

# A COMPANY PRESENTATION





# WELCOME TO KSAT

**AS A WORLD-LEADING PROVIDER OF GROUND NETWORK SERVICES AND SOPHISTICATED MARITIME MONITORING SERVICES FOR MANY YEARS, WE KNOW WHAT IT TAKES TO OPERATE AND DELIVER TOP QUALITY SERVICES – EVERY DAY.**

From our headquarters in Norway, we have been pioneering the ground segment business since 1968, and have introduced the near real-time concept within operational monitoring services as early as the 1990's.

We are very proud of our 50-year legacy, but even more proud of having managed to keep our start-up mentality and our true company spirit.

Being able to innovate and being willing to change is crucial to survival in this fast-changing industry, and we believe our position today proves that we have succeeded in staying on the frontier of what is possible. Still we do not rest on our laurels. We are always on the lookout for new technology and our hard-working, dedicated staff always do their utmost to meet our customer demands because you are very important to us.

Bigsats, Smallsats, oldspace or newspace, we don't really care what you call it – for us it has always been all about listening to our customer needs and working continuously to find the best solutions.



## CONTENT

**04** SPACE TO GROUND IS OUR BUSINESS

**06** THE KSAT GLOBAL GROUND NETWORK

**08** KSAT GLOBAL NETWORK MAP

**10** KSAT<sup>LITE</sup> – FOR SMALL SATELLITES

**12** SATELLITE OPERATIONS SERVICES

**16** THE NOBLE ART OF LEOP

**18** EARTH OBSERVATION

**20** MARITIME MONITORING SERVICES

OIL SLICK DETECTION / ICE MONITORING / VESSEL DETECTION

**24** KSAT GMS INTERFEROMETRY AND DATA



**"KSAT focuses on end-to-end services. It is one thing to build ground stations, but to provide dependable end-to-end services where data is reliably delivered is something else."**

**ROLF SKATTEBOE – CEO AND PRESIDENT**



# SPACE TO GROUND IS OUR BUSINESS

**KSAT PROVIDES HIGHLY RELIABLE COMMUNICATION SERVICES BETWEEN SPACE AND GROUND BASED ON OUR EXTENSIVE GLOBAL NETWORK OF GROUND STATIONS.**

**Pioneering the industry** for over 50 years, we have established a unique knowledge base and have perfected a well proven “build–operate–integrate” service concept.

Partnering with KSAT gives access to our global ground network consisting of stations ideally located at both poles and at hand-picked mid-latitude locations to ensure continuous access to your satellites.

Currently we operate more than 130 full-motion antennas at 21 sites ideally located for direct reception of satellite data, and we are constantly expanding our footprint to increase access and reduce data latency.

Our robust and integrated network represents a complete ground network solution offering flexible solutions for satellites and launch vehicles.

The entire network is monitored and remotely controlled/operated from one single point of contact, the TNO Operations Center at KSAT HQ in Tromsø, Norway, where our skilled team ensures easy access to the network 24/7.

Presently KSAT supports more than 1000 satellite contacts per day from over 100 missions on the network.

We pride ourselves on understanding our customer’s needs and working collaboratively to realize the full extent of what is possible with existing technologies as well as exploring new emerging technologies for space to ground communication such as inter-satellite data relay solutions for real-time tasking, and high-data throughput over optical links.

WE ARE DEDICATED TO PROVIDING INNOVATIVE AND COST-EFFICIENT GLOBAL GROUND STATION SOLUTIONS TO MEET THE NEEDS OF THE GROWING COMMERCIAL SATELLITE INDUSTRY. WE OFFER SERVICES BASED ON AN UNPARALLELED GROUND NETWORK, WITH GREAT FLEXIBILITY AND WHERE THE ONE-STOP-SHOP CONCEPT PROVIDES EASY ACCESS TO A RELIABLE AND STANDARDIZED SERVICE.

