

Jack Tull (7/12/23)

I came to COMSAT in November 1968 when we only had early bird and three INTELSAT II's in orbit and were getting ready to launch our first IS III's. I worked in the Satellite Control Center at L'Enfant Plaza. I worked there until 1975 when I and my family moved to Avezzano so I could work at the Fucino Earth Station and eventually became the COMSAT station manager. In 1978 we left Italy and went to Palo Alto to work on the INTELSAT V. From that point on I became the lead on developing software requirements for the INTELSAT ground processing systems for commands and telemetry for all IS satellite series. We returned to Washington in 1979. Also in 1979 Satellite Operations moved to INTELSAT so I then went with INTELSAT until I retired in 1994.

* * * * *

I left Kennedy Space Center in November of 1968 and came to Washington to work for COMSAT in the Satellite Control Center in L'Enfant Plaza as a satellite controller. COMSAT provided the initial Satellite Operations for INTELSAT. At the time I started with COMSAT we had 5 INTELSAT (IS) satellites in orbit. There was IS I F-1 (Early Bird) and IS II F-1 – IS II F-4. IS II F-1 was partially operational as it was in a highly elliptical transfer orbit with its apogee at geosynchronous altitude and IS I F-1 was not operational. IS II F-2, F-3 and F-4 were operational. IS III F-1 had been lost due to a launch failure in September 1968 and we were preparing for the launch of IS III F-2 on December 19th.

This would be my first launch and I was quite excited to be a part of it. IS III was the first IS satellite to have a Mechanical Despun Antenna (MDA) and during the transfer orbit phase we noticed the MDA was periodically locking up. In normal operations in geosynchronous orbit the MDA would point to earth. This problem and launch/apogee motor failures was a big issue with most of the 8 IS III satellites resulting in shortened in-orbit lifetimes with the exception of IS III F-7 which operated for 16 years. The MDA problem was a thermal issue and required periodic 180 degree reorientation maneuvers. These maneuvers were generally done with traffic and generally worked with no traffic loss about 50% of the time. One such issue with the MDA occurred on one of the IS III satellites that was carrying communications traffic for NASA between the Apollo 11 astronauts and Houston just prior to the first moon landing. This was a time of let's say great anxiety but the reorientation was successful and the moon landing communications worked correctly.

The Satellite Control Center at L'Enfant Plaza which served IS Launch and In-Orbit Operations until 1984 was initially a rather crude control center compared to today's standards. There were 2 channel strip charts that displayed Pulse-amplitude modulation (PAM) from the satellites telemetry. We used these strip charts to evaluate the telemetry data and when commanding the satellites to ensure that the proper commands were loaded in the satellite before executing the commands.

During the 1969-1972 period I was working the 4pm to midnight shift in the control center by myself and at the same time taking a 15 semester hour class load in Aerospace Engineering at the University of Maryland. Fortunately, I had some time during my shift to study. With the current

MDA and other satellite issues it became more and more time consuming for me to monitor the satellites which of course took away from my study time. Mr. Siegfried Reiger, COMSAT Vice-President Technical would occasionally visit the control center in the evening during my shift and on occasion would help me with my calculus class work. This also gave us a chance to discuss how the satellite operations were going, and the need for a better way to monitor the satellites. Thus the first steps to buy an HP2116 mini-computer were taken.

Hardware was developed to process the incoming telemetry stream and software was developed to monitor the key telemetry channels to alert the control center staff of an issue with the satellites. This was the start to provide a way for the control center staff with a way to monitor the telemetry channels in so called engineering units (volts, amps, degs F, etc) This initial system allowed the HP 2116 to process the telemetry and command channels of a satellite and print the EU data on a teletype machine. We then put a closed circuit TV camera on the printout of the teletype machine and distribute this video to the monitors in the control center. Hughes Aircraft Company manufactured the IS IV and IV-A satellite series. They provided an HP 2108 computer which drove a 6 window digital display provided by Hughes. The display presented satellite telemetry data in an octal format.

