

InfoTerra - Novel Geo-Information Services

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1 INTRODUCTION

Satellites have been investigating the Earth from Space since the seventies. Whereas the tasks they have performed up until now have primarily had a scientific character, the technology has evolved to make Earth observation satellites indispensable in many fields. The era of their commercialisation has long since begun. Today, images taken by orbiting satellites play a vital role in cartography, agriculture and forestry, exploration of terrestrial resources, environmental monitoring and mitigation of natural risks. But the requirements made of information gathered by satellite missions have also become more rigorous and commercial users now demand greatly improved quality. The information must be based on data with higher spatial and thematic resolution; their delivery needs to be fast and reliable. This has now become possible through the use of advanced SAR sensors.

Astrium GmbH (formerly Dornier Satellitensysteme GmbH) has initiated the multi-lateral **InfoTerra project** with the objective of achieving a leading role within the growing market for space-based geo-observation information. The industrial co-partner is Astrium Ltd (formerly Matra Marconi Space UK). The German Aerospace Research Institute (DLR) and the British National Space Centre (BNSC) support the industrial partners.

2 UNDERSTANDING THE MARKET - THE BASIS FOR INFOTERRA / TERRASAR

In order to understand client requirements, Astrium has, since late 1997, invested considerably in its "InfoTerra/TerraSAR" market research initiative. This two-year long study, involving numerous market research institutes, universities and potential customers, identified the global demand for geo-information, and determined the size and nature of future market segments. The results of this in-depth study have provided the basis on which the "InfoTerra" business concept is founded. The study identified that new satellite-data of enhanced quality is needed to support the increasing future commercial exploitation of satellite-imagery and the derivation of new user-focused geo-information products. As a result, new satellite sensors are required to deliver more detailed information faster and more reliably, in-order to support rapid client-user growth. Detailed Astrium studies have shown that, in addition to the optical sensors already planned for launch in the next 2 years, high resolution radar instruments, such as the Synthetic aperture Radar, will also be essential for the development of future commercial products and services.

3 RELEVANT MARKET SEGMENTS FOR INFOTERRA

As result of the market analysis, InfoTerra aims at addressing the following market segments:

- | | |
|---------------------------|--------------------|
| 1. Cartography & Planning | • Agri-Environment |
| 2. Forestry | • Risk Assessment |
| 3. Geology & Exploration | • Security |
| 4. Utilities | • Marine |

These segments are characterised by quite differing structures. Whereas the segment Cartography & Planning is characterised by a few customer target groups such as governmental agencies, international organisations (eg.UNEP or FAO), private geo-data providers, publishers and GIS-software providers, the agri-environment segment is much more fragmented. Even the sub-segment of "Suppliers" for example, is sub-structured into machinery producers, agro-chemical and seed Industry

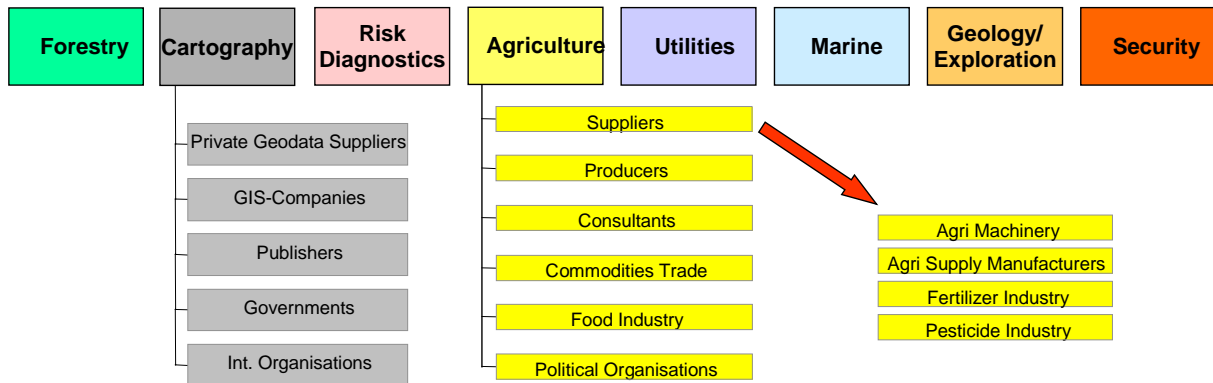


Fig. 1: The principal market segments for InfoTerra

With reference to the above sketched market segmentation the question may arise: "Why is there no Environment Segment ?"

