

## SIRIO – the first Italian telecommunication satellite

By Luigi BUSSOLINO

In 1975, together with other young engineers, I was hired by Aeritalia Space System Technical Office and for me it was like touching the sky with a finger. I arrived from the Politecnico of Turin, where I had produced a much appreciated dissertation on the aeronautical navigation systems using satellites, a future application of space satellites still valid twenty years later. The dissertation was awarded second prize in an Alitalia contest, and I was fully motivated and ready to demonstrate my capability.

While most of the other engineers joined the big Spacelab project, where already were working many dozens of engineers, supported by almost a dozen American consultants, with a friend of mine I was assigned to the project of an Italian satellite named SIRIO, where I was involved in the implementation of the thermal control subsystem, while he joined the structural subsystem group.

SIRIO, after a sequence of stop and go, from 1969, finally in October 1974 had had the green light, with all the funds necessary and with a resolute determination to launch: the companies involved in the project were reinforced, the final agreement had arrived and the money seemed to be sufficient to grant the final launch.

At that time satellites involved some risks; for this reason a “development model“ was first produced with the purpose of fine-tuning the design, then it was to manufacture the “qualification model “ for demonstrating the capability of performing the mission of the satellite and its payload without problem in the space environment and, after that, the “flight unit“ was to be integrated for being mounted on top of the launcher and delivered in space.

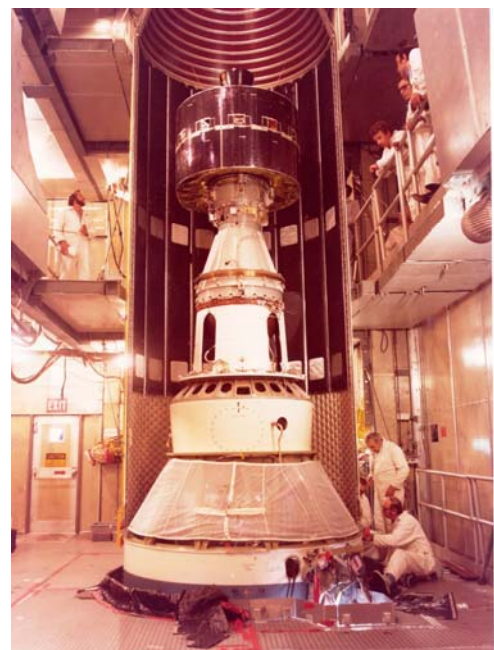
From a theoretical standpoint this was true but it was not possible to wait for the time necessary for the procurement of electronics and other equipment, that overcame the qualification test, for the integrating the flight unit (the procurement was to last eighteen to twenty four months) and the overall components procurement was anticipated, based on our own and provider’s experience, with a certain risk.

The provider of the launch vehicle was contractually responsible for making available a second launcher within six months in case of launch failure and satellite loss, and as cover for the mission, the satellite contractor was compelled to manufacture a spare unit or prepare all the parts necessary for integrating a second satellite.

Going back to the SIRIO satellite, it was derived from the payload, called PAS, to be orbited by the ELDO Europa II launcher, that was of Italian responsibility as well as the launcher fairings.

From 1969 – after the failure of ELDO consortium – to 1974, the shape and the mission of the initial payload changed drastically, passing from an inert payload to a real satellite with an important mission in the telecommunications field: Prof. Francesco Carassa, Electronics Professor at Milan Politecnico, great friends of Prof. Broglio, in 1967 proposed to experiment with Earth-satellite and back communications at very high frequencies (18 Ghz going and 12Ghz back) for studying the atmospheric fall attenuations.

SIRIO is the acronym standing for *Satellite Italiano per la Ricerca Industriale Orientata* (Italian Satellite for Oriented Industrial Research). From a technical standpoint, Sirio was a 400 kg satellite, cylindrical in shape, built around the solid propellant apogee kick motor, attitude spin controlled, with solar cells



covering completely the external surface for having always the sun available, with a despinned antenna, for maintaining it always oriented towards the terrestrial surface.

