

**Government of Northwest Territories  
Mission to Kiruna, Sweden and Munich, Germany**

**Mission Report**

**1. Summary**

- The Government of Northwest Territories (GNWT) conducted fact finding a mission to Kiruna, Sweden and Munich, Germany between May 10, 2013 and May 16, 2013.
- The objective of the mission was to visit satellite receiving stations and space organisations in Sweden and Germany who have invested in the Inuvik Satellite Station Facility, local communities that host satellite receiving and processing facilities and related educational establishments to assess the potential benefits of an expanded ISSF as a result of the planned Mackenzie Valley Fibre Link (MVFL).
- Mission Participants - the mission was led by Minister Miltenberger and included representatives from the Inuvialuit Regional Corporation, Gwich'in Tribal Council, Sahtu Secretariat Incorporated, Town of Inuvik, and in addition, the MLA for Range Lake (Yellowknife), the Deputy Minister for Finance, the Minister's Executive Assistant, and the GNWT's lead consultant on the MFVL project.
- The total cost of the Mission was \$138,945.
- Key Findings:
  - The Swedish Space Corporation facility (Estrange) is located close to Kiruna. The facility consists of 26 antennas, a 24 hour satellite control and monitoring centre, research facilities for visiting scientists and a hotel.
  - Kiruna is location of the Swedish Institute of Space Physics, which attracts scientists from around the world to study polar atmospheric physics, solar system physics and space technology.
  - The long term consistency of the satellite and space based activities in Kiruna provides a stable economic base that complements the variability in the mining sector in northern Sweden.

- The Swedish Space Corporation (SSC) and the German Space Agency (DLR) have operational satellite antennas at the Inuvik Satellite Space Facility (ISSF), and both organisations were extremely supportive of the Mackenzie Valley Fibre Link (MVFL) project which they indicated was the key enabling technology to permit expansion of the ISSF. Both SSC and DLR indicated that they would plan to commit further antenna and satellite data processing facilities at ISSF once the fibre link was operational.

## **2. Mission Participants**

- Minister Miltenberger – Mission Chief, Yellowknife, Fort Smith
- Mike Aumond, Deputy Minister, Finance, Yellowknife
- James Tolley, Executive Assistant to Minister Miltenberger, Yellowknife
- Daryl Dolynny, Member of Legislative Assembly, Yellowknife
- Amy Thompson, Executive Director, Gwich'in Renewable Resources Board, Inuvik
- Danny Yakeleya, Mayor of Tulita, Sahtu Secretariat
- Denny Roger, General Manager, Inuvialuit Dev. Corp, Inuvik
- Jim MacDonald, Deputy Mayor of Inuvik
- Stuart Salter, Consultant

## **3. Visit to Kiruna Township**

An overview of Kiruna Township was given by representatives of the Kiruna Council and a representative from the local Sami people. Key findings were:

- The economy of Kiruna is based on mining (Kiruna has Europe's largest iron ore mine, LKAB) and the space industry. The Swedish Space Corporation's extensive facility at Estrange, the European Space Agency's facility (Estrack) near Kiruna, and the Institute of Space Physics in Kiruna provide both a stable economic base for the region and a significant number of both permanent and visiting scientists type positions.
- The preoccupation during our visit was the economic challenges of the LKAB mine, and a planned expansion under the existing township site. The satellite and space sector was seen as a long term stable base and, in a sense, was taken for granted.
- Kiruna brands itself as the Space Capital of Sweden.

The Town of Inuvik presented an Inuvik flag to Kiruna.

#### **4. Visit to the Institute of Space Physics**

The GNWT gave a presentation on the MVFL (shown in Appendix 3). The Director of the Institute of Space Physics (a Swedish Government Agency) gave an overview of the research work undertaken at the Institute and at the collocated Department of Space Science of the Luleå University of Technology. The key findings were:

- The Institute has 100 full time employees in Kiruna, with an additional 60+ employees and students at the University of Luleå Kiruna campus.
- The combined Institute and Luleå University facility is world class, and attracts visiting scientists from around the world.
- There is a strong scientific linkage and sense of community with the Institute, the University of Luleå, and the satellite facilities of SSC and ESA.

#### **5. Visit to the Sami Parliament**

Presentations were given by both the GNWT and representatives from the Sami Parliament. The key findings were:

- The Sami parliament was established in 1993, and has the status of a Department of the Government of Sweden. The Parliament is funded by appropriations from the central Swedish Government, and has an advisory role within Sweden.
- The Swedish Ministry of Agriculture retains overall responsibility for Sami issues.

#### **6. Meeting with Representative from Lunet - a Northern Swedish Municipal Fibre Optic Initiative.**

A presentation was given by the President of Lunet. Lunet is a broadband distribution system that is owned by local Municipal Governments. Appendix 6 provides details of the Northern Sweden (Norrbotten) regional broadband fibre Network.

## **7. Visit to the Swedish Space Corporation Satellite Station Facility**

The mission visited the SSC Esrange facility near Kiruna, including a tour of the antenna sites (dampened by poor weather and persistent fog), the rocket launching site, and the satellite control and monitoring centre. The facility also includes a 20+ bedroom hotel and restaurant complex, for visiting scientists. The GNWT provided an outline of the progress on the MVFL project. SSC staff provided an overview of the SSC operations, both in Sweden and internationally. Key findings were:

- The Esrange site is extensive with plenty of room for further expansion, is well managed and is recognised as a world class satellite receiving station.
- Esrange is used by all major space agency's worldwide (including DLR, NASA, ESA and JAXA {the Japanese Space Agency}).
- Esrange is at approximately the same latitude as the ISSF, and has the same geographic advantages regarding the download of data from remote sensing satellites in polar orbits.
- Esrange currently has 26 operational satellite receiving antennas.
- The two antennas at ISSF are currently controlled from Esrange.
- SSC expressed interest in working with GNWT with respect to the future expansion of the ISSF.
- SSC reiterated that the key to future expansion of the ISSF was the MVFL project, in order to facilitate the "near real time" transmission of data received at ISSF to processing centres worldwide.

## **8. Visit to the German Space Agency (DLR) at Oberpfaffenhofen, near Munich, Germany.**

The mission visited the principal space facilities of DLR, including a visit to local satellite receiving antennas on the site, and the European space station control centre. The GNWT provided an overview of the MVFL project. DLR gave a presentation on the applications of satellite based remote sensing, including monitoring of the Arctic regions for surveillance and ice monitoring. Key findings were:

- DLR is one of the top five space agency's in the world, and a founding member of the European Space Agency (ESA).
- DLR installed the first satellite receiving antenna at ISSF, and remains a very strong and vocal supporter of the ISSF.

- DLR also reiterated that the key to future expansion of the ISSF was the MVFL project, in order to facilitate the "near real time" transmission of data received at ISSF to processing centres worldwide.
- DLR indicated that ISSF had been provisionally chosen as the principal global ground station for the ESA Sentinel 5 mission, due to be launched in 2016. From DLR's perspective, it was important that the MVFL be ready on schedule to support this mission.

9. **Meeting with the Canadian Company Iunctus and its German subsidiary, Rapid Eye**

A meeting was held at the Canadian Consulate in Munich with the Vice President of Iunctus. Iunctus is an innovative private sector space company based in Lethbridge, Alberta. Iunctus indicated that the ISSF should be available to private sector satellite enterprises (as is planned), and that regulations and processes in Canada need to be streamlined to meet future private sector needs.

# **Appendices**

- 1. Mission Backgrounder**
- 2. Key Contacts**
- 3. Mackenzie Valley Fibre Link (MVFL)  
Presentation**
- 4. Swedish Space Corporation - Background**
- 5. German Space Agency - Background**
- 6. Norrbotten Fibre System**

# **Appendix 1**

## **Mission Backgrounder**

## **Backgrounder: Kiruna Satellite Facility Visit**

Minister J. Michael Miltenberger will lead a delegation of representatives from Aboriginal governments and government officials on a site visit of the satellite receiving facility in Kiruna, Sweden and Munich, Germany from May 11-17, 2013. The visit coincides with meetings of the Arctic Council taking place in Kiruna.

### **Visit Objectives**

NWT objectives for the site visit include:

- Identify potential best practices and approaches for expanding the Inuvik Satellite Station Facility (ISSF) based on experience and lessons learned at the Kiruna Satellite Facility;
- Explore partnership opportunities for expanding the ISSF with aerospace agencies and companies in Sweden and Germany;
- Investigate socio-economic benefits created in Kiruna as a result of the opening of the satellite facility there.

