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South Africa opens new routes to space

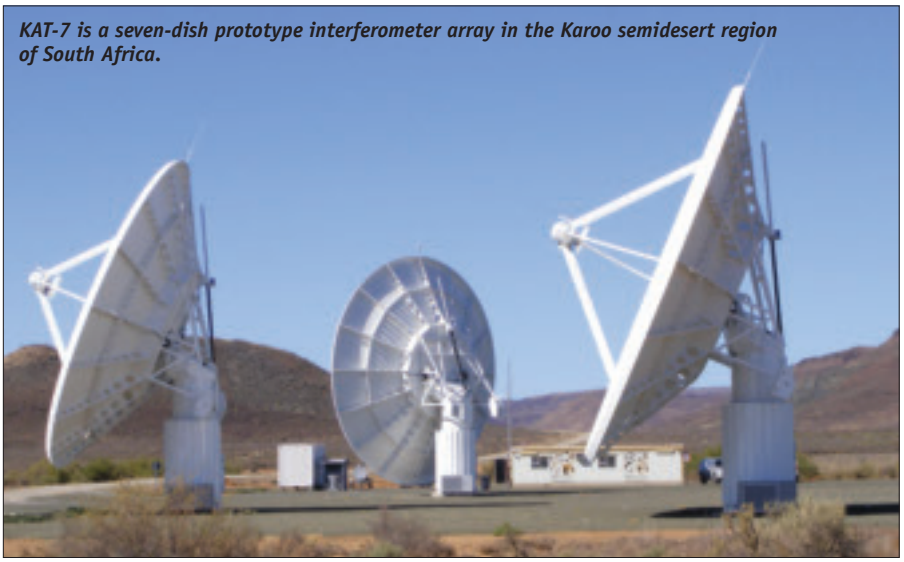
THIS MAY, THE $250-MILLION INTELSAT New Dawn communications satellite was launched on board an Ariane 5 from Kourou, French Guiana, marking another important step for Africa's growing space industry capabilities. The satellite's 28 C-band and 24 Ku-band 36-MHz transponder units have been designed to supply critical communications infrastructure for African customers, although a problem with the west antenna reflector has impaired the delivery of C-band services to the region.

Based on Orbital's STAR-1 platform, New Dawn operates from a geostationary orbital slot at 32.8° East. The satellite is designed to generate approximately 4.8 kW of electrical power to support the hybrid C- and Ku-band payload.

The program is important not just because of the increased Ku-band services it will bring to Africa, but also because it is largely a private venture: African institutions are providing around 90% of the total financing for the joint project, with Intelsat contributing the balance. A private telecommunications investment company, Convergence Partners, is leading the South African investor group, which includes the Industrial Development Corporation of South Africa and the African Development Bank.

The New Dawn communications satellite was launched in May.

According to Andile Ngcaba, chairman of Convergence Partners, "The satellite will not only deliver crucial services specifically tailored for Africa, it will also herald the dawn of a new era where Africans enjoy far greater involvement in the space communications industry."



KAT-7 is a seven-dish prototype interferometer array in the Karoo semidesert region of South Africa.

Industry grows as needs increase

Although Africa's involvement in the space industry is relatively small compared with other regions of the world, and concentrated in just a few countries, it covers a wide range of applications and is growing rapidly. The need for space-based assets for Earth observation, disaster management, and communications to support sustainable development, including the fight against poverty, is arguably greater in Africa than in any other region of the world.

South Africa is the most active of all African nations in the space market, and its space programs are concerned with pure science as well as more commercial efforts and infrastructure projects.

According to South African Minister for Technology Naledi Pandor, speaking in April at the opening of the Global Office of Astronomy for Development (OAD) within the South African Astronomical Observatory (SAAO): "We have some 60 astronomers working here in South Africa (25 here at the SAAO), and they are half of Africa's 120 astronomers. But more than numbers, we also have the political will.... We have invested in astronomy. We have invested in complex measuring instruments. We have SALT [Southern African Large Telescope], Meer-KAT [Karoo Array Telescope], and the bid to host the SKA [Square Kilometre Array]. We chose to invest heavily in science and astronomy because of its role in development, not only within South Africa, but all across Africa. Big astronomy projects such as SALT, MeerKAT, and SKA entail major capacity development programs in order to

train the next generation of engineers and astronomers from all over Africa."