It is important to point out here that a dozen world institutions, from British Telecoms to NASA, were interested in this experiment and they manufactured suitable 10 to 12 meter diameter antennas for testing these new frequency bands that would enlarge the world's communication capability and therefore they were an anxious public not expecting disappointment, as it could happen in that period in Italy, with a series of changes in unstable governments, so that for them funding bizarre enterprises, like space and telecoms activities, didn't represent a priority.

Then the fateful October 1974 arrived and the SIRIO project started. The prime contractor was Compagnia Industriale Aerospaziale of Rome (C.I.A. – a sort of name disturbing the Americans, wondering which kind of intrigues were managed there) that suddenly changed its name in Compagnia Italiana Satelliti and then Compagnia Nazionale Satelliti

This company (in which Selenia and Aeritalia had 30% of share each, and Snia Viscosa BPD in Colleferro had 20 %, and participated also by Montedison Systems, Breda Finanziaria, Montedel. OtoMelara and Laben), after a series of discussions between Aeritalia and Selenia, started to prepare the final effort under the guide of Ing. Teofilatto, and personnel coming from Selenia, like Ing. Mastracci who was the Programme Manager of SIRIO till the launch of the satellite.

The orbital operations were under the responsibility of Ing. Trumpy of CNUCE (Pisa) whilst the newly created Telespazio was managing the orbital satellite communications via Fucino and Lario ground stations, together with the Spino d'Adda station purposely built.

CNR (National Research Council) that was the end-user of the satellite, had formed the SAS (Aerospace Activities Bureau), managed up to 1979 by the legendary Prof. Scandone with project director Prof. Massimo Macchia who, taking onerous and difficult decisions, led SIRIO up to the launch.

The SIRIO satellite I took over had failed the development tests concerning the thermal control subsystem, and it was therefore mandatory to start the design activities from scratch, with the help of the first finite elements computer programs with thousands of punched cards, that took hours and hours to be worked out. Since it had no priority, we had to wait until the subsequent morning, to realize that we had a lot of paper to throw away because in a card a capital O had been carelessly replaced by a zero or a dot was replaced a comma.

I had however the chance of learning a lot mainly from Mr. Bruno Strim, the Aeritalia Programme Manager, referring to Mr. Ugo Sacerdote, and from the fruitful collaboration with Mr Forastieri of CIA, who was my technical leader till the launch and introduced me in the team of Goddard Space Flight Center in charge of evaluating the first data coming from the satellite in low orbit, before issuing the command for the apogee kick motor to insert the satellite in the geostationary orbit.



*Cover commemorating the start of the tests at ESTEC.*

Finally we arrived to the critical Solar Simulation Test performed in the HBF3 thermal vacuum chamber at ESTEC premises (the engineering branch of the European Space Agency) in Noordwijk in the Netherlands, in February and March 1977. The test was successful, as it was the test of separation from the launcher; the flight unit overcame then the thermal vacuum test with some minor problems.

For me this period of two months was very important (it doesn't matter if the simulations of sun eclipses were coming at three or four a.m. and I had therefore to stay awake waiting for the recorded temperatures showing the successful switch on of the satellite after being in eclipse for 72 minutes (the duration of the eclipse in the geostationary orbit) and for the batteries – that meanwhile

had sustained the satellite survival – starting to be recharged again and the on board equipment were switching on regularly, now powered by solar cells.

It was decided to completely dismount the OTO Melara attitude propulsion system and to replace it with a more reliable system provided by Hughes and, for caution, to lower the nominal operating life of the satellite from four to two years; the launch was planned for the subsequent August with the three stage Delta 3914 provided by the NASA contractor Mc Donnell Douglas.

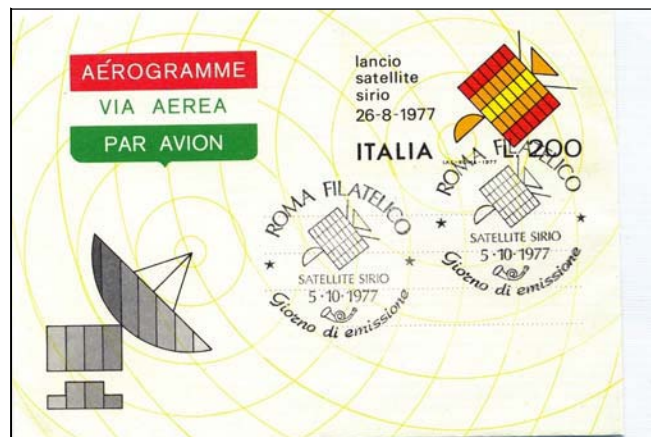
Notwithstanding the flight unit problems, Prof. Macchia decided to deliver both qualification and flight units to KSC, for overcoming the hesitation of many persons that were preferring additional tests and studies. Many persons were unconvinced SIRIO would be capable to successfully make its mission, starting from the Government itself: Hon. Andreotti , the leader of the government in that time, obliged the Scientific Research Minister Hon. Pedini to fly to the USA and to personally follow the operation.