### **Inuvik Satellite Station Facility**

The Inuvik Satellite Station Facility opened in 2010 with two satellite dishes, one each from the Swedish and German Space Agencies. The site can easily be expanded to host multiple satellite dishes and is the first Canadian Arctic satellite receiving facility.

Northern Resources Canada (NRCan) administers the facility, which was built on the site of an existing Environment Canada weather station.

It is ideally located to receive data from satellites in polar orbits and is part of a network of Arctic satellite stations that includes facilities in Alaska, Sweden and Norway. Arctic facilities provide near-real-time data; facilities in the south can have data delivery delays as the satellites orbit the earth. With the right support and investment, Inuvik could become a leading centre for remote sensing, as Inuvik is on the flight path for 11 of the 14 orbits made by polar orbiting satellites. This would diversify the regional economy, create sustainable jobs for local residents, and expand the potential for research in the Western Arctic.

---

**Media requests for interviews with Members of the Executive Council may be directed to:**

Office of the Press Secretary • Premier/Cabinet  
Government of the Northwest Territories • PO Box 1320 • Yellowknife • NT • X1A 2L9  
Tel: (867) 669-2302 • Fax: (867) 873-0111



Remote satellite data supports scientific research, environmental monitoring, search and rescue, national security and Arctic sovereignty.

The Inuvik Satellite Station Facility is a public-private partnership. The partners are:

- Natural Resources Canada (Canada Centre for Remote Sensing)
- Canadian Space Agency
- Environment Canada
- Foreign Affairs and International Trade
- Indian and Northern Affairs Canada
- Industry Canada
- Justice Canada
- Government of the Northwest Territories
- Township of Inuvik
- Inuvialuit and Gwich'in communities
- PioraNet Canada Inc.
- University of Lethbridge, Lethbridge, Alberta
- German Aerospace Center (DLR)
- Swedish Space Corporation

### **Mackenzie Valley Fibre Link**

The Mackenzie Valley Fibre Link (MVFL) would maximize the potential of the Inuvik Satellite Station Facility by allowing information to be sent from the facility to researchers and scientists around the world in real time. Right now there is a delay as data is transmitted through slower, lower capacity microwave relays from Inuvik to Whitehorse and then further south.

The MVFL link would also improve data communications for communities along the route, diversifying the economy throughout the Mackenzie Valley and supporting public programs such as health and education. The speed in communities along the route would be similar to the speed that became available in Yellowknife with the construction of the Deh Cho Bridge. This would support businesses and agencies in Inuvik, Tuktoyaktuk, Fort Simpson, Wrigley, Tulita, Norman Wells and Fort Good Hope. Colville Lake and Deline could be served through microwave radio back to the link.

---

**Media requests for interviews with Members of the Executive Council may be directed to:**

Office of the Press Secretary • Premier/Cabinet  
Government of the Northwest Territories • PO Box 1320 • Yellowknife • NT • X1A 2L9  
Tel: (867) 669-2302 • Fax: (867) 873-0111

## **Investment Opportunities**

Estimated capital costs for the full Mackenzie Valley route are \$60 million. A Dempster Highway route is estimated to cost \$45 million, but would not benefit as many NWT communities. The GNWT is seeking partners in industry and Aboriginal governments to construct the link.

## **Building the MVFL**

Environmental, permitting and regulatory requirements could take 18-24 months. Building the link is estimated to take two years.

The link's 1,115 kilometres of buried fibre optic cable would follow the existing highway, winter road allowance, and proposed Mackenzie Valley Highway route, minimizing impacts along the valley.

## **Kiruna Satellite Facility**

The Estrange Satellite Facility near Kiruna, founded in 1972, is one of the largest satellite ground station in the world. It comprises:

- Over 20 satellite antenna installations both owned by the Swedish Space Corporation (SSC), and also installed and operated on behalf of clients worldwide.
- A network control facility that manages the largest commercial ground station network in the world.
- A satellite management services group that offers lifetime satellite design, management and technical services worldwide.

## **NWT Delegation and Activities**

The NWT delegation includes:

Minister Miltenberger - Mission Chief, Yellowknife, Fort Smith  
James Tolley, Executive Assistant to Minister Miltenberger, Yellowknife,  
Mike Aumond, Deputy Minister, Finance, Yellowknife  
Daryl Dolynny, MLA, Range Lake, Yellowknife  
Amy Thompson, Board Member, Gwich'in Tribal Council  
Danny Yakeleya, Mayor of Tulita, Sahtu Secretariat  
Denny Roger - General Manager, Inuvialuit Development Corporation  
Jim MacDonald, Deputy Mayor, Inuvik  
Stuart Salter, Salter Global Consultants (SGC INC), Ottawa

---

**Media requests for interviews with Members of the Executive Council may be directed to:**

Office of the Press Secretary • Premier/Cabinet  
Government of the Northwest Territories • PO Box 1320 • Yellowknife • NT • X1A 2L9  
Tel: (867) 669-2302 • Fax: (867) 873-0111

While in Kiruna, the delegation will meet with:

Swedish Space Corporation facilities at Estrange, near Kiruna.  
European Space Agency satellite ground station facilities (Estrack) near Kiruna  
Institute of Space Physics, Kiruna  
Township of Kiruna  
The Sami Parliament

While in Munich, the delegation will meet with:

The German Space Agency  
The Rapid Eye Satellite System

---

**Media requests for interviews with Members of the Executive Council may be directed to:**

Office of the Press Secretary • Premier/Cabinet  
Government of the Northwest Territories • PO Box 1320 • Yellowknife • NT • X1A 2L9  
Tel: (867) 669-2302 • Fax: (867) 873-0111

## **Appendix 2**

### **GNWT Mission to Kiruna/Munich - Key Contacts**

#### **Kiruna Township**

Niklas Sirén, Vice President of Municipal Council

Mrs Ann-Catrin Fredriksson, Municipal legal advisor

#### **Institute of Space Physics, Kiruna**

Director, Institute of Space Physics, Prof. Lars Eliasson

Dr Craig Heinselman, *European Incoherent Scatter* Scientific Association (Atmospheric Research)

Dr Rick McGregor, Institute's Information Officer

#### **Sami Parliament**

Mr Per-Mikael Utsi, Chairman of the Board

Mr Anders Kraik, Vice Chairman

#### **Lunet - Swedish Fibre Optic Operator**

Tomas Sundström, CEO Lunet

#### **Swedish Space Corporation**

Mats Tyni, Vice President, Satellite Operations Division at Estratec

Leif Österbo, President, Satellite Management Service Division

#### **European Space Agency, Estrack Facility**

Anders Paajarvi, Kiruna Station Manager

#### **German Space Agency**

Dr Thomas Weißenberg, Head, International Relations, DLR

Gunter Schreier, Director, Earth Observation Centre

Dr Achim Roth, Scientist, Earth Observation Centre

#### **Blackbridge Aerospace and Rapid Eye Satellite System**

Ryan Johnson, President and CEO, Blackbridge and Rapid Eye

Brett Michelson, Vice President, Blackbridge

# **Appendix 3**




## **Mackenzie Valley Fibre Link (MVFL) Presentation**



**Kiruna 2013**  
**Mackenzie Valley Fibre Link**  
**Project Summary**  
**(MVFL)**

# Mackenzie Valley Fibre Link (MVFL) – Route



-  Mackenzie Valley Fibre Route (Checkpoint to Inuvik section)
-  Inuvik to Tuktoyaktuk section
-  Existing Fibre Optic Links

- 1,115 km from Checkpoint Junction (nearest fibre connection in southern NWT) to Inuvik, with extension to the Arctic Ocean at Tuktoyaktuk.
- Connects communities along the Mackenzie Valley with Canada’s high speed fibre optic “backbone” network.
  - 7 northern communities connected directly
  - 6 communities, possibility of connection by digital microwave radio
- Design/Construction Schedule – 2 years (one summer season, two winter seasons) from contract award to commissioning.

