

SATCOM:

Taming the Beast

BY TONY BAILEY

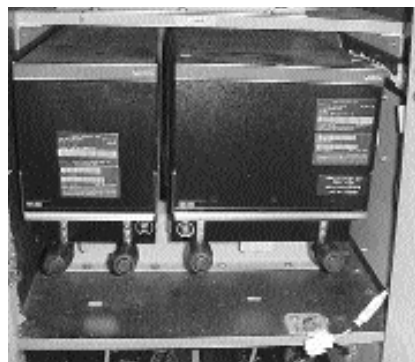
Everyone has heard about high speed data—satellite communications have been evolving at breakneck speeds. Data and voice transmissions are accelerating beyond comprehension. However, it had to start somewhere and most high speed data upgrades are based on existing SATCOM systems installed in the aircraft. Honeywell's MCS-3000/6000 Multi-Channel Aviation Satellite Communications System, Rockwell Collins SATCOM SAT-906 Satellite Communications System, or the Rockwell Collins SATCOM 5000/6000 Satellite Communications System are three examples.

The basic design of airborne SATCOM systems consist of three segments or links: the satellites, the Aircraft Earth Station (AES), and the Ground Earth Station (GES) comprising of equipment used to facilitate a satellite based, two-way L band communication link between the satellite and the aircraft, and between the satellite and a ground station. Once connected to the ground station, the exchange of information is transferred through normal telephone connections. SATCOM extends the flow of earth-based information to any aircraft located almost anywhere in the world. The aircraft can use an array of telecommunication devices, the same way they can be used on earth.

After establishing a connection with the satellite, the antenna transmits and

receives data from the selected stationary satellite. The Honeywell SATCOM system and the Rockwell Collins SATCOM SAT-906 system utilize a High-Power Amplifier (HPA) to amplify the outbound signal while the received signals are routed to the Satellite Data Unit (SDU) or optional Radio Frequency Unit (RFU) for processing. The Rockwell Collins SATCOM 5000/6000 system utilizes just the SRT-2000 Satellite Receiver/Transmitter (SRT) for similar functions.

The SDU and SRT also contain the Owner's Requirement Table (ORT) and Aircraft System Table (AST) which stores specific aircraft and operational data such as speed dialing of telephone numbers, selections of preferred GESs, audio interface characteristics, satellite identification, frequencies of channels, spot beam identification, GES identification, GES spot beam support table, and satellite location.



SDCU

Photo courtesy of Pentastar Aviation.

The SATCOM system uses aircraft supplied navigational position data to electronically or mechanically steer the antenna so it can orient itself toward the satellite in use. As the aircraft moves out of the optimum communication position with one satellite, the SATCOM automatically switches to the next best satellite.

The communication management assembly is designed to interface the user with SATCOM subsystems and their devices, either automatically, or by manually selecting communication options. When necessary, visual and/or audio messages announce SATCOM system status and actions depending on the system.

International telephone companies are the earth-based communication link that establishes worldwide information exchange. The telephone system services use control and display features of many communication devices for two-way communication. SATCOM uses satellite communication that the telephone company network supplies to make its connections. However, a satellite ground earth station is used to establish communications to one of the INMARSAT geostationary satellites while the aircraft is airborne. The satellite relays information to the SATCOM equipment in the aircraft. Once the satellite connection is established, the airborne communication devices can communicate with the

earth, using the earth-based telephone company services.

The aircraft SATCOM systems in their basic design are capable of voice and data transmissions allowing the user to communicate throughout the flight. The aircraft even has its own telephone number, just like your home phone or cellular phone. However, with the large array of communication devices that can be used with an airborne system, the aircraft communication network needs a switching device to connect the SATCOM to other communication devices. The switching device can be as simple as a switch or as complex as a Private Automatic Branch Exchange (PABX).

The operator uses various communication devices to select, control and display the type or quantity of information to be communicated. The extent of the control and display information depends on the device. The SATCOM system connects and processes all information in a digital format. The Honeywell MCS-3000 SDU contains two voice channels and one data channel while the Honeywell MCS-6000 and the Rockwell Collins SAT-906 have six channels available. The optional RFU adds three additional voice channels. The Rockwell Collins SRT contains six channels (one packet mode data plus five others or one data and four voice channels depending upon the model). Voice channels are used for voice, FAX, cockpit, and other communications. The data channels interface with ISO-8208 compatible data equipment and transmit Aircraft Communications, Addressing and Reporting Systems (ACARS) and AFIS information.

These devices can include phone handsets, FAX machines, or personal computing devices. Of course, there is a huge difference in communication speeds when comparing the SATCOM

systems of the past to the new high speed data systems evolving every day.

Usually, SATCOM installations have some combination of cockpit and cabin mounted control devices including switches and annunciators. Typical annunciators include power indication and channel selection.

For most applications, the SATCOM system can be controlled from the handset, which would normally be used only as a voice telephone. However, this is not your mother's telephone and it just might be equal to something James Bond would use. The telephone or CMU (Communications Management Unit) keyboard can be used to modify some SATCOM system management settings and the earpiece emits voice communication status messages and standard dial tone signals. The telephone keypad can also be used to change the SATCOM's installation selected options.

The Honeywell MCS-3000/6000 and the Rockwell Collins SATCOM 5000/6000 systems are similar in form and function so troubleshooting follows the same basic principals. Traditionally, avionics troubleshooting was confined to power, ground, and the last person who worked on it when you were trying to isolate problems. Some of that still holds true, like the last guy theory. The Rockwell Collins SRT is a perfect example of that. If the last guy had difficulty raising his monkey-like knuckles off the ground and damaged the ARINC 600 size II and size III connectors for the ARINC 600 avionics equipment, all kinds of problems will pop up. The ARINC 600-7 specification, which is the governing document for these connectors, requires that an extractor mechanism be used to aid in disengagement. It also requires a framework be used in the aircraft so that

only a 0.1-inch lateral movement and only a 0.2-inch vertical movement is possible. If you see Mr. Hairy Knuckles using excessive side-to-side or up and down motion to disengage the unit, make sure he learns the trick of holding a charged capacitor on his tongue.



