# The Rosetta space mission

*By Klaus Wilmeroth and Wolfgang K. Weber*

*In 2003 the European Space Agency will launch the Rosetta spacecraft that will travel to the far-away comet Wirtanen. After nearly nine years in deep space and traveling nearly three times the distance of the earth to the sun, the spacecraft will explore this unknown comet. The communication with the spacecraft will require a high-precision earth antenna. The antenna control ACU 8100 system (shown in Figure 1) from Vertex Antenna Technology is based on CompactPCI components from SMA and the operating system VxWorks is from Wind River.*

**Figure 1. ACU 8100 antenna control unit**

The control of spacecraft on a deep space mission as well as the acquisition of telemetry data and the observation of the spacecraft itself, utilize telemetry, tracking, and control (TT&C) antennas. Similarly, the Rosetta mission requires data transmission over a distance of up to 900 million km (approximately 50 light minutes). The mission not only calls for an antenna with excellent transmission and reception characteristics, but also outstanding tracking and positioning precision.

This year a 35 meter antenna suitable for this task is being built in New Norcia – about 140 km from Perth in Western Australia. This TT&C antenna will be one of the largest systems in the world and a star of the European Space Operations Centre (ESOC). Besides being a freely positionable parabolic dish, the antenna system will be equipped with special transmission and reception units that will transmit and receive in the s- and x-band (2.2 – 2.3 GHz and 8.4 – 8.5 GHz) with over 20 kilowatts. Many of elements of the antenna system were provided by Vertex Antenna Systems in Santa Clara, CA and Vertex Antennentechnik in Germany. Vertex is in charge of the transmission and reception units as well as the entire positioning system with the ACU 8100 control computer.

### How it works

The total height of the antenna will be around 40 meters. The ACU 8100 control system (schematic is shown in Figure 2) positions the 540 ton dish with exceptional precision despite average

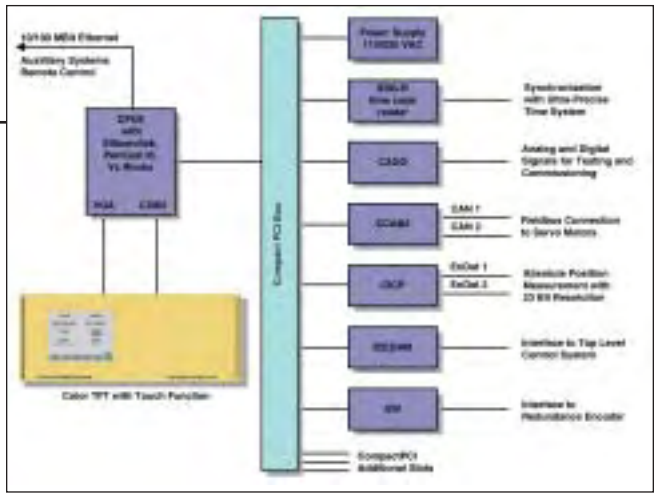

**Figure 2. Schematic diagram of the ACU 8100 antenna control unit**

wind speeds of 45 to 60 km/h. Depending on the band used, the maximal positioning deviation is around 0.026 (s-band) all the way down to 0.006 in the ka-band (photo of antenna is shown in Figure 3).

**Figure 3. Antenna system for TT&C**

### Why it works

The implementation of the positioning tasks require a powerful real-time OS. As a result, VxWorks from Wind River was chosen. The industrial PC, CompactMax from SMA boots the system and starts the application program from a solid state disk (non-rotating mass storage increases long-term reliability). The CompactMax is equipped with a Pentium III/500 and allows cycle times of under one millisecond.

### Long-term planning

The special features of the antenna and the mission duration require special consideration in terms of the computer system. The time from the initial planning in 1998 and the start of the construction of the antenna this year, to the arrival of the comet in the year 2012-2013 is very long. It is therefore mission critical that computer components are not only reliable but also available and supported. Therefore, the bus system chosen was the CompactPCIbus (serial communication processor slave components are shown in Figures 4 and 5).

**Figure 4**

**Figure 5**

**For more information about the Rosetta mission, visit the ESA Web site www.sci.esa.int/rosetta.**

**For more information on VxWorks from Wind River, visit their Web site www.windriver.com/**

**For more information regarding SMA industrial computers, visit their Web site www.sma.de/en/inco/**