# Project Overview

- The proposed route follows:
  - Existing all weather highway from Checkpoint to Wrigley
  - Existing winter road ROW from Wrigley to Fort Good Hope
  - Proposed Mackenzie Valley Highway ROW from Fort Good Hope to a point south of Inuvik on the Dempster Highway
  - Dempster Highway into Inuvik.
  - Proposed all weather highway extension from Inuvik to Tuktoyaktuk.
- Engineering Techniques outlined in the Feasibility Study include:
  - Use of armoured marine fibre cable.
  - Vibratory ploughing for summer construction.
  - Trenching for winter constriction
  - River crossings:
    - Bridges, where they exist.
    - For small creeks that are frozen to the bottom, trench through.
    - For larger crossings, including the Mackenzie, Liard, Great Bear and other larger rivers, directional drilling.



# Benefits

## Improved Delivery of Social Services



## Improving Health Services



## Sustainable Resource Development



## Improved Delivery of NWT Government Services

- **Health Care**
  - More cost effective.
  - Improved outcomes.
- **Distance Education**
  - Improved education resources for skills training.
- **Social Services**
  - Better access to Justice Services.
  - Improved protective services.

## Supporting Sustainable Regional Economic Development

- Resource Development in Mackenzie Valley and Beaufort Sea.
- “Enabling” Project for economic diversification and innovation.

# Linkages to other Infrastructure Projects

Inuvik Satellite Station Facility



Aurora Research Institute



All Weather Highway to Tuktoyaktuk



## Fibre Optic connection to Inuvik Satellite Station Facility

- High speed connection to the Inuvik Satellite Station Facility, supporting near real time transfer of Canadian and international satellite data.

## Aurora Research Institute

- Supporting Arctic Science and innovative partnerships with private sector resource and satellite data processing companies.

## Extension of all weather highway from Inuvik to Tuktoyaktuk

- MVFL will use proposed Highway extension Right of Way.

## Mackenzie Valley Highway

- MVFL will use proposed Highway/ Pipeline/Communications Infrastructure Corridor.

# Project Status



- **Technical Feasibility Study Complete**
- **Business Case Complete**
  - Design, Build, Finance, Operate and Maintain model proposed.
- **Project Description Report, in progress**
  - Provides information for a Preliminary Environmental Assessment.
- **Request for Expressions of Interest (RFEI)**
  - Closed April 10, 2013
- **Request for Qualifications (RFQ)**
  - Expected Release June 2013

Schedule / Tasks	2012		2013				2014				2015				2016	
	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr
Environmental Assessment	→															
Define System Requirements			→													
P3 RFP Process					→											
Design and Build Contract							→									

A photograph of a winter sunset. The sun is a bright yellow-orange circle in the upper left, surrounded by a red and orange glow. The sky transitions to a deep blue. Below the horizon, there is a body of water, a line of evergreen trees, and a snow-covered foreground with some bare branches. The text "Thank You" is overlaid in white on the right side of the image.

Thank You

## **Appendix 4**

**Swedish Space Corporation**

**(SSC)**



# SERVICES & TECHNOLOGY

FOR SUCCESSFUL SPACE PROJECTS









# WHAT CAN WE DO FOR YOU?

It all started in the 1960's, with the first scientific rocket launches from northern Sweden. The Swedish Space Corporation, SSC, was founded in 1972 and has since developed into a global business offering unique services and technologies to the aerospace industry.

The rocket and balloon launch services at Esrange Space Center are still among our core businesses. Our engineers develop rocket systems and advanced experiment payloads for a variety of scientific applications.

The SSC Group also offers an extensive range of tailored services for the aerospace sector. Our global ground station network provides reliable access to our customers' space vehicles in virtually any orbit. Our experienced teams

of engineers and scientists bring high quality expertise into customer projects, all the way from satellite program concept to mission execution.

Through ECAPS and NanoSpace, we are forerunners in the fields of space propulsion and miniaturized systems.

Add to this our airborne maritime surveillance systems, used by coast guards around the world, and it is evident that our activities span over a large spectrum, yet with a very clear and unfailing focus: Our customers and their needs.

Close customer cooperation, long experience and our skilled devoted staff have taken us this far, and we are always looking ahead, towards new challenges.

We welcome you to join us on this journey!



Esrange's location above the Arctic Circle is particularly advantageous for accessing polar orbiting satellites.



# GLOBAL CONNECTIVITY FOR SPACE OPERATIONS

Through PrioraNet, our global network of satellite ground stations, we provide access to our customers' space vehicles in any orbit for a wide variety of space applications. Our Network Management Centres are at the core of the network, providing customers with a single-point interface to the worldwide services.

## Global access to space

The SSC Group provides satellite management services that meet mission requirements at a fraction of the cost of owning your own dedicated station. Our PrioraNet network comprises our own stations as well as partner stations around the world, connected by reliable and secure terrestrial communication.

By utilizing SSC's ground segment services, our clients can take advantage of our substantial investment in global resources that can either be utilized in their existing form, or tailored by SSC's extensive in-house engineering capability for specific needs. Regardless of how demanding the requirements, we can provide a cost-effective solution to most applications.

Mission critical services that are available, reliable and affordable

Mission requirements are met through a full range of ground segment services that include leased-time access to existing global ground stations, data communications for backhaul of high volume satellite data, and hosting of customer-dedicated assets. The SSC Group offers alternatives to fit any profile.

Ground system proficiency is enhanced through the execution of exceptional maintenance and operations programs on both SSC and customer-owned equipment. Reliability, data integrity and security, tailored for each customer, are built into all our satellite management services, making the SSC Group the right choice for any mission critical ground segment solution.

## Services for the entire mission life cycle

*SSC ground network services effort begins in the mission preparation phase, which includes developing and testing the interfaces between the customer Mission Operations Center and the SSC Network Management Center to ensure successful in-orbit operations. Testing may also include SSC engineers traveling to the spacecraft manufacturer's facility or the launch base to perform radio-frequency compatibility testing with the spacecraft prior to launch. Our services continue through launch and early orbit operations and in-orbit testing, and are utilized for in-orbit spacecraft operations for the life of the program.*



### Reliable solutions

*PrioraNet is our network of tracking stations designed specifically to provide comprehensive communications and support to Earth-orbiting satellites. Through this unprecedented global network of ground stations, the SSC Group offers clear benefits to owners and operators of space-based assets.*

*PrioraNet sites are linked in a broadband network, enabling our clients to securely access their satellites when they want – without interruption or delay.*

*Utilizing the PrioraNet global infrastructure enables satellite operators to reduce overall mission cost while increasing overall system reliability and availability. PrioraNet is just one more example of how the SSC Group allows its clients to make better use of space.*



PrioraNet Stations



Collaborative Stations



Network Management Centers



Communications Point of Presence





**Esrange**

**Stockholm**

**Weilheim**

**Fucino**

**Bangalore**

**Mauritius**

**Hartebeesthoek**

**Yatharagga  
USN Western Australia**

**Perth**

LSE Space engineers in the Main Control Room at ESA's space operations centre ESOC in Darmstadt, Germany. Photo: ESA/Shlyayev



# EXPERTISE FOR SUCCESSFUL SPACE MISSIONS

**The SSC Group provides a wide range of engineering services through its experienced teams of engineers and scientists. We bring high quality expertise into customer projects as an integral part of the customer team.**

## From concept to execution

We support customer projects at all stages of the mission life cycle, starting with studies and requirements, moving to procurement and management tasks and ultimately to operations through to end of the mission. Our experts provide a broad range of space segment skills in the areas of mission assessment, spacecraft specification, development engineering support and payload research. Our engineers support ESA project teams ensuring that satellites are specified, procured and successfully commissioned.

## Mission operations and training

The SSC Group has over 20 years of experience in satellite and ground segment operations engineering. We cover the full mission range including manned space missions, earth observation and geostationary telecommunications satellites, navigation constellations, interplanetary satellites and astronomical missions. Our engineers complete tasks throughout the operations spectrum including mission analysis, specification of system requirements, implementation of satellite and ground segment operational procedures and the execution of operations throughout the launch and early operations, commissioning and routine operations phases. Our offer also includes tailored training courses in all aspects of satellite opera-

tions. The training we deliver is based on actual satellite and systems operations experience and includes real world scenarios to create a realistic context.

## Procurement and implementation

Based on customer requirements, the SSC Group can provide tailored systems and tools for ground segment systems and will also provide monitoring for industrial procurement contracts. Our staff is active in the specification, development, validation and maintenance of satellite and science operation centres including satellite monitor and control systems, mission planning systems and data processing products.