SATCOM Rack Assembly.

Most SATCOM units go through a self-test during start-up and display the results of the most recent self-test. At anytime during operation, a self-test can be initiated by pushing the self-test button for more than three seconds if one of the following on-ground criteria is met: Both Weight-On-Wheels (WOW) discretes indicate on-ground; IRS data indicates a ground speed of less than 40 knots; and neither IRS input is presenting valid data, but strapping indicates that at least one IRS is installed.

From the SATCOM main menu on the Rockwell Collins SRT, the CDU BITE STATUS page can be accessed for the current status. General definitions of reported statuses on the BITE STATUS pages are as follows:

Continued on following page

SATCOM: TAMING THE BEAST

Continued from page 51

OK

The LRU reports it is ready for normal operation.

FAULT

The LRU is reporting an abnormal condition.

NO DATA

The LRU reports an SSM of NCD (No Computed Data).

INACTIVE

The data bus input from the LRU to the SRT is dead.

TEST

The LRU is in test.

NONE

The SRT-2000 is not strapped to enable this LRU.

This is a key page to troubleshooting the SATCOM system as it gives a general condition of system health. Utilizing the different menu screens and item selections can access further diagnostics. To access current fault information on the Rockwell Collins SATCOM systems, enter 64# from the handset of any telephone connected to the SATCOM analog port and listen. The SATCOM system will report one of the following audio messages:

a.) If the SATCOM system is in the process of logging faults at startup, "NOT AVAILABLE" will be heard.

b.) If the SATCOM system has no current faults to report, "00" will be heard.

c.) If the SATCOM system has recorded current faults, the user will hear fault code numbers. Refer to the Maintenance Manual to decode the reported fault(s).

In some aircraft installations, SATCOM system status messages, configuration information, and current fault

Acronym	Description
SATCOM	Satellite Communications
SRT	Satellite Receiver/Transmitter
CDU	Control Display Unit
ACARS	Aircraft Communications, Addressing and Reporting Systems
RFU	Radio Frequency Unit
PABX	Private Automatic Branch Exchange
AST	Aircraft System Table
ORT	Owner's Requirement Table
AES	Aircraft Earth Station
GES	Ground Earth Station
HPA	High-Power Amplifier
SDU	Satellite Data Unit
WOW	Weight-On-Wheels
INMARSAT	International Maritime Satellite Organization
CMU	Communications Management Unit
DTMF	Dual Tone Multiple Frequency
LRU	Line Replaceable Unit
BSU	Beam Steering Unit



SATCOM Screen

messages can be accessed from a DTMF (Dual Tone Multiple Frequency) interface device that is connected to either SDU analog channel 1 or analog channel 2. The DTMF device can be a TCU-906, WH-10, and/or DTMF-compatible telephone interface unit.

To determine if status messages, configuration information, and fault messages can be accessed from an aircraft telephone system, it is recommended that maintenance personnel turn the SATCOM system on, identify a telephone or fax machine handset, and enter *61#. If voice messages are heard, SATCOM system status messages, configuration information, and current fault messages can be accessed.

Entering *62# plays the system configuration message. When the user enters this command, the following message groups will be heard: "All X of Y channel modules installed are available," "Hardware part number is XXX-XXXX-XXX," "Software part number is XXX-XXXX-XXX." If an owner requirements table (ORT) is installed, the ORT part number will be heard. If no ORT has been installed, no message at all will be heard.

For fault code access, enter *64#. For each failure a different fault code will be heard. The fault codes can indicate: (1) that one or more of the SATCOM LRU's has failed BITE tests, (2) an LRU is inactive on the ARINC 429 digital bus, or (3) other conditions prevent the system from logging on.

For the Honeywell system, most failure messages are in plain language. They are listed in the Honeywell SATCOM Maintenance Manual. The system displays a list of Honeywell LRU part numbers after the last failure message. After the part numbers, the display lists "ORT ID" on two message lines. This is the 24-character ORT identification that is normally cus-

tomized when the SDU is installed. This display also indicates if the ORT has been modified.

Any time you work with an operating SATCOM system it is imperative that the technician is aware that the satellite communications system antenna radiates intense microwave energy. All personnel must maintain a minimum distance of 20 feet (6 meters) from any SATCOM system antenna during installation testing or normal operation.

The antenna normally used for SATCOM systems are full duplex capable. Two types are used; single top-mounted (fin mount) and dual side-mounted (conformal mount). Dual side-mounted antennas are mounted on each side of the aircraft, about 45 degrees from the horizon. Fin mounted antennas such as the Ball antenna are normally steered mechanically while conformal mounted antennas such as the EMS Technologies AMT-50G antenna are steered electrically. Electrically steered antennas utilize a Beam Steering Unit (BSU) to translate antenna beam position data and beam change commands received from the SDU into the signals required to select antenna elements in combinations that result in the beam pointing at the desired satellite.

In the ever-evolving world of high speed data, the complicated aircraft satellite communications system can be quite a beast for even the most knowledgeable avionics technician to tame. Hopefully these troubleshooting tips will help you bring it back into submission. □

Reference: Honeywell Satellite Communication System (SATCOM) Operations Manual Pub. No. A28-1146-103-00; Rockwell Collins SAT-906 Satellite Communications System Installation Manual P/N 523-0778263; and the Rockwell Collins 5000/6000 Satellite Communications System Installation Manual P/N 523-0780286.