Bloostar: space at your fingertips

by Michele Ferrara

Private companies are intensifying the race to space, and there are already about thirty of them with aerospace programmes that have started up or are in development. One of them, Zero 2 Infinity, is perfecting an interesting system to put small satellites into orbit using a hybrid carrier rocket that combines a high-altitude balloon and a small three-stage rocket.

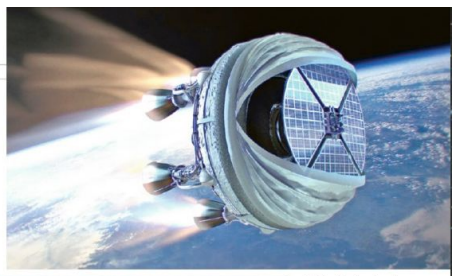
When sending an object into space, the tallest hurdle by far to be overcome is Earth's gravitational force. It does not make much difference whether the object must escape our planet's pull, remain in orbit around it or if it simply will make a brief suborbital flight. In any case, the object must be brought high enough to perform its mission. And that is exactly the problem.
Launching a load into space from the Earth's surface is an extremely wasteful operation: the cost of transport may total tens of thousands of dollars per kilogramme. On average, about 90% of the mass that takes off from a surface launchpad is squandered within the first few minutes: the fuel is burned, the carrier rocket is discarded, the troposphere is polluted: all this to take the remaining 10% (or less) to its destination.
More effective solutions have been around for recovering at least some of the stages of the carrier rockets in order to reuse them

Render of Bloostar rocket launcher separate from its ignition, hanging from the balloon gondola. (Zero 2 Infinity)

Left, side view of Bloostar with its fairing closed. Below, the three stages of the rocket and the platform that will host the payload. (Zero 2 Infinity)

cade that led to the first real space mission (Sputnik), when a probe called Deacon was repeatedly launched into suborbital flight. It has been about 60 years since those early attempts, and now the idea of a rockoon (a portmanteau of the words 'rocket' and 'balloon') has come to the fore again, thanks to the Spanish aerospace company Zero 2 Infinity.
Founded in 2009 by Jose Mariano Lopez-Urdiales (the current CEO), this Barcelona-based company specialises in the high-altitude transport of scientific instruments using these balloons and the recording of data from these journeys. Using a system called the "near-space balloon platform", in May 2016, Zero 2 Infinity successfully carried into the stratosphere – 28 km high – the first satellite made by the Aistech company (also located near Barcelona). That mission was essentially a test of the solutions and instrumentation the two companies used, but for Zero 2 Infinity it was also an important step towards implementing its Bloostar project. Defined as a 'short-cut into orbit', Bloostar is a hybrid carrier rocket that launches small satellites (up to about 100 kg), consisting of a stratospheric balloon designed to take a special kind of 3-stage rocket to a maximum height of 40 km, where it then must thrust the payload into its orbit. For a given weight carried, this launch system has obvious benefits over the traditional rocket that departs from a launchpad on the ground: it saves a lot of propellant; the sizes of the rocket stages are significantly reduced; it is no longer necessary to construct and manage a classic launchpad; most of the components of the hy-

(the so-called Reusable Launch System), but these solutions have not been perfected and are mostly applicable to light payloads, meaning small satellites, headed for low orbits. If the goal is essentially to transport small satellites, another trail was, in fact, blazed around the middle of the last century, one that allows a payload to be launched with a carrier rocket of reduced power and size, brought to a high altitude using a balloon capable of reaching the stratosphere. It is, in short, a kind of flying launchpad.
This solution was tried during the de-



Right, Bloostar fairing opening before first stage separation. (Zero 2 Infinity)

Above, Bloostar first stage separation. Side, last stage with satellite. (Zero 2 Infinity)

Scheme of the ascent profile for the Bloostar system. [Zero 2 Infinity]

brid carrier rocket can be reused within a short time; and the pollution of the air we breathe is reduced to nearly zero.
The Bloostar rocket consists of a series of engines running on liquid propellant, in an arrangement of concentric tori, coupled centrally to the payload. Each torus works as a traditional rocket stage, but much less thrust is required, as the carrier rocket begins from an altitude that has already left behind 95% of the atmosphere's mass. The smaller sizes of the rocket stages are also an

Bloostar prototype is elevated to 25 km. [Zero 2 Infinity]

Above, Bloostar is reaching 25 km. Below, ignition close up. [Zero 2 Infinity]

advantage in terms of their recovery and reuse, as their modest mass reduces the damage caused by friction with the atmosphere during re-entry. Furthermore, being able to ignite the engines in an environment with very rarefied air, above any turbulence, allows the payload to be aimed precisely at the target orbit, up to a maximum altitude of 600 km.
On March 1 of this year, Zero 2 Infinity successfully tested a Bloostar prototype, launching the first rocket from the upper atmo-

Left, Bloostar ignites at 25 km, before flying away (below). [Zero 2 Infinity]

sphere, about 25 km up. Company officials say that the goals for this test included assessing the telemetry systems under conditions like those in space, which it did successfully. In addition to this, the company tried to control the ignition and stabilise the rocket, to monitor the launch sequence, to open the parachute and to recover the carrier rocket from the ocean. Having met these objectives as well, Zero 2 Infinity is now the only aerospace company able to offer a reliable rockoon system to put small satellites into orbit in the near future.
Bloostar's first commercial launch is expect-

ed in 2019. In 2018, it will begin true orbital testing. For the test flight this March, the rockoon's trip began off the coast of continental Spain, but for payload launching, the Bloostar missions will begin in the sea near the Canary Islands, where the geographical location is more favourable to the successful orbiting of the satellites it will carry. Zero 2 Infinity will handle the rocket igni-

Here is an amazing video that illustrates the Bloostar concept. [Zero 2 Infinity]

Right, video of the first flight test of Bloostar. Below, Jose Mariano Lopez-Urdiales, the CEO and founder of Zero 2 Infinity, stands near the Bloon module. [Zero 2 Infinity]

tion operations, the release of the payloads, their introduction into orbit, and the rockoon recovery.
The artificial satellite industry welcomed the Bloostar experimentation, enough so that Zero 2 Infinity has already racked up more than 250 million dollars in letters of intent for future launches.
Under these conditions, it is quite likely that the Barcelona aerospace company will form a stable part of the market for small launchers, because, while it is true that Bloostar has a limit in payload mass, it is also true that satellite miniaturisation is increasing, and now with small payloads of minimal weight it is possible to attain data and images previously only accessible to satellites having significant tonnage. In addition to the greatly reduced costs in comparison to traditional carrier rockets, the Bloostar system will also offer a greater launch frequency and shorter reservation times. What is more, it can transport the satellites without needing to fold up any of their component parts to fit the capacity of the hold. With traditional carrier rockets, more than one satellite in the past was compromised to some degree by a failure to unfold solar panels or certain scientific instruments. Bloostar is warding off this danger, because its satellites can be released in their final configuration.
As we await future developments of the Zero 2 Infinity rockoons, it may be of interest to note that this is not the only field of business this company is operating in. Zero 2 Infinity also offers services for testing the reliability of satellites and scientific instruments under different environmental conditions, and it is also developing a space tourism programme that anticipates carrying people on board the stratospheric balloons to an altitude of 36 km, not far from 'black sky', where one can view the Earth in its entirety and see its fragility and uniqueness against the depths of the cosmos. The space tourists will stay in a special cabin called Bloon, which was already tested last January with very satisfactory results. ■