In preparing for the first IS IV launch which occurred on 26 January 1971 we became more sophisticated in our processing of telemetry data and commands. We developed programs to process the IS IV telemetry data and present the data on a TV monitor (rather than the teletype) in a format that could be subsystem or mission stage oriented for the engineers monitoring launch and in-orbit operations. Charlie Johnson, the IS IV engineer for COMSAT at Hughes began working on programing the 2108 in assembly language due to its small 8k memory size. I remember sometimes at liftoff Charlie would be giving me software change to be put into the 2108. This I would say in some ways we were flying by the seat of our pants. It all worked out and it was successful. At the same time we were programing the HP2116 computer using Fortran to develop more user friendly displays. During this period we began developing Command Assistance Programs which allowed us among other things to develop commands for controlling the recharging of the satellite batteries during the twice annual eclipse seasons. The software would produce command instructions for the satellite controllers to execute. We tried to develop the most versatile software we could to accommodate every type of anticipated operational need.

Sometimes we tended to outsmart ourselves. One such occasion was that we could tell the software to delay the start of the recharge cycle following eclipse to allow for a more favorable thermal charging condition. One day we put so much delay in beginning the recharge cycle that the software computed the start time during the following days eclipse time. OPPS!! This of course would never work as the battery would have entered the next discharge cycle uncharged causing a satellite outage due to lack of power. We corrected the software to not allow this to happen again. Somewhere in this early 70's time frame we began using telemetry data from ground testing of the IS IV satellites to validate our ground processing software. This technique used over many satellite series proved to give us a ground processing system with no errors. By the way I did receive my BSAE from the University of Maryland in 1972 and thus took on engineering duties after that.

In the summer of 1975 my family and I moved to Avezzano, Italy for me to begin my work at the Fucino Earth Station which was one of 4 TT&C (Tracking, Telemetry & Commands) earth stations at the time that supported IS satellite operations. Mr. Lee Jondahl was the COMSAT Manager and Mr. Don Pavlak also was on staff there for COMSAT. Eventually I became the COMSAT Manager until my departure in June 1978. My time here allowed me to learn much about TT&C operations at the earth station level. One of the techniques we developed during my time there involved monitoring the success or failure of an apogee motor fire by observing the doppler shift during the firing. The idea was to show the shift on a stripchart after calculating what the shift should be from the beginning to the end of the firing. We did some other firsts by using a large 30 meter antenna to track just launched satellites in a transfer orbit. We also experienced some excitement in which the Red Brigades threatened to take over the Fucino Earth Station because we were transmitting information on the abduction and eventual killing of the Italian Prime Minister (Aldo Moro) to the world. We were guarded by the Italian Army which took up residence at the earth station. I had my hiding place under the building.

In June of 1978 we left Italy and moved to Palo Alto to begin work on the IS V satellite. This satellite built by Ford Aerospace and Communications Corporation would be the first INTELSAT satellite that used 3 axis stabilization rather than spin stabilization. I worked at the COMSAT office again with Charlie Johnson. I began developing software requirements for the IS V satellite launch and in-orbit operations. The software was developed in Washington and as in past IS series we tested the software using actual telemetry data captured during satellite ground testing. We were surprised that on a couple of occasions we found faults in the satellite wiring by testing our software with real telemetry data. This was my first real experience in working closely with actual flight hardware.

The COMSAT staff at Palo Alto consisted of highly trained and most capable subsystem engineers. I was able to design displays for launch and in-orbit operations of the IS-V satellites by sitting down with each subsystem engineer and going over each phase of the mission to determine what information they needed to see and how it would be laid out in a display. We also developed requirements for stripchart configurations to monitor mission related events. I also began working on the Sequence of Events that we used to detail the step by step operational process we would use for launch operations. Prior to launch we would conduct launch rehearsals with the launch team in the control center using the Sequence of Events and simulated data that we could manipulate to represent certain satellite configurations with the simulated data changing with commands being executed.

In the Summer of 1979 we returned to Washington and soon after that year INTELSAT took over the Satellite Operations Department and many of us moved to INTELSAT. The Satellite Control Center developed by COMSAT remained in operation until 1984 when INTELSAT moved to their new building which contained a new Satellite Control Center.