My company, ignoring the fact that I was selected for the flight operations at GSFC, decided to deliver only two people, never involved in the project before and they were sent under the flag of CIA, so that there wasn't any sign of Aeritalia participation.

It was a very hard time. A contribution came, first of all, from NASA and its launch schedule: NASA planned the launch in that period two important interplanetary probes with a very narrow launch window. Also McDonnell Douglas contributed in delaying the launch: as responsible for the Delta launcher as well as of the Marman clamp band (for installing the satellite on top of the missile and releasing it when in orbit by switching-on explosive bolts) they erred in accurately producing a component of the clamp band.

Due to those two facts the launch was delayed by some days

In the same days the experimental ESA satellite OTS (Orbital Test Satellite) which had to test some of the SIRIO frequencies, failed the launch because a vernier rocket collapsed due to rusted bolts (and we fear the same would happen to the SIRIO launcher of the same age )... All these facts seemed justify the persons waiting for a failure (also in many companies of the Group there were somebody waiting for a failure, hoping to get some indemnification from the insurance company and to close the deal).



*Postal stationery featuring the antenna of Fucino tracking the SIRIO satellite in orbit.  
The launch was initially planned by August 18th, 1977, and then delayed to the following week.  
The printing bureau of the Poligrafico dello Stato (which prints out stamps and official postal items in Italy)  
had to destroy the 60.000 "wrong" items produced meanwhile with the original date. .*

In that period I married as planned, and – since my engagement at GSFC had been cancelled – I decided to enlarge my honeymoon and to fly to a Caribbean Island.

The same day when we returned at beginning of August, at nine o'clock I was urgently called by Mr Sacerdote, the Director of the Space Dept.



Two covers commemorating the two launch delays, cancelled in Rome.

Mr. Sacerdote and Mr. Bevilacqua, the head of the satellite unit, asked me to analyze a series of different attitudes of the satellite in transfer orbit as required by Mr Forastieri at GSFC, and then I had to pass several days working in a company most of whose personnel were on holiday.

It must be said that Somebody in the sky decided that level of pessimism not to be right, and then allowed the American launcher to perform very well its job in that hot and humid late evening at KSC (2 a.m. in Rome) and, in addition to that, the BPD apogee kick motor, that would have to impart a speed increment of 1631m/s for reaching the geostationary orbit, was also correctly and precisely performing (no one m/s more nor one less) so that the satellite at its second transfer orbit was inserted into the final geostationary orbit at 36.000 km height with very high precision.



On the left: cover comemmorating the launch, cancelled at the Kennedy Space Center  
 On the right: card written from the Control Romm of the Goddard Space Center by Ing Forastieri

The Italian staff were so happy that they celebrated the successful event with spaghetti and Chianti wine, in a freezer till that day, food that followed the satellite and electrical ground support equipment and passed the customs as technical support equipment.

Frankly speaking it was a great success for Italy that, after the launch of San Marco satellite managed by Prof. Broglio at Wallops Islands range in December 1964, was now gaining positions among the advanced technology nations in the world.

All the world's antennas, prepared for following this mission and experimenting these new type of telecoms frequencies, obtained a great mass of useful technical data, paving the way to new communication standards; but some Italian ground stations, completed only two years after launch, risked missing this gold chance.