## POLE-TO-POLE

### **Svalbard Satellite Station:**

The unique location at 78° North – almost at the North Pole – ensures a complete coverage that provides access to every orbit – 14 of 14. It is today recognized as the best-located ground station in the world for satellite control. Being able to acquire data from all passes in one place makes it possible to significantly reduce the time from data collection to delivery of information to the end-users. The solutions provided by KSAT at the Svalbard Satellite Station are optimal for supporting low-latency polar-orbiting satellite missions.

In combination with the Antarctic TrollSat ground station at 72° South, KSAT offers a truly unique Pole-to-Pole capability. Supporting missions from both Svalbard and Troll allows for global data acquisition and TT&C twice every orbit, enabling rapid data access worldwide, with baseline latency of 45-minutes for LEO spacecraft.

In addition the KSAT ground station in Inuvik, Punta Arenas, and the upcoming Ground station in Nuuk, Greenland are all extremely important additions to the KSAT Global Network.

Strategically located on the far south tip of the South American continent, the Punta Arenas station completes the global coverage footprint operating perfectly in concert with the KSAT Antarctic Station. They complement each other and in combination, they provide a unique capacity in the southern hemisphere that is unparalleled in the market.

The KSAT stations at Inuvik and Greenland likewise complement the Svalbard Station, providing even more capacity in the northern hemisphere. KSAT also provides optimized locations in mid-latitude regions. These stations provide strategic locations for direct reception of satellite data to reduce data latency.

In total, the KSAT network consists of more than 130 antennas located at 21 sites worldwide, optimizing the communication from space to ground.

### **Our Global network offers**

UHF/VHF, S-Band, X-Band, C and L-Band and operational Ka-band.



# THE KSAT GLOBAL GROUND NETWORK

## **Ka-band Support**

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Due to requirements for larger data rates from space to ground, KSAT has invested in brand-new state-of-the-art Ka-band solutions for our customers. The Pole-to-Pole service is available and operational in Ka-band from key locations. Due to low precipitation rates, the Arctic and Antarctica deserts of SvalSat and TrollSat are ideally located to receive Ka-band data. KSAT can also provide solutions in Ka-band from optimized sites in the mid-latitude regions.



# KSAT GLOBAL GROUND STATION NETWORK



 KSAT GROUND STATION

 KSAT PARTNER STATION

  
SVALBARD

  
  
TROMSØ  
TNOC  
VARDØ

  
PUERTOLLANO

  
DUBAI

  
BANGALORE

  
SINGAPORE

  
TOKYO

  
HARTEBEESTHOEK  
MAURITIUS

  
AWARUA

  
ANTARCTICA  
TROLL

# KSAT LITE

**THE SERVICE OFFERING IS A FLEXIBLE CONCEPT WHICH REDUCES COST AND INCREASES CAPABILITY FOR SMALLSAT CUSTOMERS WHILE RETAINING THE MARKET LEADING CHARACTERISTICS OF THE KSAT GROUND STATION NETWORK; UNIQUE POLE-TO-POLE SERVICE LOCATIONS, GLOBAL INTEGRATED NETWORK SUPPORT, VOLUME EFFICIENCY, AND THE EASY, "CAN-DO" ATTITUDE WHICH HAS BECOME OUR TRADEMARK.**



# KSAT<sup>LITE</sup> – OPTIMIZED FOR SMALL SATELLITES AND BIG CONSTELLATIONS

**INNOVATIVE, COST-EFFICIENT SATELLITE PROGRAMS NOW HAVE  
ACCESS TO AN EQUALLY INNOVATIVE, FLEXIBLE AND COST-OPTIMIZED  
GROUND STATION NETWORK.**

KSAT<sup>LITE</sup> is a small-aperture, low-cost global ground network where the standardized and scalable services are catered to the specific needs of the fast growing NewSpace Small-Sat industry. We have deployed this network through leveraging years of experience combined with new and innovative solutions – a dedicated ground solution that is easy to use and available at a leaner price point.

The KSAT<sup>LITE</sup> network allows satellite operators to scale their ground communications support as the constellation grows, starting with support on a per pass basis and providing the option for moving to full antennas as the communication demand grows. Using this existing network enables satellite owners a bridge to space communications that is proven, low risk, scales easily, and has demonstrated capability.