We will also take full responsibility to manage, operate and maintain customer specific facilities. We establish the management systems needed for inventory and maintenance tracking, problem management and staff management based on our extensive experience.

## Customer focus

*The SSC Group provides efficient and reliable services in both the public and industrial sectors by fully embracing customer requirements and applying our unique mix of skills. Our distributed organisation covering Europe and the Middle East provides responsible and responsive management within reach of our customer facilities.*

*SSC management places emphasis on the quality of the staff recruited, including the right attitude and the necessary range of skills to successfully complete your projects. Staff skills are further developed and maintained through training activities which cover technical, teamwork and managerial skills.*





Sounding rocket payloads land with parachute and are transported back to Esrange by helicopter within one hour.

# GIVING SCIENTISTS ACCESS TO SPACE

**No other company matches SSC's experience and comprehensive services for sounding rockets and high-altitude balloons. Our services span from mission design and development of experiment modules and service systems to launch services and recovery.**

## Rockets and tailored payloads

Scientists come to SSC's Esrange Space Center to fly their instruments on sounding rockets, either to study the atmosphere and near-Earth space or to perform experiments in weightlessness. Along with the launching services, we offer our customers a complete infrastructure that makes their stay both efficient and convenient.

Our engineers develop experiment modules for scientific research in microgravity environment, often within the fields of material science, fluid physics and biology, to be flown primarily on sounding rockets but also on other means such as parabolic flights. The modules are tailored in close cooperation with each science team to meet all specific requirements, including hardware and software required to carry out, monitor and control the experiments in real time during flight.

## SSC rocket programs

SSC's sounding rocket program MASER is a complete, cost-efficient concept for short duration research in microgravity. MASER rockets bring experiments to an altitude of 250 km, providing 6 minutes of microgravity conditions. The MAXUS rockets, an SSC-Astrium ST joint venture, reach 800 km and provide 12 minutes of microgravity.

## Stratospheric balloons

Many science teams return to Esrange year after year to fly their instruments with stratospheric balloons. The objectives range from astronomy and atmospheric research with large telescopes to test flights of aerospace systems. We can launch the largest existing stratospheric balloons carrying payloads of up to four metric tons.

The geographic location of Esrange is very beneficial for balloon flights as the wind conditions allow both for long-duration circumpolar routes and for flights where the payload can stay in telemetry line-of-sight for several days.

## Student research programs

The REXUS/BEXUS student program aims at fostering a new generation of scientists and engineers by offering experiment flight on dedicated rockets and balloons. The program is financed by the German Aerospace Center (DLR) and the Swedish National Space Board, supported by ESA and executed by SSC and DLR/MORABA.

## Test and validation of aerospace systems

*Stratospheric balloons and sounding rockets are cost and time effective tools in development and tests of aerospace systems.*

*Balloons are used as high capacity and high altitude (40 km) sky cranes to release and test aerospace vehicles, parachutes and atmosphere reentry systems. They may also be used for instrument calibration and validation of, for instance, satellite projects.*

*Sounding rockets are used for a large range of technical development and tests, including reentry trials. The microgravity environment is utilized to test the functionality of large space structures, liquid propellant tanks or other mechanical systems to be used in microgravity.*





The flight proven 1N HPGP thruster and LMP-103S propellant are baselined for several upcoming missions.

# INCREASED PERFORMANCE AND REDUCED MISSION COSTS

ECAPS provides complete space propulsion systems tailored to meet customer-specific requirements. Our High Performance Green Propulsion (HPGP) provides higher specific impulse and higher propellant density than traditional propulsion.

## Patented performance

The novel HPGP monopropellant is called LMP-103S. It is based on ADN (Ammonium DiNitramide) and provides increased performance compared to traditional propellants like hydrazine. As a result, the satellite can be fitted with a smaller tank, or the mission duration can be extended.

HPGP thruster technology, including the catalyst and propellant, has been patented by ECAPS.

## Low toxicity simplifies handling

LMP-103S is considerably less toxic than traditional propellants. Handling of LMP-103S requires only minimal protective clothing. This makes pre-launch fueling both faster and less expensive. LMP-103S is also insensitive to air and humidity, making it easy to handle and de-fuel if necessary. It can be stored for over 20 years, and is insensitive to space radiation.

LMP-103S can safely be transported to the launch site by air together with the satellite, rather than requiring separate shipment by land or sea.

## Thrusters and complete systems

All our thruster models are designed to replace hydrazine in monopropellant systems. We offer both individual thrusters and complete propulsion systems. We are also able to provide worldwide launch site fueling services.

## Environmentally benign

LMP-103S has significantly less impact on the environment than hydrazine. Adding this clear benefit to the lower costs and higher performance, we dare say that no other propulsion system technology can match HPGP.

Different thrust levels to suit your application	Status, Sept. 2012
<b>1 N HPGP thruster</b> <i>designed for attitude and orbit control of small-sized satellites</i>	<i>Flight-proven on Prisma in 2010</i>
<b>5 N HPGP thruster</b> <i>designed for attitude, trajectory and orbit control of small and medium-sized satellites</i>	<i>In development (TRL 5)*</i>
<b>22 N HPGP thruster</b> <i>designed for attitude and orbit control of larger satellites</i>	<i>In development (TRL 5)</i>
<b>50 N HPGP thruster</b> <i>designed for trajectory and orbit control of medium and larger satellites, or launch vehicle applications</i>	<i>In development (TRL 3/4)</i>
<b>220 N HPGP thruster</b> <i>designed for trajectory and orbit control of larger satellites, and launch vehicles upper-stage applications</i>	<i>In development (TRL 4/5)</i>

\* TRL = Technology Readiness Level



Propulsion components in the hands of NanoSpace engineers in the MEMS production facility.

# WHEN SIZE MATTERS

**NanoSpace is a forerunner in the rapidly growing market of miniaturized systems for space. Using MEMS (Micro Electro Mechanical Systems) technology, NanoSpace develops a range of novel products, such as the world's smallest rocket engines.**

## MEMS technology

Having changed the landscape in many scientific and industrial fields, MEMS technology is currently being introduced into the space sector. NanoSpace is one of the few companies devoted to this development. The key resource of NanoSpace is our highly skilled engineers and researchers with a proven track record to develop, manufacture and deliver MEMS components.

## Why so small?

Miniaturization has always been an issue in space technology, where weight reduction is in constant demand. Until now, this demand has been met by the introduction of new materials, tools and methods. MEMS technology is a quantum leap. By integrating electronics and mechanical structures at the micrometer scale, it offers the benefits of significantly reduced mass and power consumption, translating directly into decreased costs, and allows for higher system redundancy.

## Components for improvements

One of our unique MEMS products is a propulsion system for nano satellites. MEMS technology enables us to package a complete propulsion system inside a 10x10x3cm

box. Nano satellites are a fast growing trend and NanoSpace's propulsion module will open up a new range of missions and applications.

We also develop a xenon flow control module for electric propulsion systems. The system is placed between the tank and the engine to control the propellant flow to the ion engine. The key in this case is to precisely control a very low flow rate of xenon, an application for which MEMS technology is ideally suited. Our product range also includes an accurate propellant gauging system for spacecraft, enabling operators to fully utilize a satellite's entire operational life.

NanoSpace has access to clean rooms and equipment at the Ångström Laboratory at the University of Uppsala, Sweden. In addition to our patented product range, we can manufacture MEMS devices on a subcontract basis.

## CubeSat module

*NanoSpace is currently developing a propulsion module that can be fitted onto virtually any CubeSat via the standard payload interface. The propulsion module contains a propellant storage and feed system and four thrusters. Each thruster can be controlled individually and deliver exactly the commanded thrust in the range 0-1 mN at any time.*

*The key technology in this system is the closed loop control that measures delivered thrust in real time. With this technique, a new thrust level can be commanded and delivered every second with a precision better than 1%. The propellant used is butane and in the 10x10x3cm module that weighs about 250 grams, a total impulse of 40Ns can be achieved. This capability enables CubeSats to perform advanced missions including orbit corrections, precise and agile attitude control, formation flying and even docking.*



The Finnish Border Guard uses its two Dornier 228 aircraft, equipped with MSS 6000, to monitor the Baltic Sea.