Of course, the environmental sector which is of paramount importance and to which satellite-borne information can contribute key information has not been forgotten. However, environmental issues are addressing most of the segments above in a horizontal fashion. A good example within the agri-business is precision farming, serving the economic interests of the farmers by minimising costs for fertilizer and pesticides as well as providing an important contribution to soil and ground water protection by reducing the use of these chemicals.

Thus, environmental aspects are not missing in our market analysis but are integrated within the majority of the identified market segments.

4 THE PRODUCTS AND SERVICE CONCEPT OF INFOTERRA

Concluding the major results of our market analysis, the envisaged services of InfoTerra will include a series of

- high resolution products,
- high thematic information content products - with respect to land cover and change detection
- digital elevation models (DEMs)
- focused on the key markets identified above.

This will be achieved with a SAR (synthetic aperture radar) system called **TerraSAR** on the basis of dual frequency (X- and L-band) and multipolarisation SAR instruments. They will be specially designed for land monitoring, enabling routine data capture without the disadvantage of cloud and illumination constraints.

The X-band complement will feature resolutions in the 1 m class for land mapping. Fig.2 shows an example of a high resolution X-band product of an area close to DLR Oberpfaffenhofen acquired by the Dornier developed airborne system DoSAR.

L-band with its unique strengths for land monitoring will enable discrimination of land cover types because of its penetration ability, and with polarimetry enhancing both land cover classification and soil moisture retrieval. The sensor system capabilities include stereo in X-band and repeat pass interferometry in L-band

Simultaneous dual frequency operation in combination with image sharpening will provide high resolution colour images of a quality that has so far only been available from optical systems. Fig. 3 is a sample product to demonstrate the envisaged quality of TerraSAR products. It was generated on the basis of simulated TerraSAR data using the DLR developed and owned airborne E-SAR.

The services generated by InfoTerra will combine features of airborne and optical satellite sources with the weather independence of SAR and will be complementary to established and planned optical remote sensing services, in particular in areas affected by frequent cloud cover (e.g. tropical and mountainous regions).

This actually means that the services provided by InfoTerra will not only be based on data from TerraSAR but will make use of all information sources which are necessary to generate an optimised customer product – either from alternative satellite and airborne systems or existing data, etc.



Fig. 2: The airport of Oberpfaffenhofen with DLR research centre on top – X-band data at 1 m resolution provided by the airborne Do-SAR

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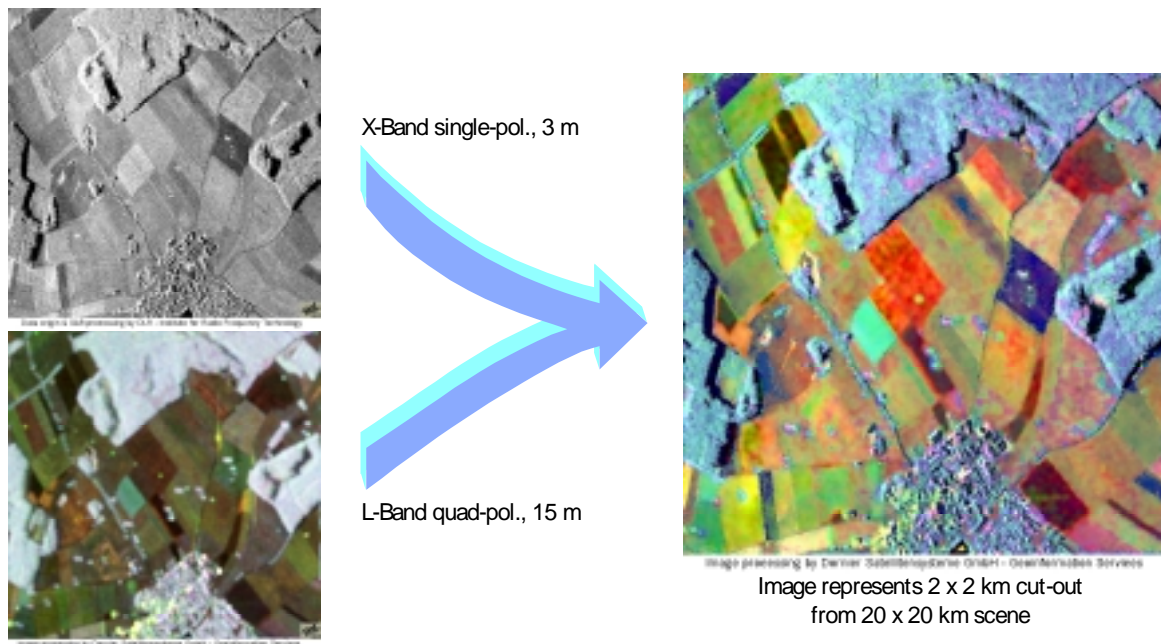