KSAT<sup>LITE</sup> is live today – currently supporting over 10,000 passes a month – which enables new missions to receive support instantly, without incurring any risk of delay that might occur for systems that are untested or may require more modification to enable interoperability.

With KSAT<sup>LITE</sup> we have used a very flexible software-defined ground radio system that allows us to support all of the major standards in satellite and launch vehicle communications. We also utilize a software-optimized scheduling system to enable us to support many different missions, which in sharing the basic infrastructure costs among more users, allows each mission to receive support at a much more affordable pricing structure.

**The KSAT<sup>LITE</sup> portfolio currently supports the following Satellite-to-Earth (downlink) and Earth-to-Satellite (uplink):**

UHF downlink and uplink, S-band downlink and uplink, X-band downlink and Ka-band downlink. All through our global network of smaller aperture antennas.

Combined with the strength of the operations excellence that enables KSAT to support hundreds of spacecraft every day, KSAT<sup>LITE</sup> brings an innovative approach to sharing standardized hardware via software scheduling that enables a revolutionary breakthrough in access.



# SATELLITE OPERATIONS SERVICES

## HOSTING AND MAINTENANCE SERVICES

KSAT provides hosting and maintenance services to a number of satellite operators within the navigation and satellite communication segments. Our long-term operational experience in implementation at locations worldwide, and the ability to understand local conditions, facilitate and adapt to different environments, assures the best hosted network solutions for our customers.

KSAT provides support in the entire process of establishing and operating satellite ground networks; site identification, site surveys and infrastructure establishment. The customer systems and infrastructure are installed in close cooperation with KSAT to cater to the specific requirements and to optimize the solution.

## TT&C SERVICES

**KSAT provides Telemetry**, Tracking and Command (TT&C) services for LEO satellites. Available from our global and integrated network in S-band and UHF/VHF frequencies.

### **KSAT TT&C services include:**

- Routine operations provided in real-time
- Access to TT&C anywhere anytime ensures rapid tasking in case of disasters, emergencies and urgent needs, important for timely access to the satellite
- A global network providing optimal solutions for Launcher and LEOP support
- Optimal for Emergency and Critical Operations support

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## DATA COMMUNICATIONS SOLUTIONS

**KSAT provides complete** end-to-end data backhaul solutions, from the satellite to customer sites worldwide (Customer Data Centre or Mission Control Centre). Through a close partnership with telecommunication providers, we guarantee reliable and cost efficient solutions. KSAT owns and operates communications solutions to support

customer needs from our Svalbard and TrollSat/Antarctica stations. Solutions are adapted to customer needs from low-cost Internet services to secure VPN solutions and dedicated fiber links with the highest reliability, security and redundancy. Secure communication solutions are of critical importance to KSAT and our customers.

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## DATA ACQUISITION SERVICES

**KSAT Data Acquisition services** are provided from our global network, for real-time acquisition and data dump of on-board storage in S-, X-, Ka-, C-, L- and UHF-band. We also provide advanced data processing and distribution to any place in the world.

### **KSAT Data Acquisition services include:**

- Ground stations optimally located to meet customer needs
- Data dump at one single site (SvalSat) for each orbit of polar orbiting satellites
- Pole-to-Pole service including X-band and fully operational Ka-band infrastructure
- Data handling services including NRT processing, archiving, storage and distribution







PHOTO: ESA - STEPHANE CORVAJA, 2016

# THE NOBLE ART OF LEOP

## LAUNCH VEHICLE, SATELLITE, AND SOUNDING ROCKET SUPPORT

**THE OPERATIONS DURING LAUNCH AND EARLY OPERATIONS PHASE (LEOP) ARE AMONG THE MOST CRITICAL OF A MISSION. SUPPORTING LAUNCH VEHICLE AND PAYLOAD IN THIS CRITICAL PHASE IS AN ART BROUGHT TO PERFECTION BY KSAT.**

From minutes after lift-off of the rocket, through separation of the payloads from the launch vehicle, KSAT provides TT&C support from our global network. By combining our unique Pole-to-Pole concept with an extensive set of strategically-located ground stations around the globe, we tailor our support map to fit every launch trajectory.