# COMPLETE SOLUTIONS FOR MARITIME SURVEILLANCE

**SSC's maritime surveillance system MSS 6000 is a user-friendly solution used worldwide for surveillance of coastal waters, protection of the environment, sea rescue and ship traffic control.**

## Field-proven technology

SSC's experience in building airborne remote sensing systems began with the Swedish Coast Guard in the 1970's. That initial system was used for oil spill monitoring, which is still the most common use among our customers. Several system generations later, and after more than 80 systems delivered, MSS 6000 is in operational use in a number of countries around the world. Close cooperation with our customers has given us invaluable experience and feedback. We continuously develop our system in accordance with new requirements, legislations and available technologies, and we are always there to support our customers both in their daily missions and with continuous improvements.

## All you need to monitor the sea surface

The MSS 6000 is a fully integrated system with Side-Looking Airborne Radar, search radar, IR/UV scanner, Forward-Looking Infrared and Automatic Identification System as well as digital still and video cameras. The core of MSS 6000 is a mission management system that links all available information together to present a situation overview to the onboard operator for further action. The mission management system is based on Geographical

Information System (GIS) technology, and presents information against a backdrop of a digital nautical chart. The information from onboard sensors and external input is presented live to the operator and also recorded for later analysis. The reports generated from the mission management system are customized to specific requirements and can be viewed, analyzed and forwarded in real time via satellite data link.

## The Mission Command Centre adds new capabilities

Our ground-based Mission Command Centre, MCC, has further improved the efficiency of maritime surveillance missions. It is a real-time tool for the mission command to plan, follow, direct and manage the missions of all flying units. Mission data can also be saved in the MCC for later analysis.

## A more efficient MSS 6000

*In 2012, SSC took another step forward in providing a complete solution for surveillance of sea surface activities. The latest version of MSS 6000, installed for the Finnish Border Guard, provides two integrated workstations, advanced search radar, a radio direction finder and a FLIR with HD capability, in addition to the SLAR, IR/UV and camera system.*

*Any or all sensors can be operated from both workstations as well as displayed to a separate observer station and on the cockpit monitor. This facilitates the crew cooperation based on a common understanding and situation overview. Data, images and video can also be relayed to the ground in real time via the high speed satellite data link.*

## SSC

*provides satellite management services and develops satellite, rocket and balloon systems as well as airborne maritime surveillance systems. Launches rockets and balloons and provides flight test services. Parent company of the SSC Group.*

## SSC

P.O. Box 4207  
SE-171 04 Solna, Sweden  
Tel: +46 (0)8 627 62 00  
[www.sscspace.com](http://www.sscspace.com)

## SSC

Estrange Space Center  
P.O. Box 802  
SE-981 28 Kiruna, Sweden  
Tel: +46 (0)980 72 000

## SSC

Vidsel Test Range  
P.O. Box 93  
SE-942 22 Älvsbyn, Sweden  
Tel: +46 (0)929 370 00

## SSC

Stockholm Teleport  
Vidjävågen 15  
SE-123 52 Farsta, Sweden  
Tel: +46 (0)8 447 35 70

## SSC

ESA Satellite Station  
P.O. Box 815  
SE-981 28 Kiruna, Sweden  
Tel: +46 (0)980 760 00

## SSC

Room 812  
Shi Teng Business Hotel  
82 Bei Yuan Road  
ChaoYang District  
Beijing 100101, China  
Tel: +86 10 649 685 51

## SSC

256/3, Soi 8  
Sukhumvit 55  
10110 Bangkok, Thailand  
Tel: +66 2 714 90 89

## ECAPS

*develops in-space thrusters and propulsion systems for spacecraft applications based on high performance, environmentally benign propellant.*

## ECAPS

P.O. Box 4207  
SE-171 04 Solna, Sweden  
Tel: +46 (0)8 627 62 00  
[www.sscspace.com/ecaps](http://www.sscspace.com/ecaps)

## NANOSPACE

*develops products for the space market based on Micro- Electro-Mechanical Systems (MEMS) technology.*

## NanoSpace

Uppsala Science Park  
SE-751 83 Uppsala, Sweden  
Tel: +46 (0)8 627 62 00  
[www.sscspace.com/nanospace](http://www.sscspace.com/nanospace)

## LSE SPACE

*provides engineering, operations and consultancy, services for manned and satellite missions.*

## LSE Space

Argelsrieder Feld 22  
D-82234 Wessling, Germany  
Tel: +49 (0)8153 881099 26  
[www.sscspace.com/lspacespace](http://www.sscspace.com/lspacespace)

## LSE Space

Robert-Bosch-Strasse 7  
D-64293 Darmstadt, Germany  
Tel: +49 (0)6151 870 11 37/38

## LSE SPACE MIDDLE EAST

*provides engineering services, ground segment operations and maintenance training to Middle East customers.*

## LSE Space Middle East

Fortune Tower  
Office 1606  
Jumeirah Lakes Towers  
P.O. Box 309 147  
Dubai, UAE  
Tel: +971 55 55 04 379  
[www.sscspace.com/lspacesmiddleeast](http://www.sscspace.com/lspacesmiddleeast)

## AURORA TECHNOLOGY

*provides a team of software engineers, spacecraft system engineers, applied physicists and scientists.*

Aurora Technology  
Crown Business Centre  
Heereweg 345, 2161 CA Lisse  
The Netherlands  
Tel: +31 252 532239  
[www.sscspace.com/aurora](http://www.sscspace.com/aurora)

## UNIVERSAL SPACE NETWORK (USN)

is a U.S. based independent subsidiary of SSC, with US government approval and oversight, that provides satellite management services through the PrioraNet network.

## Universal Space Network

417 Caredean Drive  
Suite A  
Horsham  
PA 19044, USA  
Tel: +1 215 328 9130  
[www.sscspace.com/usn](http://www.sscspace.com/usn)

## Universal Space Network

1501 Quail Street  
Suite 103  
Newport Beach  
CA 92660, USA  
Tel: +1 949 476 3432

## SSC CHILE

*runs the Santiago Satellite Station, a vital Southern Hemisphere node of the PrioraNet network.*

## SSC Chile

Autopista Los Libertadores Km 28  
Colina, Santiago, Chile  
Tel: +56 2698 1702  
[www.sscspace.com/ssc-chile](http://www.sscspace.com/ssc-chile)

## PRIORANET CANADA

*Provides satellite operations services through its Inuvik Satellite Station, a member of the PrioraNet network.*

## PrioraNet Canada

3528 30 Street  
North Lethbridge  
AB T1H 6Z4, Canada  
Tel: +1 403 332 6018

## SSC SPACE AUSTRALIA

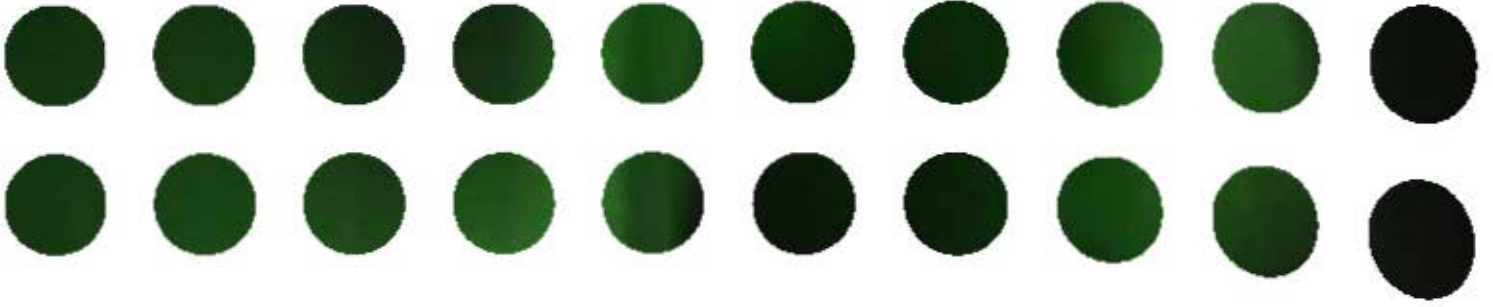
*Responsible for the Yatharagga Satellite Station in Western Australia.*

## SSC Space Australia

1 Ensign Lane  
East Perth  
WA 6004, Australia  
Tel: +61 8 9221 3644







# Appendix 5

## German Space Agency (DLR)

( *Deutsches Zentrum für Luft- und  
Raumfahrt* )



# Earth Observation Center (EOC)

German Remote  
Sensing Data Center  
(DFD)





# EOC's German Remote Sensing Data Center

The German Remote Sensing Data Center (Deutsches Fernerkundungsdatenzentrum – DFD) and the Remote Sensing Technology Institute (Institut für Methodik der Fernerkundung – IMF) together form the Earth Observation Center (EOC). This association of two institutes within the German Aerospace Center (Deutsches Zentrum für Luft und Raumfahrt - DLR) is Germany's leading research and development organization in the field of earth observation.

