The NanosatC-Br Program

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Brazil has built its first satellite in the late 80´s and early 90´s. The Brazilian satellite SCD-1 was launched by a Pegasus launcher in February 1993 and it is still sending data. The mission is a data collection for environmental purposes. The satellite weighs 110 kg. The second satellite of this family was launched in 1998, the SCD-2, also working until the present days. Both satellites were designed for a one year nominal life. These launches were part of the MECB Program, the Complete Brazilian Space Mission, planned during the 80´s. This Program also called for the development of a 4 stages all solid launcher with capacity to launch 200 kg. satellites at 650 km., and also for the ground infra structure of the country: control center, ground stations and launch site. Of these the launcher project was discontinued after a few flight test failures, but the other objectives were achieved. After this first large space program, the country has established an international cooperation with China for remote sensing missions, in the CBERS Program. The first launch came in 1999 and 5 large satellites, ranging from 1.7 to 2 tons, were launched since, with one failure due the Long March 4B launcher failure to place the satellite in its right orbit.

These were large programs with large budget requirements. With the introduction of the cubsats in the beginning of the century, more opportunities were opened for different types of missions with low budgets and with the inclusion of junior engineers and students that need practice in space projects, since its conception up to the use of the data generated by the mission, and going through its launching and operation. The Brazilian NanosatC-Br, Cubesats Development Program or NanosatC-BR Program, was designed in the beginning of the decade with the objectives to provide a new and low cost platform for Brazilian space missions from different universities and companies in the country, and working with students and young engineers. The Program was created in cooperation with Federal University of Santa Maria – UFSM, where INPE has its Southern Regional Space Research Center.

The strategy of the Program was first perform a successful cubesat launch that could show to the Brazilian scientific community that cubesats work and they could consider it for further projects. Under this strategy was important to have a reliable platform with a certain flight heritage, and an international bid was put forward for it. So the focus of the local effort for the mission was in the development of the payloads, its integration and testing and its operation. The first cubesat of the Program was the NanosatC-Br1, a 1U. It has three experiments proposed by Brazilian institutions: i) a magnetometer, ii) a fault tolerant FPGA software, and iii) a radiation tolerant IC. The on board software and the fabrication of the payload board were made by the same company that developed the platform of the cubesat. NanosatC-Br1 was launched in June, 19, 2014, from Yasni, Russia, with a DNEPR launcher. The cubesat is still operating and sending its data from the platform subsystems and its payloads.

This paper shows the results obtained with the NanosatC-Br1, its operation and the lessons learned used for the development of the second cubesat in the Program.

NanosatC-Br2 is a 2U presently under development with launch expected for next year. There are twice as much experiments: a Langmuir probe, a fault tolerant attitude determination subsystem, a store forward communication software for amateur radios and a second version of the board with three experiments flying in NanosatC-Br1. The number of universities participating also doubled. Still the platform was purchased but the payload boards (there are 4) have being fully developed by the proposing institutes. The on board software, both for data handling and attitude control is also being developed in house, as the mission ground control software. Three of the experiments were delivered and are being tested and integrated in the platform and with the on board software. Startup companies, from former students participating in previous projects, are being incorporated in the development of the NanosatC-Br Program. The paper describes NanosatC-Br2, its payloads, its present stage of development and the difficulties being faced to its conclusion.

A third phase of the Program has started at the beginning of the year and aims to develop the platform subsystems in the country. A few companies not necessarily from the space sector were identified and approached to develop these subsystems and commercial talks led to a few that are going to develop the first of them. Due to development costs and available budget, two of these subsystems (on board computer and transceiver) will still have to be imported for the first mission in this platform development phase of the Program. This mission will use the 1U platform to mount two or three X ray detectors on a payload board. The on board computer and the transceiver will be developed later when budget resources are renewed. The transceiver development was already submitted for these new funds.

The operational success and results of the first cubesat of the Program already encourage the development and launch by other Brazilian institutions and universities. Three of them were launched with mixed results, and a fourth one is delivered to launch. But the space sector in the country, including its Brazilian Space Agency as well its space research institutes, private companies and universities are much more aware of the existence of the cubesats and the possibilities they allow within a limited budget situation. More sophisticated missions are being planned such as in the Moon orbit and with formation flying and constellations in LEO for science and remote sensing missions. International cooperation missions are also being developed with NASA, American universities and other Brazilian institutions. Startup companies created by young engineers have joint the Program and start to offer jobs. Other companies are considering exploring the use of cubesats data generated services. The NanosatC-Br Program acted as a pathfinder for these developments.