Reliable and frequent communication during Launch and Early Orbit Phase (LEOP) of operations is essential for the safety and success of the mission. During this critical phase where the satellite is brought into orbit, skilled KSAT engineers provide dedicated monitoring and hands-on support to ensure that essential TT&C information is rapidly received, both by the spacecraft and the owner and operator. Typically a rotating team of 24/7 engineers will provide engineering support via voice and data communication for three to ten days following the launch, until the mission has been deemed successful through early check-out milestones. Given the various missions all supported on launch day, the LEOP team

will have dedicated members to support the launch vehicle, the primary payload, and several secondary payloads.

For over ten years, KSAT has an impressive track-record in this critical support phase. Drawing from our extensive network of antennas, we provide extreme redundancy on launch day, scheduling duplicate antennas to enable fallback support, in addition to our dedicated engineering support that provides real-time troubleshooting in case of an emergency. The importance of having regular support on the satellite during these mission critical phases cannot be overstated, so the redundancy in antenna and engineering support is crucial for achieving our track record of success.

Additionally, through our years of experience in supporting launch and early operations, we have developed a set of rigorous test procedures, which allow us to ensure the extremely high standard of service that is necessary for these critical stages of support.

# EARTH OBSERVATION

## WHAT SATELLITES CAN DO FOR YOU:

Did you know that it's possible to detect a small oil leak from space, and that we can alert your operations-team about it just minutes after a satellite image is taken?

...That we can detect a small ship trying to avoid detection in the middle of the Arctic Ocean? That we provide actionable information contributing to the fight against global fisheries crime – every day?

...That we can help mariners and offshore operators detect, and avoid, risk from floating or static ice?

...And that it's possible to detect a millimetre change on the ground by comparing sets of satellite images over time?

Satellites serve as your eye in the sky. A powerful and unique tool providing everything from the BIG picture all the way down to the measurement of small but significant movements.

Satellites can effectively retrieve information from remote or inaccessible areas, some of them can see in the dark and through clouds and observe features and changes that would otherwise go undetected.

At KSAT we have specialized in using satellite data in operational monitoring services to provide information and decision support, and we have invested heavily in people and infrastructure over many years, so that our end-users can benefit from the world's fastest available acquisition and processing chain, enabling Near Real-Time services and rapid data delivery.

We can offer easy access to satellite information through one point of contact; you can rely on KSAT's expertise to be available any-time through the unique KSAT 24/7/365 manned operations-center for analysis and emergency support.





# MARITIME MONITORING SERVICES

**KSAT HAS SUPPLIED SOPHISTICATED  
MARITIME MONITORING SERVICES  
DATING BACK TO THE 1990S.**

By using an extensive combination of commercial satellites in a virtual constellation, we are able to provide relevant, timely and targeted information from anywhere on the globe.

By leveraging our unique ground station network, we can deliver satellite imagery and derived products with the fastest available delivery times in Near Real-Time (NRT) – we call this our Multi-Mission Service.

The service concept is mainly based on Synthetic Aperture Radar (SAR) sensors, which image the sea surface regardless of daylight, cloud cover or other occlusions, and can scan large areas in one image - a powerful tool for detection of features on the sea surface, installations and vessels.



An oil slick is detected in the satellite image and our expert analysts prepare a comprehensive report including information about the spill; time, exact position, extent, confidence level and possible source that is delivered to the end user in NRT.

## OIL SLICK DETECTION

**Detecting pollution as early as possible, reducing both clean-up cost and environmental impact, is the primary objective of the service.**

The key elements are:

- Highly experienced analysts assessing NRT information 24/7/365
- Confirming detected slick (with possible source identification) or a clean sea state.
- Delivery of fully analysed reports normally between 20-120 minutes after imagery acquisition

Whether the slicks originate from vessels, installations, or natural seeps, satellite monitoring is the best available tool for detecting oil slicks on the sea surface, in terms of both cost and operational effect. In Norway, satellite monitoring is stated "best available technology" for early detection of oil slicks on the Norwegian continental shelf.