Whereas IMF focuses on basic development work more directly related to the earth observation sensors, DFD concentrates on generating geoinformation products and services based on sensor data and on customizing methodologies for specific applications.



The Earth Observation Center – EOC – in Oberpfaffenhofen near Munich

At DFD data from national, European and many international satellite missions are received, processed, archived and made available to the public. For this purpose the institute operates receiving stations not only in Germany but around the world, among other places in the Antarctic, Canada and Mexico, in cooperation with international organizations and companies. The raw satellite data are then processed to yield data products which are made available over the Internet and safeguarded long term for retrospective analyses.

DFD develops methodologies and information systems which address such urgent social challenges as the preservation of the environment, global change, disaster relief and early warning. DFD offers advice, services and data products to scientists, public authorities and the public via Web interfaces. In addition, DFD assumes sovereign obligations as operator of the German Satellite Data Archive and in the context of DLR membership in the International Charter Space and Major Disasters.

DFD assists the next generation of scientists. An endowed chair at Würzburg University and lectureships at other institutions promote close interactions with academia. DFD cooperates with universities in Augsburg and Munich (TUM) as well as with numerous research institutions worldwide, industry, and international organizations. As a partner of public authorities and commercial customers, DFD links the science sector with end users.

Earth observation can expedite the solution of important social concerns. As part of the Earth Observation Center, the German Remote Sensing Data Center makes the relevant information available.

The German Remote Sensing Data Center is certified in accordance with ISO9001.

# Current Fields of Research

## Global Change

Temperatures rise, perpetual ice melts, fertile landscapes turn into deserts, animals and plants become extinct, megacities proliferate. Global change has many aspects. Earth observation satellites measure ice thickness and the flow velocity of glaciers. They register how the chemistry of the atmosphere is changing and monitor worldwide how humans overrun natural environments.

Only remote sensing offers the view from space which makes it possible to record and comprehend the dimensions of global change and provide information vital for planning and decision making as well as input data for climate modeling. For example, earth observation data are being used to analyze complex ecological and hydrological interactions in the Mekong Delta. The satellite data are integrated in an environmental information system that was established in a German-Vietnamese joint project (WISDOM) with the support of DFD, so that water resources can be used sustainably and precautions taken against flooding. Another example: satellites are employed to map ecologically valuable habitats and to monitor their development for biodiversity research.

## Emergency Mapping and Crisis Management

High resolution satellite data provide a precise image of a given situation, also in remote and inaccessible disaster areas. Within a short time large areas can be recorded and analyzed, even if they are hidden under a thick layer of clouds, smoke or fog. DFD has concentrated the relevant experience in its Center for Satellite Based Crisis Information (ZKI).

Satellite image maps for disaster management after natural catastrophes and for humanitarian emergencies are provided by ZKI to national crisis response teams, European relief services and international organizations. On behalf of DLR, DFD assumes responsibility for routine operations associated with the International Charter Space and Major Disasters. It additionally supports the United Nations information platform for disaster aid, UN-SPIDER. DFD also provides continuous monitoring services based on satellite data, such as fire monitoring for Europe and neighboring regions.

## Information Systems for Decision Support

Human receptiveness quickly reaches its limit if many different kinds of information have to be processed simultaneously. This is particularly the case if the data are rapidly changing temporally and spatially, which is precisely the case in crisis situations.

Here, intelligent information technology can ease the burden on those responsible. DFD has put to use its experience in the field of data and information management systems to develop a decision support system (DSS) as part of the German-Indonesian GITEWS project. It is part of an innovative tsunami early warning system for Indonesia developed and established by a consortium of German research institutions.

The decision support system continuously combines data arriving at different times from various measurement systems, com-

pares them with simulations and then provides the heads of situation centers with a precise and comprehensive overview of the momentary situation. These leaders can then decide within minutes whether and for which region a tsunami warning must be given and the population evacuated. DFD's system will be expanded so that early warning can be provided for other types of catastrophes.

## Health Care and Environmental Pollution

Satellites not only monitor the atmosphere to provide weather forecasts. Information about trace gases in the upper layers of the atmosphere or on air pollutants can be derived from remote sensing data.

Every day, DFD provides up-to-date information on air quality for all of Europe, and uses modern communication and navigation technology to facilitate easy access for users. Local and timely information on environmental hazards such as the level of ultraviolet radiation can be conveyed to any interested person via SMS and thereby help reduce health damage to individuals.



# Data Reception and Processing



DFD Receiving Antenna in Inuvik, Canada

## Payload Ground Segment for Earth Observation Missions

Worldwide, DFD receives data from numerous satellite missions. The payload ground segment required for data reception includes, in addition to antenna facilities in Neustrelitz and Oberpfaffenhofen, an international network of receiving stations which in some cases are managed in cooperation with public and commercial partners. These stations are equipped for multimission operation and are also available for scheduled campaigns as well as routine assignments for European and international missions. Important partners and customers are the European Space Agency (ESA), Europe's operator of weather satellites (EUMETSAT) and commercial data distributors.

DFD's processing and archiving centers (PAC) process the received data to generate standard products which can be easily integrated into various applications. Increasingly, geoinformation is also being directly derived and offered as an information service by DFD. Examples are data on air quality, ultraviolet radiation hazards, vegetation indices and fire monitoring. For time-critical applications the data are processed into information products already at the receiving stations and are accordingly available soon after acquisition.

## Data Management and Information Technology

More and more satellites are providing images in ever greater detail. Therefore, the amount of data which must be automatically received, processed, archived and made available to users is rapidly increasing: an information-technology challenge. Now with the TanDEM-X radar mission the data volume safeguarded in DFD archives already surpasses two billion megabytes.

Together with industrial partners DFD has developed a Data Information Management System (DIMS) to handle this amount of data. This system can be flexibly adapted to meet the various requirements of different ground segment. Currently, DIMS technology is not only being used at DFD, but also by ESA and international partners.

The earth observation data managed at DFD by DIMS are safeguarded long-term in the German Satellite Data Archive (D-SDA). Via Web interfaces this collection can be searched and data ordered. Robots access the entire archive and process orders automatically. The DFD data archive adheres to European standards and contributes to the creation of a joint European geodatabase. DFD contributes its experience in data management also to the development of decision support systems.

# Analysis and Applications

## Atmosphere

With the help of satellite earth observation, climate change and variations in the atmosphere can be continuously monitored and adherence to international environmental conventions verified. For this purpose DFD measures the distribution of such atmospheric constituents as ozone, greenhouse gases, aerosols, clouds and pollutants on global, continental and regional scales.

Mathematical processes combine the measurement data with complex models of the atmosphere and biosphere. This kind of data assimilation makes it possible to obtain information which the satellite cannot measure directly and to supply forecasts to warn people about problematic levels of pollutants such as fine dust, ground-level ozone and pollen.

These data are available from the World Data Center for Remote Sensing of the Atmosphere (WDC-RSAT). This center is operated by DFD under a mandate from the United Nations' World Meteorological Organization (WMO) and the International Council for Science (ICSU).

But there is more to be learned about the atmosphere. Temperature fluctuations at 87 km altitude not only reveal climate signals but could in the future also warn of approaching tsunamis. This possibility is being investigated by DFD as a member of the virtual institute Schneefernerhaus Environmental Research Station (UFS) on the Zugspitze, Germany's highest mountain.

## Terrestrial Ecosystems and Environment

People are exploiting Earth's natural resources at an increasing pace. With the help of satellites it is possible to monitor the consequences for terrestrial ecosystems relating to land use, mining operations, biodiversity, carbon capture by vegetation, and the water cycle.

These observations in combination with geodata from other sources are analyzed in geographic information systems (GIS). With help from mathematical models, trends and future threats resulting from climate change, natural catastrophes and pressures from high-density human settlements such as megacities can be anticipated, providing a basis for effective environmental management and a sustainable economy.