The OAD is a partnership between the International Astronomical Union, the global association of astronomers, and the South African National Research Foundation. In 2009 the IAU launched its Astronomy for the Developing World program, which uses astronomy to foster education and capacity-building throughout the world. The new South African facility has been built to "stimulate development at all levels including primary, secondary, and tertiary education, science research, and the public understanding of science, building on the success of the International Year of Astronomy 2009," according to the SAAO.

SALT is the largest single optical telescope in the southern hemisphere.

Astronomy research on the rise

South Africa has growing capabilities in astronomy research. SALT is the largest single optical telescope in the southern hemisphere. It has a hexagonal primary mirror array 11 m across, comprising 91 individual 1.2-m hexagonal mirrors, and is similar to the Hobby-Eberly Telescope in Texas. Designed to operate from the near ultraviolet to the near infrared, SALT is funded by a consortium of international partners from South Africa, the U.S., Poland, India, the U.K., Germany, and New Zealand.

The telescope has had some teething problems. Originally built in 2005, it was taken out of commission in 2009 for upgrades aimed at improving the quality of outer-field images. The fix was completed in 2010, and since then the telescope and instruments have been undergoing recommissioning, due to be concluded by the end of this year.

"SALT is currently operational and undertaking commissioning observations," according to SALT astronomer Nicola Loaring. "These are engineering tests coupled with scientific observations designed to test the functionality of SALT and to accurately characterize its instruments. Some data from these observations are scientifically useful and have been/will be published. We currently have a call for science proposals due to be launched on 30th June 2011 for 2011 Semester II observations; Semester II will commence on 1st September 2011. We expect that the majority of commissioning observations will be completed by this time and SALT will move more into regular scientific operations."

The big prize, however, would be for South Africa to host the Square Kilometre Array, a $1.5-billion program for which the country is in competition with Australia. The SKA Science and Engineering Committee, based at Manchester University in the U.K., will announce the selected site for the telescope in 2012. The SKA will be between 50 and 100 times more sensitive than any other radio telescope on Earth, and South Africa is in a consortium with eight other African partner countries to host the project.

Under construction in the Northern Cape is MeerKAT, South Africa's precursor telescope to the proposed SKA. MeerKAT will comprise 64 Gregorian offset dishes, each 13.5 m in diameter, and will be delivered in three phases: commissioning in 2014/2015, with science operations starting in 2016 via a processing bandwidth of 750 MHz, followed by second and third phases with the addition of two receivers. The processing bandwidth will be increased to at least 2 GHz, with a goal of 4 GHz.

According to SKA South Africa, the organization behind the country's bid for the SKA project: "MeerKAT supports a wide range of observing modes, including deep continuum, polarization and spectral line imaging, pulsar timing, and transient searches." Among other operations, MeerKAT will be used to investigate gravitational radiation, observing the distant universe and nearby galactic objects.

MeerKAT will also be part of the global very long baseline interferometry network of telescopes working together simultaneously to seek extraterrestrial intelligence and download information from space probes.

A new space agency

Meanwhile, the South African National Space Agency (SANSA) was launched in December 2010, along with a national space strategy. SANSA's remit covers a wide range of activities, from Earth observation to space engineering, operations, and science. SANSA Space Operations, headquartered at Hartebeeshoek, conducts tracking, telemetry, and communications activities, launch support, in-orbit testing, mission control, and space navigation.

South Africa launched its second LEO satellite, the SumbandilaSat, on a Russian Soyuz in September 2009. Since then it has been transmitting images to support various applications including disaster management, food security (crop yield estimation), land use, and safety and security.

The first South African Earth observation satellite was Sunsat, a 64-kg spacecraft housing a multispectral imager with a 15-m resolution operating

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from an altitude of 600 km. Built by postgraduate engineering students at the University of Stellenbosch, it was launched by NASA in February 1999.