KSAT provides proactive monitoring for spills or leakage from offshore oil platforms, FPSOs, pipelines and related infrastructure and can contribute in all phases in the lifecycle of a field. This spans from detection of natural seeps for exploratory purposes, to support during drilling activities and critical testing, through production and eventual de-commissioning and abandonment.

Use of satellite monitoring is also very useful in supporting those involved in clean-up operations and the key decision-makers who manage them. It is also an excellent tool to document the chain of events in any spill scenario.

Supporting corporate zero spill policies, pro-active monitoring can in some cases prove that the end customer was not responsible for a particular pollution event.

The KSAT oil slick detection service includes planning, ordering, data download and image processing, interpretation and reports. We can also offer 24/7/365 emergency support.



Satellite imagery from KSAT for improved ice charting in Greenland. The Danish Meteorological Institute believes replacing helicopter with the use of synthetic aperture radar (SAR) images will result in a better ice-service making observation less vulnerable to darkness and fog.

## ICE MONITORING

**KSAT provides updated satellite-based ice information for supporting navigation and critical operations in the Arctic and ice prone waters around the world.**

One of the key elements in our service concept is the Near Real-Time (NRT) capacity, where data from multiple satellite missions is captured through our unique Svalbard Ground Station located at 78°North. Our in-house processing and analytical capabilities ensure the availability of updated satellite information about the ice edge and regional ice conditions, often in less than 30 minutes.

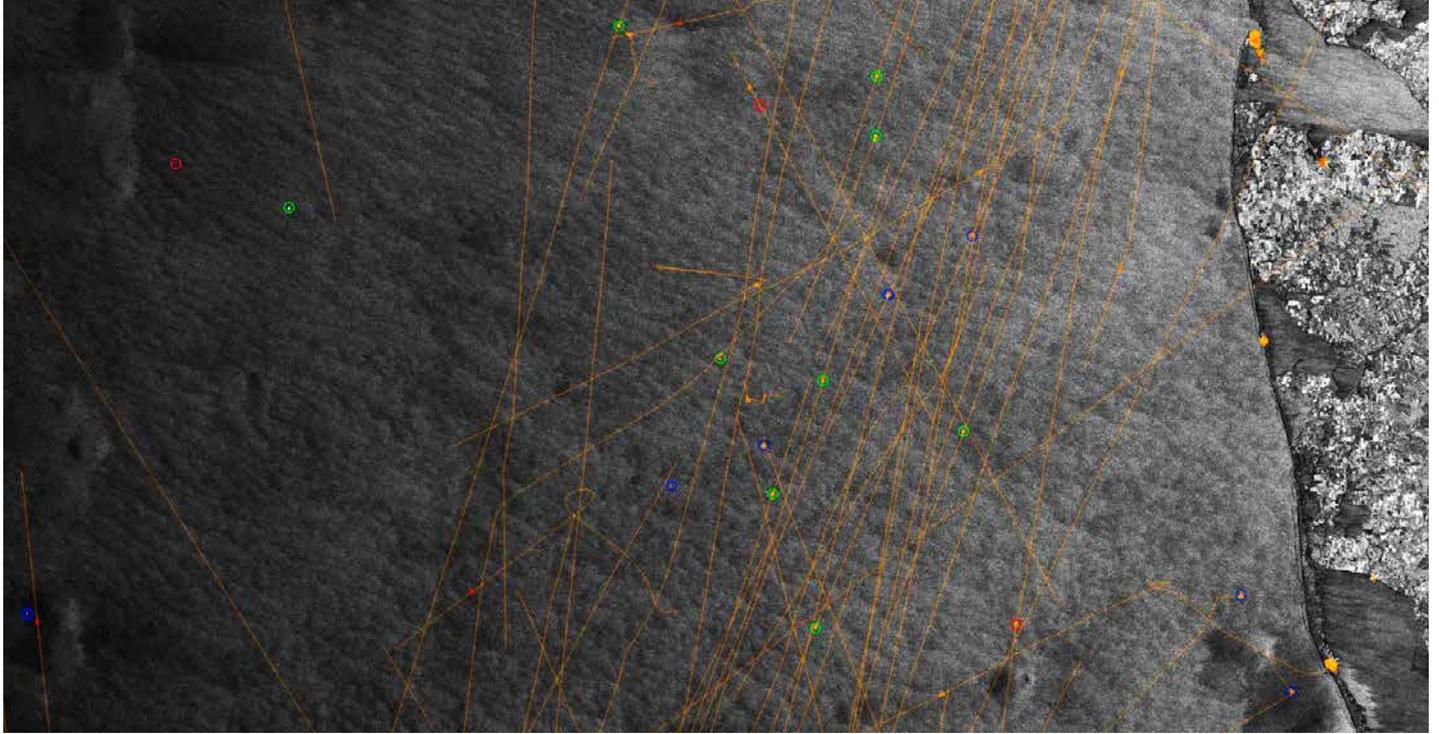
**Satellite ice monitoring can deliver the following benefits:**