In addition to "classic" multispectral recordings, radar and hyperspectral data are also employed for these purposes. Hyperspectral analysis provides highly precise information about the quality of soil and water as well as the health of vegetation. Radar approaches enable to assess slope collapse or volcanic eruptions, and make it possible to monitor worldwide the melting of global ice masses also during polar night. The methodologies are being experimentally tested and in some cases readied for routine application.

## Civil Crisis Information and Geo Risks

Natural and environmental disasters, humanitarian emergencies and technology accidents demand coordinated action by all participants. Geoinformation provides an important basis for planning this response.

But earth observation data is not only suitable for rapidly mapping seriously damaged areas as part of crisis management. They are above all also used to plan and implement preventive measures.

Risk and vulnerability analyses can be used to draw up evacuation scenarios and to prepare the population for impending disasters.

The early warning system developed at DFD integrates such analyses with measurements collected by sensor networks and monitoring systems and combines them with results from models and simulations. The emerging situational awareness can lead to timely warning of the threatened population in emergencies.

## User Services



DFD develops earth observation methodologies and encourages their use in science, industry, and society in general. Therefore, in addition to research activities it offers products and solutions via specialized services tailored to the needs of particular user groups.

### Center for Satellite Based Crisis Information (ZKI)

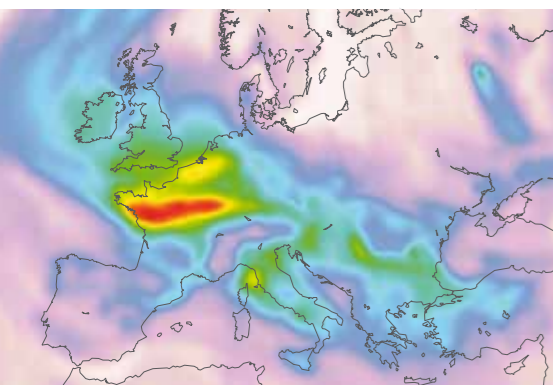
ZKI offers crisis reaction teams satellite mapping services at short notice for use during natural catastrophes and humanitarian emergencies. Particularly within the framework of the "International Charter Space and Major Disaster," satellite data is rapidly recorded, analyzed and processed to yield customized and easy-to-use thematic maps and visualizations. ZKI is integrated into national and international networks and staff members are also involved in the United Nations disaster management initiative SPIDER.

### World Data Center for Remote Sensing of the Atmosphere (WDC-RSAT)

WDC-RSAT is one of the World Data Centers of the International Council for Science (ICSU) and the World Meteorological Organization (WMO). It processes and archives satellite data on the atmosphere from a variety of sources and makes available data and derived products free of charge to scientists and other users via Web interfaces.

### Optical Airborne Remote Sensing and Calibration Facility (OpAIRS)

The "Optical Airborne Remote Sensing and Calibration Facility" brings together the relevant experience and infrastructure available at the Earth Observation Center from IMF and DFD. In this laboratory, hyperspectral sensors are calibrated and operated, and customized data products are generated on request.



## DFD Structure

### Institute Director

Prof. Dr. Stefan Dech

Staff Function  
Business Development and GMES:  
Dipl.-Geophys. Gunter Schreier

### Departments

#### National Ground Segment

Neustrelitz  
Head: Dipl.-Ing. Holger Maass

#### International Ground Segment

Oberpfaffenhofen  
Head: Dr. Erhard Diedrich

#### Information Technology

Oberpfaffenhofen  
Head: Dipl.-Inf. Eberhard Mikusch

#### Atmosphere

Oberpfaffenhofen  
Head: PD Dr. Michael Bittner

#### Land Surface

Oberpfaffenhofen  
Head: Dipl.-Geol. Andreas Müller

#### Civil Crisis Information and Geo Risks

Oberpfaffenhofen  
Head: Dr. Harald Mehl

#### Science Communication and Visualization

Oberpfaffenhofen  
Head: Dipl.-Geogr. Nils Sparwasser

#### Endowed Chair in Remote Sensing

Julius Maximilian University Würzburg  
Director: Prof. Dr. Stefan Dech

EOC Central Functions  
(shared with DLR-IMF)

#### Controlling

Oberpfaffenhofen and Neustrelitz  
Head: Dipl.-Forstw. Hans-Henning Voß

### Addresses and Contacts

#### Oberpfaffenhofen

Deutsches Zentrum  
für Luft- und Raumfahrt (DLR)  
Deutsches Fernerkundungs-  
datenzentrum (DFD)

Münchner Straße 20  
82234 Oberpfaffenhofen

Telephone: +49(0)8153-28-1389  
Fax: +49(0)8153-28-3444  
Email: helpdesk-dfd@dlr.de

#### Neustrelitz

Deutsches Zentrum  
für Luft- und Raumfahrt (DLR)  
Deutsches Fernerkundungs-  
datenzentrum (DFD)

Kalkhorstweg 53  
17235 Neustrelitz

Telephone: +49(0)3981-480-116  
Fax: +49(0)3981-480-299

### Internet

[www.dlr.de/eoc](http://www.dlr.de/eoc)

Data access: [eoweb.dlr.de](http://eoweb.dlr.de)  
ZKI: [www.zki.dlr.de](http://www.zki.dlr.de)  
WDC: [www.wdc.dlr.de](http://www.wdc.dlr.de)

## DLR at a Glance

DLR is Germany's national research centre for aeronautics and space. Its extensive research and development work in Aeronautics, Space, Energy, Transport and Security is integrated into national and international cooperative ventures. As Germany's space agency, DLR has been given responsibility for the forward planning and the implementation of the German space programme by the German federal government as well as for the international representation of German interests. Furthermore, Germany's largest project-management agency is also part of DLR.

Approximately 6,900 people are employed at fifteen locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also operates offices in Brussels, Paris, and Washington D.C.

DLR's mission comprises the exploration of the Earth and the Solar System, research for protecting the environment, for environmentally-compatible technologies, and for promoting mobility, communication, and security. DLR's research portfolio ranges from basic research to innovative applications and products of tomorrow. In that way DLR contributes the scientific and technical know-how that it has gained to enhancing Germany's industrial and technological reputation. DLR operates large-scale research facilities for DLR's own projects and as a service provider for its clients and partners. It also promotes the next generation of scientists, provides competent advisory services to government, and is a driving force in the local regions of its field centers.



DLR

**Deutsches Zentrum  
für Luft- und Raumfahrt e.V.**

in der Helmholtz-Gemeinschaft

**Deutsches Fernerkundungsdatenzentrum**  
Oberpfaffenhofen

[www.DLR.de](http://www.DLR.de)

# **Appendix 6**

## **Norbotten (Northern Sweden)**

### **Municipal Fibre System**



# IT-Norrbotten

FTTH CASE STUDY

## County-wide fibre backbone connecting municipal networks

*IT-Norrbotten brings high-speed fibre connectivity to rural areas in Sweden's northernmost county, enabling small towns to thrive.*

With a population density of just 2.6 inhabitants per square kilometre, the county of Norrbotten in Sweden is one of the most sparsely populated regions in Europe. Population centres are small (most have between 3 000 and 10 000 inhabitants) and the distances between them are long. "There is no interest from commercial operators to take broadband to rural areas, but for us it is a matter of survival," said Tony Blomqvist, chief executive of IT-Norrbotten.

### General information

**Project promoter:** IT-Norrbotten

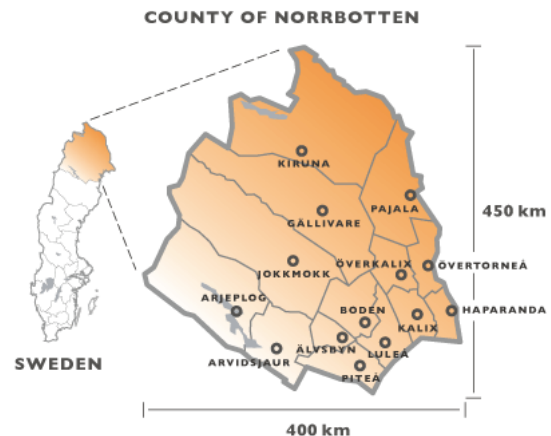
**Location:** Sweden

**Project name:** Broadband network - Lumiora

**Network size:** 3500km

IT-Norrbotten was created in 1996 by the municipalities of Norrbotten, Luleå University of Technology, and Norrbotten County Council together with the County Administrative Board. (Since 2005 the company has been owned by the 14 municipalities of Norrbotten and Norrbotten County Council.) In the late 1990s the Swedish government decided to encourage development of IT infrastructure to counter regional imbalances between the sparsely populated north and the more densely populated south of the country. IT-Norrbotten was given the task of coordinating the building of broadband networks for the 14 municipalities in Norrbotten, which were built between 2001 and 2006.