On the left: cover commemorating the launch, cancelled at Selenia, one of the Partners of the SIRIO project.. On the right: cover postmarked at the Post Office of Avezzano, near Aquila, close to the Telespazio Fucino ground station

NASA thanked Italy for the support provided by the SIRIO satellite in reestablishing communications with its Voyager probes which were to leave the Solar System; thanks to SIRIO they were able to evaluate the signal attenuation through the atmosphere, and then to set up accordingly the phases and frequencies for the commands to be delivered to the probes equipment.

I believe that the happiest in the world were the Italian people living in USA, who delivered in Rome a great bronze plate thanking for the important and positive improvement of the relationships between the two nations, and the soccer fans who, after the initial message of the President of the Italian Council Hon. Andreotti, were able to see broadcasted Italian soccer games, as first attempt of connection.

As it transpired, the life cycle was a very large bonus: the satellite, designed for a two years performance, operated for at least ten years, allowing many telecom experiments, starting from European Economical Community that utilized it for a couple of years (and a special Italian postmark commemorates this event); USA and Canada used also this connection till 1983 when the satellite was shifted in a different orbit to serve China and later Indonesia. The last experiment was done by Prof. Foni of Pisa University, who oriented again the satellite using the pressurizing gas still on the at this time empty hydrazine tanks, fully eleven years after the launch.



Undoubtedly SIRIO satellite mission was a great success for Italy that demonstrated noticeable scientific capability (such as the idea of Prof. Carassa) as well as technological and industrial capabilities that allowed Italy to well show at European level, but as usual, it was not possible to fully enjoy because a lot of controversies about the cost that at the end reached the overall amount of 90 billion liras.

This was the equivalent of the cost for fifty kilometers of highway or the loss of two months in the bottom line in the balance sheet of the Italian Railways, that at this time was reaching a total loss of 600 billion lira per year, but it did serve as the base for creating the national space industry.

*SIRIO was so successful to be quite often represented. This Italian stamp (1979), prepared by Emilio Greco for the third World Telecommunications Exhibition, features a woman calling through an old-fashioned phone device, with Sirio flying in the background.*



The CIA became involved in a storm of controversies that limited its activity in favour of the other firms (such as Selenia and Aeritalia mainly) and at the end disappeared, absorbed by Selenia Spazio.

Aeritalia won many contracts for designing and implementing structure subsystems of OTS-like telecom satellites, such as ECS/MARECS, Telecom, LSAT, later called “ Olympus “ – the largest telecoms satellite of ESA and, for many years, also of the world – while in parallel was nearing the completion of the SPACELAB project that opened a new path in space activities.

Selenia took profit from the gained system capability, and proposed many telecoms satellites such as ITALSAT 1 and 2 for phone conversations, SICRAL for encrypting military transmission and many others.

BPD continued operating in the field of missile propulsion as of today with the implementation of VEGA, the small European rocket, recently launched from Kourou range.

Other companies such as Laben and Fiar entered the space business while others such as OTO-Melara disappeared.

After SIRIO-1 there was a SIRIO-2 satellite, derived from the previous one by modifying the spare unit, which would carry into orbit two ESA scientific experiments.

In less than two years, CIA implemented a satellite devoted to meteo data distribution to Europe and North Africa and synchronization atomic watches through satellites via laser (an experiment called LASSO for Laser Satellite Synchronization) . Unluckily, the launch with the European launcher ARIANE, on September 9<sup>th</sup> 1982, due to the failure of the third stage, was not able to reach the final orbit, and fell into the Atlantic Ocean.



This mission was the first astronautic event to be celebrated by the newly-born Aeritalia Philatelic Club. The Club was created by yours truly Luigi Bussolino who had the charge of secretary, while as President was appointed Prof. Ernesto Vallerani and Art Director was Mr. Renzo Turino who designed a lot of splendid covers.

The Club had a very intense activity in astrophilately for more than twenty years from 1982 to 2003.

In this very event we were obliged to rapidly prepare a red rubber stamp for recording that the mission was not successful and the satellite was not able to reach the desired orbit. Fortunately, seldom we did we have to use this rubber stamp on other covers.

#### References :

- “ L'Italia nello spazio, prima e dopo il Sirio “ di Ragno e Antonucci - Fratelli Palombi editori
- “ L'Italia nello spazio “ di G. Caprara – Editore Levi
- “ Lo spazio tricolore “ di Dari Laruffa – Edizioni UTET