Polar Bears and Spacecraft Tracking

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Spitzbergen is probably more often associated with polar bears and extreme Arctic winters than with high technology and cutting-edge satellite ground stations. This is now changing! Since the end of 2000, ESOC has been tracking the ERS-2 spacecraft from a ground station at Spitzbergen. Now, a new phase in the cooperation between ESA and Norway is about to commence, with the establishment of a long-term agreement for the provision of launch and early-orbit-phase and routine-operations services from Spitzbergen for the soon to be launched Envisat satellite.

Introduction

The Svalbard satellite station at Spitzbergen is the most northerly ground station in the world. It is this unique location (Fig. 1) in the Svalbard archipelago, at 78 deg 13 min north, that provides the station, known as SvalSat, with its unique coverage. SvalSat is the only station able to provide ground contact for all orbits of ERS-2 and Envisat and most other polar-orbiting satellites. For Earth-observation satellites, this means an opportunity to perform a global data dump for each orbit at a single site. It also means that, with just one ground station, Telemetry Tracking and Commanding (TT&C) services can be provided for every orbit.

Based on its experience with the ERS-2 service, ESOC has placed a long-term frame-contract with the Tromsø Satellite Station (TSS) company for support from SvalSat. A first slice covers Launch and Early Orbit Phase (LEOP) support and extensive tracking support for Envisat (five passes per night throughout the mission's lifetime), as well as a continuation of the current ERS-2 support (two passes per

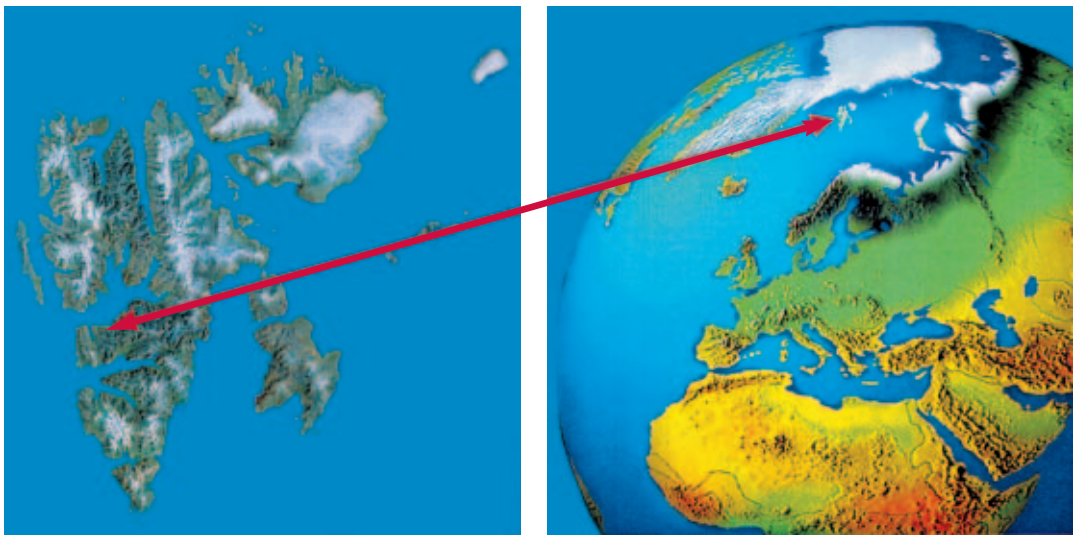

Figure 1. Location of SvalSat

night). In addition, any future ESA or third-party Earth-observation mission with a polar orbit that is operated from ESOC will also be covered by this frame contract.

SvalSat's history

As some Bulletin readers may remember, ESRO/ESA had a VHF station on Spitzbergen in the 'early days'. The station used now, however, is not owned by ESA but by Norwegian industry, and is installed at a different location. This new facility has been established by the Norwegian Space Centre (NSC) with support from TSS. It was designed, procured and constructed between 1996 and 1998. The construc-tion work included the provision of an access road, power, the station building and related infrastructure and all basic services.

Figure 2. The radome housing the 11m antenna for NASA support

The development at Svalbard was triggered by NASA, who had requested a location for an antenna to be used for its Earth Observing System (EOS) Polar Ground Network. The NASA-dedicated TT&C activities from SvalSat were initiated in 1997 when TSS started operating the ground station on the Svalbard archipelago under a contract with NSC. Today, TSS has 11 staff working permanently on the island. The station is manned around the clock and operations and maintenance are handled by three shifts.

