The satellite network: STELLA (1978-1983)

Luciano Lenzini tells the story

In Europe the development of the first computer satellite network, called STELLA (Satellite Transmission Experiment Linking LAboratories), began in 1978 on request and with the funding of high energy physicists, who carried out experiments on elementary particles at CERN in Geneva.

Things went like this. In 1978 Prof. Italo Mannelli, supervisor of my degree thesis in Physics, and later Director of Research at CERN, phoned me proposing work on the project to contribute to the design and implementation of the STELLA network. My answer was immediately positive and after a few weeks the CNUCE became an official partner of the project.

The reasons that favored the birth and development of STELLA are to be found in the very nature of the experiments carried out by physicists with the CERN particle accelerator. Such experiments normally involve the collection of huge amounts of data generated at CERN during the experiments, which are subsequently processed by groups of physicists located in various European countries. This interaction between communities of scientists located in different areas of Europe was the key to the functioning of CERN and an essential element in the excellence of its results. However, a rapid and efficient data transmission service between CERN and these laboratories was lacking, and its absence complicated the processing of experimental data. Highly expensive traditional means were used, both in terms of time and of real economic costs.

The data produced by the experiments at CERN were stored on magnetic tapes (boxes and boxes of them!) and then transported to individual national laboratories by car, train or plane.

This type of work organization, of course, was not sustainable. It brought about a multiplication of data, over time very difficult to manage, and of the processing programs, and it involved a very high number of work trips. Furthermore, physicists outside CERN were in fact prevented from following the temporal evolution of experiments, which was the most stimulating period of their development.

For these reasons CERN enthusiastically received the proposal of the European Space Agency (ESA) to use the Orbital Test Satellite (OTS) to implement

a high speed (well, 2 Mbps) data service between CERN and the laboratories of five research institutions. These were the INFN (Pisa and Frascati) in Italy, the Rutherford laboratory (RL) in England, the Desy laboratory in West Germany, the University College (UC) of Dublin, EIRE and the Technical University (TU) of Graz in Austria.

In 1978 these institutions officialized, together with CERN and ESA, their membership of the STELLA project (MoU STELLA), forming three distinct, but constantly collaborating groups. ESA, University College Dublin and the Technical University of Graz focused their activity on research into antenna and radio-frequency systems, as well as on satellite channel measurement systems. CERN, CNUCE and Rutherford dedicated themselves to the design and development of the architecture, protocols and hardware of the network. Finally, high energy physicists obviously played the role of users of the services made available by STELLA. As for Italy, subscription to the STELLA project was signed by Prof. Antonino Zichichi, then INFN President.

Technical analysis
STELLA technology and architecture

The INFN, having no experience in the field of networking, had rightly involved the CNUCE Institute of CNR, where in those years we were conducting pioneering studies on computer networks, thereby assigning us a relevant role in the design and development of the networking part.
Each project partner was equipped with a PDP/11 mini-computer, called LDC (Link Data Computer). This was connected in sequence with the CIM (Communications Interface Module), implementing the MAC protocol for satellite access (designed by CNUCE), a modem and a 5 meter-satellite antenna.
In Italy, the antenna was installed in the courtyard of the CNUCE, in Pisa. The CIM hardware was designed and built by CERN, while the modem was built by Marconi and GTE based on specifications provided by ESA.
In each laboratory, the LDC was connected to (at least) one Local Area Network, to which one or more mainframes were also connected.

The first phase of the STELLA project, which from now on we will call STELLA/I, took place from 1978 to 1981. The architecture of STELLA/I was similar to that of SATNET, but with a MAC protocol for station access to the much simpler satellite channel. With STELLA/I we offered physicists the possibility of transferring large data files resident on disks or on tapes, at a speed of 2 Mbps. The data to be transferred, however, had to reside on the mini computers (LDC) located at the ground stations.

While waiting for the OTS satellite to be operational for testing, at CNUCE we tested the software and hardware of STELLA/I using the (glorious) Italian SIRIO satellite, exploiting the equipment provided by Telespazio at the Fucino and Gera Lario stations.

The second phase of the project, STELLA/II, began immediately after the conclusion of STELLA/I and ended in 1983. We aimed to develop the results of STELLA/I in two

directions. On the one hand, an application of "Remote Control Room" was designed and implemented, thanks to which the researchers of laboratories scattered throughout Europe could follow the evolution of the experiment carried out at the particle accelerator like their colleagues present at the CERN. This was an evolution of the project, therefore, which provided an additional tool to scientists. On the other hand, STELLA/I was enhanced by integrating local networks and networks with extensive geographical coverage or WANs (Wide Area Networks). This was to make both the "Remote Control Room" service and data transfer available to institutions that were distant from the ground stations. The CNUCE group was responsible for designing and implementing an interconnection protocol functionally equivalent to the IP protocol, which at that time was being tested in the USA and Europe.

On 19 October 1983 we performed a demonstration of the project at the Domus Galileiana in Pisa. Physicists came from all over Europe and were able to follow with great enthusiasm, in real time, the evolution of a high-energy physics experiment that was taking place at that time at CERN. The participants were able to observe the same graphs and data that were being observed by the CERN researchers.

Many years on from that day, I like to remember an episode that occurred before the demonstration. While I was illustrating the project to those present, a colleague of mine from the back of the room made me realize that the system had stalled and nothing was working. We verified what we call, in jargon, the "demo" effect. From the frantic gestures of my colleague, I realized that I had to keep my presentation going as long as possible, so as to enable the developers to understand what had gone wrong, and then restart the system. Fortunately, the problem was solved quite quickly and, when everything started up regularly, the colleague returned to the room and signaled that I could finish my presentation and start the demonstration. And everything worked perfectly!