Fig. 3: Combination of high resolution X-band data and multipolarisation L-band data to generate thematically and geometrically high resolution products - data sources: E-SAR / DLR

5 THE PARTNERSHIP CONCEPT

A major element of InfoTerra is the partnership concept, bringing together all the key players acting in this business:

- **Production partners** which own specific knowledge and experience in a particular market segment,
- **Marketing partners** having established market access in either specific areas or certain segments,
- **Innovation partners** from the research communities for the development of innovative product ideas
- **Financing partners** from the public and private sector.

On a national level, this partnership concept has been successfully implemented in a first attempt by the so-called *ProSmart* project in 1998 / 1999 by bringing together:

- DLR as public, co-funding partner,
- DLR as provider of high performance airborne data for the generation of product demonstration examples,
- Service companies from the value-adding sector, providing expertise and introducing new customers
- Research units from universities.

The overall objective of *ProSmart* is to demonstrate the technical feasibility of products on the basis of improved quality remote sensing data and to prepare the basis for the further implementation of production processes.

The *ProSmart II* campaign, started in 2000, continues the development and demonstration of further InfoTerra products

6 THE SATELLITE SYSTEM TERRASAR

The space segment currently planned to be based on a single satellite in a 620 km dawn-dusk orbit. A tandem constellation is also being considered as an option, depending on the market requirements for quick access, short revisit times and interferometric products.

- ❑ High spatial/ thematic resolution
X/ L-band SAR
- ❑ High productivity active antenna system
 - spotlight: 1- 2 m/ 10 km
 - stripmap: 3 - 15 m/ 35 - 70 km
 - scan SAR: 15 - 30 m/ 100 - 200 km
 - beam steering: 20 - 50° Incidence angle
- ❑ Solid state storage: 500 Gbit
- ❑ High speed Ka-band downlink: 600 Mbps
- ❑ Product location accuracy: 5 m

- ❑ Mass: 2,200 kg
- ❑ Dimensions: 4.1 x 2.7 m stowed (< 9 m deployed)
- ❑ Launcher: medium class

Table 1: The major characteristics of the TerraSAR satellite

The active SAR system, which can rely on national technology programmes in progress, enables short revisit or site access times of 3 days or better with a single spacecraft, and of 1 day for tandem constellation.

The flexible modes of the active SAR system (spotlight, strip-map and scanSAR, beam steering) will provide 10 km spots at very high resolution as well as 100 km swaths at high thematic resolution.

The data chain is optimised for high productivity, allowing different service types like base mapping and object-oriented monitoring in an alternating manner. Corrected images and data sets will be archived and provided by a few stations to a number of globally distributed service nodes. Optionally, real-time data reception by small inexpensive terminals with image provision capability is considered.

7 THE IMPLEMENTATION OF INFOTERRA

Initially, the Friedrichshafen-based unit “Earth Observation Services” of Astrium, will be integrated into a new company, “Infoterra GmbH”, which will remain located in Friedrichshafen, Germany. In addition the British “NRSC Ltd” (National Remote Sensing Centre), a 100-percent subsidiary of Astrium, located in Farnborough and Barwell (UK), will be renamed “Infoterra Ltd.”. NRSC is already a leading supplier of geo-information products, with a 20-year history. Upon launch “Infoterra” will immediately become a major player within the geo-information marketplace, with annual revenues in excess of 20 million Euro. Infoterra, with a combined workforce of 190 employees, will operate under the stewardship of a joint pan-European management structure. On an international scale, Infoterra will provide a unique fund of resources and expertise.

8 CONCLUSION

The industrial initiative InfoTerra, comprising the TerraSAR satellite system can be considered as a major step towards the implementation of operational and commercial Earth observation.

Based on thematic and geometric high resolution SAR data, InfoTerra will fulfil one of the most important customer requirements - the guaranteed provision of reliable geo-information.

Founded on a partnership concept, InfoTerra will also support the development of a strong service segment for satellite-based geo-information services thus stimulating further, application-oriented research.