- Support efficient and safe navigation by providing information about icebergs and shoots before going into critical areas.
- Help find the optimal route through the ice saving both time and fuel.

- Ice management support and enhanced safety for oil and gas activity by detecting ice features in the image, also by cross-referencing with vessel Automatic Identification System (AIS) information.
- Analysis and reports about ice conditions and rapid delineation between sea ice and open water.
- Data collection for baseline mapping, statistics and seasonal activity planning.

By using multiple satellites with a frequent revisit time, we are able to deliver customized services with a higher temporal and spatial resolution than is provided by public ice services. The possibility of integrating satellite data with important information like weather forecasts and ice information from public sources, in a dedicated interface(\*), allows efficient on-board decision support.

(\*With partners StormGeo)



Detections of vessel signatures in a satellite image can be combined with AIS signals containing identity of the vessel, position and flag. By correlating the information our analysts can confirm detections and highlight non-reporting vessels, so called “dark” targets.

## VESSEL DETECTION

**KSAT supports the fight against Illegal, unreported and unregulated (IUU) fishing through our industry-leading vessel detection service.**

We provide important information on the presence of vessels and their positions. By fusing detections in satellite images with other data sources, we can identify the detected vessels and highlight vessels that are not reporting their positions.

- SAR is an excellent tool when wanting to monitor large ocean areas, detecting signatures of the vessels, as it does not require a transmitted signal from the vessel.
- Reports with information on vessel positions and length estimates are provided to the customer in NRT.
- Used in combination with other data sources (Automatic Identification System, optical imagery), it is possible to identify vessels which are non-reporting.

Information about the presence of vessels in the area, their position and length estimates, is provided in a comprehensive report to the end-user shortly after the image is acquired.

Combining and correlating detections of vessel signatures in the SAR image with AIS signals is a technique that is used to highlight non-reporting vessels, so called “dark” targets.

Vessels engaged in IUU fishing, piracy, smuggling or trafficking of goods or people, often turn off or tamper with their AIS-transponders wanting to hide their activity, thus the lack of an AIS signal is an indicator of potentially suspicious behaviour.

Through our vessel detection service we take part in the increasing global response to the world-wide problem of IUU fishing and fisheries crime.

### **Automatic Identification System, AIS**

The International Maritime Organization’s International Convention for the Safety of Life at Sea (SOLAS) requires all passenger ships and international vessels with a gross tonnage of 300 or more to be fitted with an Automatic Identification System (AIS) transmitter, which broadcasts information about the vessels. These transmissions can be read by polar-orbiting satellites, and KSAT receives data streams from a number of commercial AIS satellites and Norwegian government satellites, including sensors on the International Space Station.



**KSAT GMS**

**DUE TO THE UNIQUE ACCESS TO SATELLITE DATA FROM DIFFERENT SATELLITE SOURCES, BOTH SYNTHETIC APERTURE RADAR (SAR) AND HIGH RESOLUTION OPTICAL, KSAT CAN OFFER A VARIETY OF PRODUCTS AND SERVICES TO END USERS.**

# KSAT-GMS, GROUND MOTION MONITORING

**There is an increasingly high demand for reliable space-based ground monitoring services, and therefore the need for a robust yet scalable service providing national or even continental scale products, in many sectors.**

KSAT-GMS provides high quality, cost-effective and operational INSAR ground monitoring services both to public (supra-national, continental scale areas) and private customers (local small areas). INSAR, which relies on the phase difference of satellite SAR images, detects small ground movements over large areas from space with millimetre accuracy.

