Russian Satellites: Smaller, Lighter, Cheaper

by Yury Zaitsev
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One of the advantages of mini-satellites is their low production and launch cost, such as this SSTL-built microsat seen here.

Mini-satellites are all the rage these days. None of the Russian space firms attending the MAKS-2007 air show failed to exhibit one. Modern technologies enable spacecraft weighing a few hundred kilograms to perform tasks once the preserve of satellites of several tons. Satellites are getting ever lighter and smaller: there are already micro-satellites with a weight of between 10 and 100 kg, and nano-satellites, between 1 and 10 kg. Designers have even conceived of pico-satellites, weighing less than one kilogram, but they are still a long way off.

All these "babies" cannot, of course, completely replace their big brothers. One cannot, for example, reduce the size of space observatories (you cannot cheat the laws of optics) or interplanetary stations designed for comprehensive research, such as the delivery of extra-terrestrial matter to Earth.

One of the advantages of mini-satellites is their low production and launch cost. They are relatively inexpensive, easily adapted to different missions and can be placed in orbit by light or heavy rockets by the dozen. Because they cost less, mini satellites reduce the financial risks of losses from failures on the ground or in space. Such craft can also be stringed together to produce multiple systems, useful in communications, Earth monitoring, and research.

The project "Mini-satellites in fundamental research", part of Russia's federal space program for the period 2006-2015, provides for five such launches scheduled for 2008, 2009, 2011, 2013 and 2015, respectively. Mini-satellites will be made up of standard components configured around the same platform and adapted for particular objectives.

They will help to study the Sun and solar-terrestrial relations; cosmic rays; and the physics of the Earth's atmosphere, ionosphere and magnetosphere. The program also includes Earth observations, such as monitoring the surface of the oceans. These fundamental studies will examine the dynamics and structure of phenomena such as tides, tsunamis, giant eddies, currents, and storm waves, and update our knowledge of the Earth's topography.

The studies will involve the direct participation of European, American and Asian centers in Russian satellite experiments and joint international research programs for making so-called multi-point measurements. Combined with ground observations, this will make it possible to separate factors of space and time in, for example, the Earth's magnetosphere, which is important for forecasting "space weather" and studying its impact on the Earth's biosphere, including humans.

An example of a mini research satellite is the Karat unified platform developed at the Lavochkin science and production association. Fully loaded and taking into account the designer's margin, it weighs a mere 96 kg. But it carries a payload of 60 kg. A mini-satellite on this platform can be launched either as a self-contained probe or as a piggyback cargo. An add-on booster section can modify its orbit.

The Yakhta unified platform, developed at the Khrunichev Center, has been used to build the Monitor-E remote sensing satellite.

The Strela platform, developed at the NPO Mashinostroyenia military and industrial corporation, is being readied for launch together with a series of mini-satellites. They will carry, among other things, radar and optoelectronic systems for remote observation of the Earth. Both systems feature high resolution, as suggested by the satellite's name Kondor. The same unified platform is being used to develop the Ruslan mini communications satellite.

The Neva unified platform has been developed at the St. Petersburg Arsenal Design Bureau. It will produce spacecraft weighing up to 300 kg to be launched by rocket from aboard a Tu-22M Backfire plane. Each vehicle will carry a task specific module, depending on its intended purpose.

Studies conducted at the Arsenal have shown that a mini-satellite could be built on the Neva platform to carry a synthetic aperture radar for monitoring the Polar ice cap. Such a project would be of interest not only to Russia, but to everyone interested in exploring and developing the Arctic sea shelf. Radar images will be processed directly in space and transmitted to existing ground receiving facilities established for Resurs-DK, Monitor and Kondor satellites. One frame, covering an area of 550 km by 550 km, would cost just $300-600. This compares with $3,000 for a similar frame shot by the larger Canadian RodarSat craft.

More than 10 Neva-based projects have been selected and screened. The mini-satellites can be launched by any existing launch vehicles, depending on their power, either singly or in clusters, but the emphasis will be on combined air and space launches.

The Sterkh mini-satellite was one of the exhibits displayed at MAKS-2007 by the Krasnoyarsk Research and Production Association of Applied Mechanics. It is designed to upgrade the KOSPAS-SARSAT search and rescue system. The satellite will determine the coordinates of vessels in distress with greater accuracy and will be capable of transmitting information about them practically in real time.

The use of mini-satellites based on unified platforms will enable Russia to increase the scope of its orbital fleets and strengthen its standing in space research.

Yury Zaitsev is an expert at the Institute of Space Research. The opinions expressed in this article are the author's and do not necessarily represent those of RIA Novosti.