Technical installations

The antenna infrastructure at SvalSat today consists of two operational 11-metre S- and X-band systems applied both for TT&C and for data reception (Fig. 2). The number of satellite operators signing up for service provision from Svalbard is growing steadily and TSS is therefore currently finalising the installation of a third complete multi-mission (13 m) ground station to be co-located with the existing ones (Figs. 3 & 4). This third system will become operational in February 2002 and will be supporting ESA's Envisat and ERS-2 missions on a priority basis.

The Norwegian telecommunications provider Telenor also has several antenna systems installed at SvalSat and provides telecom-munications services to the Norwegian mainland. The communications to and from Svalbard have generally been recognised as a critical issue for reliable operations. TSS has therefore established a dedicated communi-cations link directly between Tromsø and SvalSat, which is now the primary link for all operations tasks. To maintain communications redundancy between TSS and SvalSat, switched ISDN lines are used as a backup in case of prime satellite link failure. Near-real-time services requiring very reliable and fast distribution systems are offered by TSS, who are presently distributing data to customers at rates ranging from 9.6 kbit/s to 2 Mbit/s. Further possibilities are to establish dedicated satellite links.

Operations concept

SvalSat is manned around the clock by a team of 11 TSS engineers and an operations manager. They carry out all operations and maintenance at SvalSat. Additional managerial support in terms of special maintenance, financial administration and quality assurance is provided from TSS in Tromsø. Two engineers staff the station at all times, ready to respond immediately on site if anomalies occur. One of the antenna systems available at SvalSat (the NASA-dedicated system) is operated locally by this TSS crew. The remaining two (including the new TSS antenna) are remotely controlled and operated by the Tromsø Network Operations Centre (TNOC).

TNOC is a part of TSS and since December 2000 it has been providing operational S-band support to ESA's ERS-2 satellite. Since 1 April

Figure 3. The new 13 m SvalSat antenna

Figure 4. Installation of the radome for the new 13 m antenna

2001, TNOC has also been certified for full operations on several NASA missions. There are also two engineers available at TNOC at all times, to respond immediately to operational or technical-support requests. Any scheduling of the remotely controlled installations is also handled by TNOC (by e-mail or voice communication).

The remote operations are supported by a powerful Unix-based station computer. The telecommunications connection between the ground segment at Svalbard and TNOC is via a leased satellite link. In the event of a failure in that link, the station can be controlled locally by the SvalSat staff.

Continuity and experience are important factors when operating an advanced technical installation in the Arctic, and the staffing of the Tromsø office and the Svalbard site is therefore seen in an overall context, with engineers being rotated from time to time between the two. This helps to maintain both the technical competence and Arctic experience within the organisation. The fact that operating in an Arctic environment calls for special competences to ensure personnel safety is also focused upon.

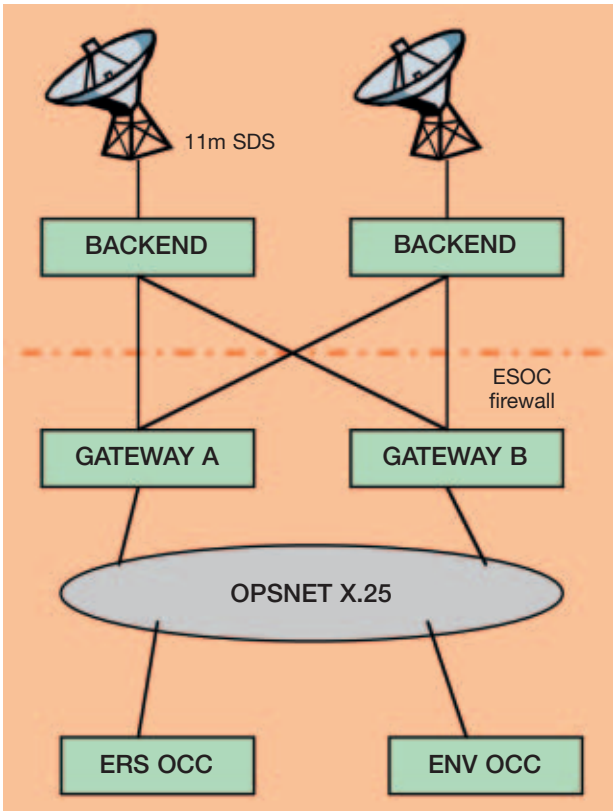

Figure 5. SvalSat TT&C links to ESOC

Preparing to support ESA

The procurement of a pure TT&C service from an external station, without having any ESA installations on site, was a first for ESOC. Before starting the endeavour, therefore, a number of technical and operational changes had to be implemented. At ESOC's end (Fig. 5), a gateway had to be developed that translates the different formats and protocols used at the Svalbard station into something that make it look like a standard ESA ground station (it translates Svalbard's TCP/IP-based protocol to the standard ESA SDID/X.25 format). Connection with SvalSat is initiated from ESOC, in Darmstadt (D), by calling either of the

gateways. Traffic between SvalSat and ESOC is routed via a firewall. At the SvalSat end, some specific features required for ERS and Envisat had to be installed in the station's up- and down-link chains.

