Building a satellite; an industrial puzzle

The scientists and users set the wishes and demands for a satellite like Metop, but it is only the industrial community that can concretise these wishes into an operational satellite. No company alone has the knowledge required, and to gather all information into one piece is an enormous puzzle for the organisations.

Text: Baard Kringen, NordicSpace

For ESA, responsible for the developing and building of Metop, it was necessary to involve the best within the space related industry at the very beginning of the project. Much of the structures in the satellite are based on the Polar Platform, and very much like the structure in Envisat. Some of the instruments onboard are further developed instruments from the same satellite, whereas others are especially developed for this one.

Involving the whole of Europe

Building, let alone managing such a complicated satellite, is like putting together an enormous puzzle. Weight, volume and energy consume is very critical for all instruments, and the demands from the users vary. The project therefore involves many of the space qualified companies with experience from similar programmes in Europe. Most people only hear about the prime constructors in addition to the large suppliers, however, equally important are the many co-suppliers of all tiny pieces that provide a basis for the completion of the satellite.

Parts for the ASCAT antenna

One such co-supplier is the Norwegian Norspace, until some years ago a part of French Alcatel, today an independent supplier of key components to the space related industry world-wide. Many of the small pieces in the puzzle the company deliverer are based on the key technology, Surface Acoustic Waves (SAW), a technology the company is well- known for. However, for Metop, Norspace has developed and delivered parts for the receiver of the ASCAT antenna. ASCAT, the Advanced Scatterometer, is primarily designed to provide global ocean wind vectors operationally.

GRAS built in Sweden

Among the large suppliers to the satellite is the Swedish Saab Ericsson Space AB (SES). Onboard one can find the first scientific instrument built by the company, the GPS Receiver for Atmospheric Sounding (GRAS). The instrument is developed in cooperation between ESA and EUMETSAT, and can measure atmospheric humidity and temperature through tangential scanning of the atmosphere. This is unlike all the other instruments since they are based on vertical scanning. The instrument receives precisely calibrated position data from the American GPS system. The Doppler shifts of the received signals are directly affected by the refraction of the signal by the gradients of atmospheric temperature and humidity. The instrument combines Saab Ericsson Space's experience within the field of antennas, microwave technique and computers/signal processing.

Signal Processing and NOAA Interface Unit

CNES then ordered a signal processing unit for the IASI-instrument to be developed and built. The Infrared Atmospheric Sounding Interferometer is a multi-purpose instrument, which through a vertical scanning and of a resolution of 1

km, can measure temperature, water vapour, trace gases such as ozone nitrous oxide etc. as well as surface temperature, surface emission and cloud characteristics. The signal processing is carried out by several parallel working signal processors onboard, and this is developed and built by Saab Ericsson Space.

To adjust the American instruments onboard Metop to European signal standards the company has built the large NOAA Interface Unit. Additionally, electrical design and tests of ASCAT (Advanced Scatterometer) antennas are carried out. These antennas sit in pairs on three different directions onboard.

The onboard computer also comes from Saab Ericsson Space, because this computer is based on, and is similar to, the onboard computers on the SPOT satellites, and SES has delivered this computer to all of the Spot- like satellites.

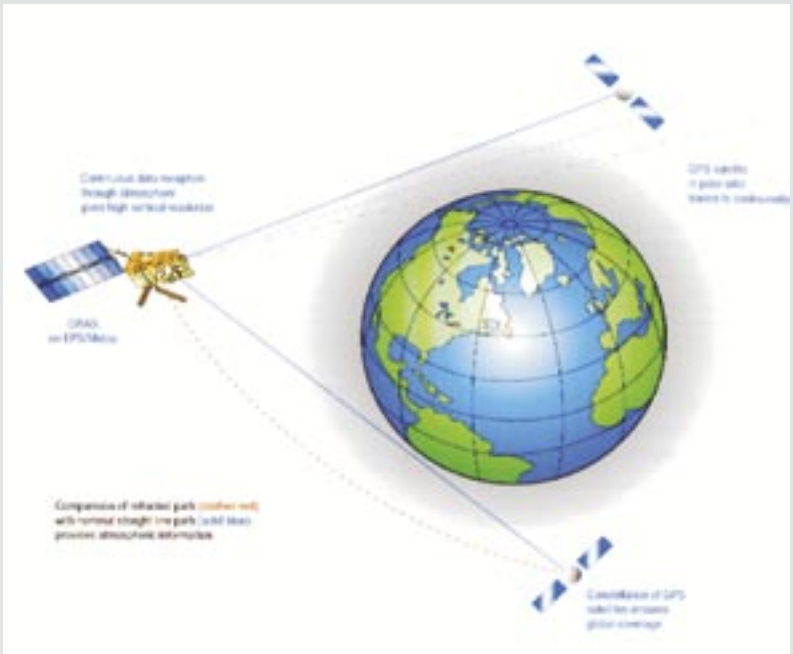
Finally, it is worth mentioning that SES also built the HRPT antenna onboard, thus making the Saab Ericsson Space's engagement complete. The HRPT antenna is an L-band spiral antenna for transmitting high-resolution pictures to the ground stations.

Antenna for the GRAS Radio occultation instrument, developed and built by Saab Ericsson Space. Photo: Saab Ericsson Space

Data to manage the satellite

To manage the satellite and instruments onboard requires that companies develop their own private services, alternatively, buy those services from others. An example is data on navigation. Very accurate positioning is necessary both for the satellite itself and for some instruments onboard. This raw data, which consists of accurate distance between the GPS satellites and Earth's surface, has been delivered from the Norwegian Fugro Seastar AS. Distance measurements to the GPS satellites are collected from sixteen measure points around the earth, eight primaries and eight backups with an updating frequency of one second. This data is utilised by the European Space Operations Centre (ESOC) to calculate position of the GPS satellites, and thus, also the accurate position for Metop.

The GRAS instrument onboard (GNSS Receiver for Atmospheric Sounding) uses the radio occultation phenomena to calculate both temperature and humidity in different levels or heights of the atmosphere. To carry out this calculations the instrument depends on very accurate positions, both by Metop and by the navigation satellites the instrument receive signals from. This is also based on the raw data Fugro Seastar delivers. The GPS data that is used is collected from the American Global Positioning System.



The GRAS instrument is very dependent on accurate positioning, both for itself and for the GPS satellites. Figure: EUMETSAT