# ORBIT Case Study

MORABA | DLR

## Background

The Mobile Rocket Base (MORABA) is a department of the German Aerospace Center (DLR). As of 1960, MORABA has conducted scientific high altitude research missions with unmanned rockets and balloons, and has developed required mechanical and electrical systems. MORABA's unique operational areas include upper atmosphere research, microgravity research, astronomy, geophysics, materials science, as well as hypersonic research.

## The Challenge

Tracking a rocket launch is one of the more complex and risky tasks faced by any telemetry operator. The unpredictable path of the rocket, ever-changing weather conditions and the uncertainty that accompanies every telemetry test heighten this challenge.

MORABA designed a complete, fully equipped TT&C ground station for command, tracking, telemetry and data acquisition for their sounding rockets and stratospheric balloon research, as well as a support system for satellite missions during launch and early orbit phases. To support such complex and resource-intensive research missions, MORABA sought a highly dynamic and accurate tracking system. The new system had to ensure continuous and reliable data acquisition across a wide range of applications. Accordingly, tracking stability and redundancy were crucial functional requirements.

This undertaking was made even more complex by the velocity and unpredictability of the sounding rocket's flight path. To overcome this challenge, MORABA required a solution that could work with two antennas in parallel. Primary design goals were accuracy and redundancy, along with the ability to support mobility and versatility for maximum flexibility. Hence, it required a portable TT&C solution that could fit into standard 20-foot ISO containers, and would allow for fast setup and maximum compatibility with any location and infrastructure. In addition, as the system was to be deployable anywhere in the world, it had to be rugged enough to withstand extreme weather conditions of -40°C to +50°C.

## The Solution

MORABA was aware of ORBIT's reputation and experience in supplying these types of highly dynamic and accurate tracking system solutions. Having provided numerous turnkey tracking and telemetry solutions to leading space agencies and other facilities over the years, ORBIT was able to build and deliver a tailored solution in accordance with MORABA's challenging requirements.

ORBIT's solution was based on a best-of-breed approach using two antennas for optimal tracking of any flight path. An acquisition aid antenna attached to the main feed would track the first few seconds of flight after lift-off, which are highly dynamic in terms of acceleration and velocity. Tracking is then seamlessly switched over to the main feed for the more stable and predictable part of the flight path. The use of two antennas also allows for backup and redundancy.

The main antenna features a segmented 5.0 meter parabolic reflector on ORBIT's AL-4034 pedestal. This highly dynamic elevation-over-azimuth pedestal is equipped with an S-band tracking feed with supplementary acquisition aid. The pedestal is mounted on a flat rack detachable container to enable mobility. The feed supports simultaneous uplink and downlink in S-band, both with polarization diversity for improved signal quality even under adverse conditions.

The second antenna, 1.5 meters in diameter, sits atop ORBIT's AL-4012 pedestal mounted on a quad-pod and represents an autonomous tracking system. With its large beam width and high-speed positioner, it is ideally suited for acquisition of fast targets. It can slave the main antenna and can take over the backup or split target tracking during operation. The slaving functionality was built by MORABA and used by ORBIT for tracking.

Both antennas are controlled and monitored remotely by ORBIT's AL-4000 Antenna Control Unit (ACU). The ACU GUI was customized to meet MORABA's requirements.

To meet MORABA's portability requirements, ORBIT reduced the size of its standard pedestals and specially designed an antenna that can be easily assembled and disassembled by means of a segmented reflector.

## Delivery & Installation

As scheduled, ORBIT delivered the customized system to MORABA for on-site acceptance tests in December 2013, only 11 months after project kickoff. ORBIT's technical team worked with MORABA to deploy and verify the system in Germany. After an extensive testing process which took several months, the system was approved for operations and moved to its first operating site in northern Sweden.

## The Customer's Point of View

> ORBIT's antennas are excellently engineered and fulfil MORABA's stringent requirements. Both antennas have proved to be reliable and robust systems capable of auto-tracking even fast rockets straight from lift-off. MORABA's previous antennas could achieve this only with very large distances from the launch site, where the required angular velocity was low. Now ORBIT's antennas are the key instrument of MORABA's tracking & control station.
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