. There is one spacecraft emulator and one SXIE at the WCDAS. SWPC has one SXIE, which is configurable to provide a 400 kbps MDL downlink containing SXI data, fill data and static PCM data, and which has a serial interface for connecting to an MRS&S.

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