During the initial service-optimisation phase, ESOC teams visited the TSS control centre and the Svalbard site (Fig. 6) and thereby experienced first hand the particular challenges of operating such an installation in an Arctic desert. In winter, the weather can change rapidly from good, with no snow or wind, to very bad, with strong winds and dramatically lower temperatures. When conditions do deteriorate, the road from the local settlement to the station has to be closed and the crew transported by helicopter (Fig. 7). The station is equipped to survive for a week or two without a fresh supply of water or waste removal (for environmental reasons, everything that goes up to the station has to be removed after use).

Apart from the obvious climatic peculiarities, there is a real danger of encountering polar bears outside the settlement. Consequently, everyone leaving the settlement or even just walking between the equipment building and antenna radome has to be accompanied by station staff carrying large-calibre guns. This frontier atmosphere also pervades the hotel bar at the settlement, where a special cupboard is available for depositing the guns whilst having a drink!

Outlook

The current NASA missions supported from SvalSat include Landsat-7, AM-1/Terra, EO-1, SACC-C, Acrimsat, Champ, QuickScat, Kompsat, Cobe, Aqua and Quicktoms.

Figure 6. The SvalSat site at Longyearbyen

Preparations for new NASA missions are also in progress. The European meteorological satellite organisation, Eumetsat, has also decided that SvalSat will be their prime site for polar-orbiting missions, which will result in the installation of two complete EPS ground stations (10 m antennas). Eumetsat has already signed a contract with TSS for providing the Polar Site Infrastructure and Operational Services for the EPS system. The MetOp satellite that ESA is providing to Eumetsat for this programme is planned to be launched in 2005.

With ESA's 'return' to the Svalbard location, ESOC is now in a position to offer excellent coverage for polar-orbiting missions. The service from Svalbard complements the proven support already provided from the ESA station at Kiruna, and will enable ESOC to react more flexibly to the programmatic and operational needs of its customers.

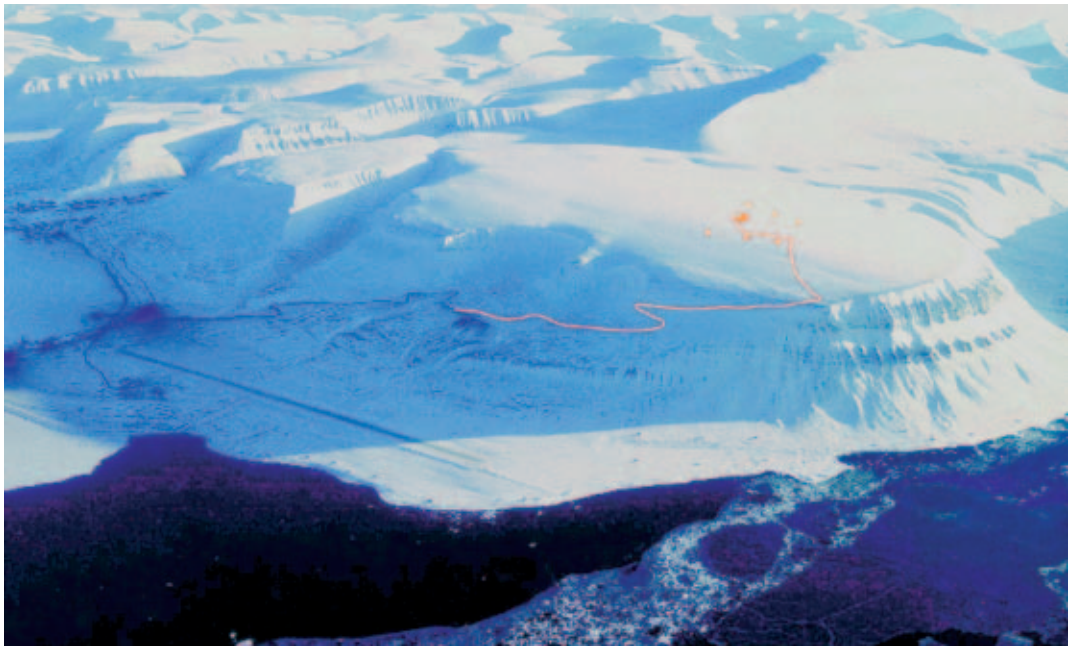

Figure 7. The route to the plateau