According to CEO Sandile Malinga, "SANSA focuses on four key themes, namely, Earth observation, space science, space operations, and space engineering. Data obtained through Earth observation is provided to government to facilitate resource management and planning. Space science monitoring provides valuable information on the impact of space weather as well as basic research in the space environment. In terms of space operations, SANSA has an ideally located ground station that services a vast array of international clients. Lastly, on engineering, South Africa intends to build on the experience gained in locally developing SumbandilaSat to further improve local satellite manufacturing capability in the microsatellite segment. All our programs are underpinned by a strong capacity-building drive and emphasis on science advancement and outreach."

Collaborative efforts

The route to space for most African nations is via collaboration, and South Africa participates in a number of pan-African communications and EO programs. For example, the GEONETCast initiative is a global collaboration 'system of systems' network that allows for coordinating and integrating satellite data and information such as video broadcasting and imagery for Earth observation. It is part of the intergovernmental Group on Earth Observations network through which South African research and government departments are leading work groups in several areas. These include developing a global network of airborne, space-based, and ground-based sensors, creating a climate education series of teaching aids, and providing politicians around the world with a common, science-based model of environmental risks and vulnerability.

With EADS, SANSA is also developing a dedicated satellite sensing source to be owned and operated by African authorities. Called GEO-Africa, it will be "a permanent African space observatory based on an innovative mid-high-resolution geostationary satellite to be operated by Africans. It will be developed and implemented in partnership with the European Union. The GEO-Africa will ultimately provide for the much-needed real-time mapping for Africa, together with the associated communication of the spatial information for various societal and economic applications," according to SANSA. The satellite would monitor water levels, vegetation destruction, disasters, and agricultural production throughout Africa.

"SANSA is identifying partnership opportunities with other African space agencies to maximize the impact of our resources for the benefit of Africans," Malinga explains. "Currently we offer exchange programs for students from African universities to work with our scientists and engineers to share knowledge and build the necessary skills. SANSA will also have the space engineering directorate operational, and this will offer added value through production of space satellites and other technologies. There is also a plan to take part in a multinational satellite program called the African Resource Management Constellation, in partnership with Algeria, Kenya, and Nigeria."

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What marks South Africa's new impetus into the space market is not a simple concentration on Earth observation and telecommunications satellites, the focus of most nations that wish to acquire a foothold in the space market. Rather it is a much broader ambition to play a full role in space science and astronomy domains as well.

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SANSA: Developing operational capabilities

Since its formation in 2010, the South African National Space Agency (SANSA) has been gradually evolving to undertake a wide range of operations. April marked the start of its second, or foundational, operating phase, with the integration of different operations and the refinement of structures, policies, and plans. Next will come the 'full operating phase,' starting 2012/2013, which will entail the start of the National Space Program: Earth observation, space operations, space science, and space engineering.

"SANSA was established by the government in a bid to steer the country from a largely resource-based economy to a knowledge-based economy through delivery of the 10-year National Innovation Plan, which addresses five priorities including space science and technology," according to Sandile Malinga, SANSA's CEO. "Emanating from this is a national space strategy that focuses on environment and resource management; health, safety, and security; and innovation and economic growth. Primarily, SANSA is to ensure that the national space strategy is implemented by bringing together key strategic institutions, promoting better coordination of national space activities under SANSA, and creating a visible point of contact for national space activities. The long-term goals for SANSA are to coordinate all space science and technology-related activities from a central entity and support government's goals through the 10-year national innovation plan."

A primary operational focus will be further improvement of the Earth observation data center. Space operations include data acquisition, tracking, telemetry, and control activities, together with in-orbit testing, launch support, and satellite mission control. The agency plans to host increased amounts of ground-station infrastructure. SANSA space science will take a multidisciplinary and multiinstitutional collaborative approach to academic research, and space engineering will involve institutions such as Stellenbosch University, Cape Peninsula University of Technology, the University of KwaZulu-Natal, and Tshwane University of Technology, as well as industry partners, to develop South Africa's indigenous space capability.

According to Malinga, "The wisdom of embarking on a satellite program has always been challenged by those who argue for perpetual procurement of data from external satellite programs. Apart from the technological capacity development inherent in pursuing an indigenous space program, the overall benefit associated with the independence of controlling one's own satellite and imaging routines is immeasurable."

SANSA therefore aims to strike a balance between acquiring data for the nation's immediate and pressing requirements and deliberately pursuing a satellite program for future needs.