At the same time IT-Norrbotten planned and built the regional backbone, which connects the municipal-owned networks or "stadsnät". The regional backbone, called "Lumiora", is a resilient dark fibre network that links all the population centres in the county. The network provides connectivity to local authority sites such as schools, hospitals and administrative centres and to the municipal



networks. As well as managing the network for the public sector, IT-Norrbotten sells business-grade services and wholesale connectivity (Ethernet, wavelengths and dark fibre) to large businesses and telecoms operators.

To improve broadband services to residential properties in northern Sweden, in 2008 IT-Norrbotten signed a framework agreement with communications provider OpenNet. The framework provides an opportunity for each municipality to contract with OpenNet. "We chose OpenNet because it has a well developed model for the promotion and development of urban networks and extensive experience in similar assignments," explained Blomqvist.

OpenNet operates the urban networks, but does not provide any services of its own. Instead, it invites retail service providers onto the network, who then provide the services and content for the end users. This is good for the consumer because it creates a competitive retail environment in which they have a choice of service providers. Customers can change provider at short notice, and even have different providers for Internet, telephone and TV if they wish. It is also good for service providers because they get access to a large number of urban networks in Sweden and can expand without major infrastructure investments.



### Deployment & Take Up

**Technology/architecture:**

Lumiora is a regional backbone (dark fibre) network

**Time to deploy:** 2001 to 2006

**Municipal networks connected to Lumiora:** Arjeplog, Arvidsjaur, Gällivare, Haparanda, Jokkmokk, Kiruna, Pajala, Överkalix and Övertorneå (98% of homes in the county have access to broadband).

Being owned by the public sector, IT-Norrbotten is motivated not just by commercial interests, but also by the benefits that high-speed networks bring to society. The Lumiora network enables local government to work more efficiently, and has brought significant improvements to how the county council delivers healthcare and education services.

IT-Norrbotten has linked municipal administrations with the County Council in a joint platform for distance meetings. This opens up new possibilities for cooperation between municipalities and county councils. The administration of the Association of Local Authorities was first off the mark, and now conducts the majority of its meetings long distance. In the same way, municipal chief executives, council leaders and other chief officers often meet digitally. Travel is reduced, saving time, money and the environment.

## Business Case

**Total cost:** ~€73M invested in IT infrastructure including ~ €7M from EU structural funds

**Who runs the network:** IT-Norrbotten (regional backbone), OpenNet (municipal networks).

Norrbotten County Council is responsible for health, medical and dental care. With the help of IT-Norrbotten, the council has linked the county's five hospitals, 33 health centres and 34 dental clinics. A number of services have been improved by the fibre network: electronic prescriptions, patient record systems, digitised X-ray handling, virtual meetings and IP telephony.

Virtual meetings are widely used in healthcare, typically to allow local doctors to access consultants in larger hospitals. For example, a consultant dermatologist can see the problem areas of a patient's skin and diagnose them remotely; ear surgeries are performed at local hospitals with the help of specialists from the regional hospital at in Luleå working at a distance; with



videoconference it is possible to "borrow" doctors from other hospitals to help overcome a shortage of doctors in adult psychiatry, for example.

Another exciting use of the technology is to monitor premature babies when they first go home. Families with premature babies often stay in hospital for a long time and feel unsafe and insecure when they finally go home. To ease the transition, the parents can borrow videoconference equipment and use it to stay in touch with the hospital. The personnel at the hospital can see the baby over the video link and give their recommendations to the parents at home.

## End-user Services

**Residential:** consumers have a choice of supplier for broadband, TV and phone services, available through OpenNet – [www.norrbotten.opennet.se](http://www.norrbotten.opennet.se)

**Business:** IT-Norrbotten offers wholesale services to other operators, as well as business-grade services direct to local businesses and the county council.

In education, videoconferencing is used for remote learning. Pupils in Norrbotten are entitled to mother-tongue lessons in more than 91 languages, but there are not enough qualified teachers in each town to cover so many languages. Instead, pupils from different language areas have virtual meetings for learning and practising their mother tongue. This takes place during the school day together with pupils from other schools across the county. Through sound and image, the teacher communicates with the pupils in the schools that are participating in the session. The technology makes it possible to coordinate mother-tongue teaching, and to hire qualified teachers for all the languages.

Written in December 2011  
Contact us on [info@ftthcouncil.eu](mailto:info@ftthcouncil.eu)



Sweden (ÖVRE NORRLAND, Norrbottens län)

## Broadband for the Far North

The Objective 1 programme has enabled the outermost regions of Northern Sweden to access broadband. It has had practical implications for education, health and industrial research.

### Context

The quality of infrastructures related to information and communication technologies (ICTs) is essential for such remote, extensive (165 000 km<sup>2</sup>), sparsely populated (3 hab./km<sup>2</sup>) regions with very harsh climate conditions, as found in the county of Norrbotten in the far North of Sweden. In this market area which is considered to be unprofitable

by the private sector, the Swedish State has to install and guarantee the quality of these infrastructures, all at a reasonable usage cost for the populations concerned. Structural Fund assistance has extended the State's action by providing it with additional funding to enable the most remote areas of its territory to have access to these facilities.

ICTs form a significant part of the Objective 1 "Norra Norrland" programme, with a total budget of 75 million euros for the development of these technologies. The aim is to make Norrbotten "a high-tech region in a high-tech country". In Norra Norrland they have made clear that expansion of Information technology infrastructure must benefit all users, households, companies and the public organisations. The programme therefore prioritises two lines of action: the extension of the telematic broadband network and the development of telematic applications based on broadband communications.

### Inhabitants and operators in synergy

The laying of some 3,000km of fibre optic cables was entrusted to the public company, IT Norrbotten AB, owned by the Council and the 14 municipalities in the County. The Local Councillors had to decide on the order of priority for connecting the villages. Once they had been equipped, various Internet service providers took over.

Apart from the considerable technical challenges created by climatic conditions, the entire procedure relied on close, sustained relations between technical operators and the local populations in order to guarantee the best service at the best price. The fact that inhabitants and municipal departments were included in the process also facilitated the appropriation and encouraged the use of this technology, which was new to many people.

### Results

Over 300 villages in Norrbotten now have broadband and once the work has been completed at the end of 2006, 93% of the regional population will have access to broadband.



Perceived as an opportunity for rural development, the initiative involves a number of citizens, associations and regional organisations, thereby reinforcing territorial cohesion. The project has led to the creation of 60 jobs and three businesses.

Investing in broadband Internet promotes growth and local services. In this respect, the connection of northerly areas to information highways has already generated innovative applications in three specific areas:

- Education. All the schools in the region are now connected, the whole of Norrbotten now has access to significant training facilities.
- "e-health". Owing to the digital and audiovisual possibilities offered by broadband, the "Tryggve" project aims to test remote solutions for a whole range of therapeutic services: routine medical checks (pulse, blood pressure, etc.); post-operative physical rehabilitation for patients suffering from chronic kidney diseases; post-childbirth check-ups and assistance for new parents; and monitoring the quality of healthcare in old people's homes.
- Industrial research and engineering networking. For practical reasons (extreme conditions, the need for secrecy) car tests are often undertaken in remote rural environments. Access to broadband has enabled Volvo to remotely test its new vehicles in real time in Norrbotten, where pilots and test platforms are directly connected to the manufacturer's laboratories in Gothenburg, a thousand kilometres away.

---

## Technical information

<b>Project:</b>	Broadband for the Far North
<b>Program:</b>	Objective 1 (2000-2006)
<b>Total Investment:</b>	€ 10,200,000
<b>EU contribution:</b>	€ 4,500,000
<b>Contact:</b>	IT Norrbotten AB Projektledare Anders, SjödinS96150, Boden Sverige Tel.: +46 921-570 94 Fax.: +46 70-565 70 94 E-Mail: anders.sjodin@itnorrboten.se <a href="http://www.itnorrboten.se/index.aspx?langID=ENG">http://www.itnorrboten.se/index.aspx?langID=ENG</a>
<b>Draft date:</b>	01/06/2006