Stakeholders and applications are very diverse: from urban planning applications in the context of modern smart cities, to the energy sector requiring precise information in relation to mining or oil and gas extraction activities (to governments trying to identify critical areas prone to subsidence or natural hazards).

KSAT-GMS is a consortium of three world-renowned SAR service providers in their respective domains: KSAT (Time critical SAR imagery delivery), PPO.Labs (INSAR R&D excellence) and NORUT (applied Earth Observation R&D). This partnership offers full operational capability and scalability, including all the steps of the service chain, from satellite data acquisition to deformation map generation, consultancy and R&D.

# MULTI-MISSION DATA AND DERIVED PRODUCTS

**By leveraging the unique global ground network KSAT can deliver updated satellite imagery and derived products to customers shortly after acquisition.**

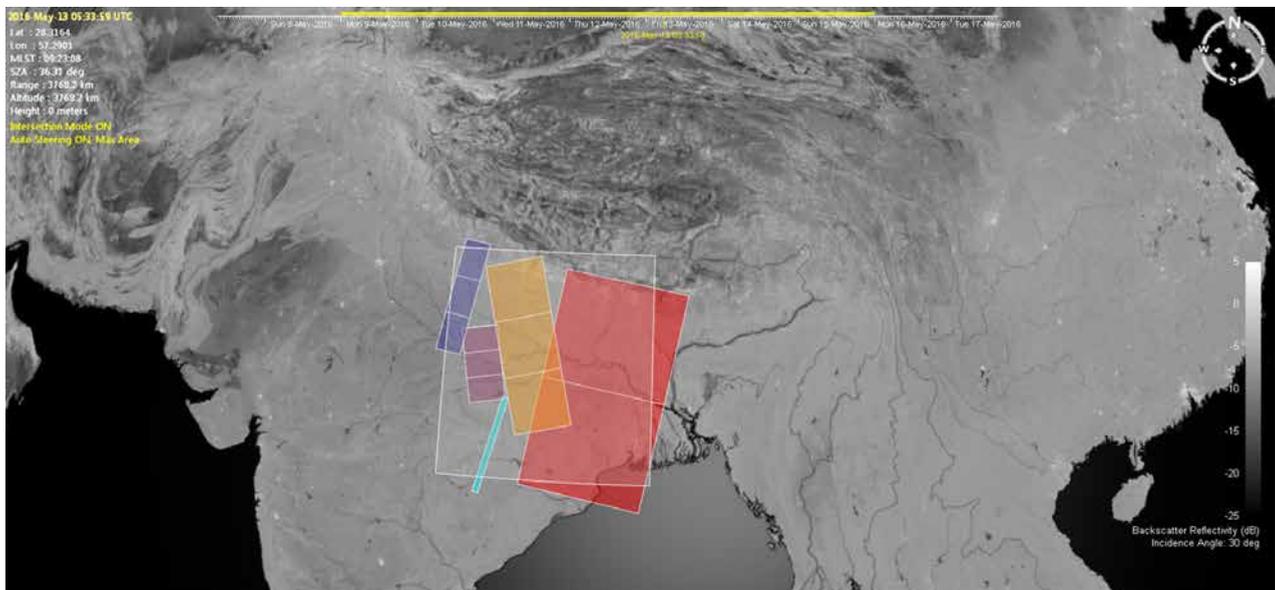
Supplementing SAR imagery with data from medium- and high-resolution optical satellites through a network of targeted reseller agreements. Our industry-leading analysts operate 24 hours a day, 365 days a year, so they are always ready for customer requests.

Our unparalleled multi-mission, near real-time offerings therefore serve to empower our customers, whether they are global petroleum companies, defence and intelligence agencies or government

national organizations or any other end-user who require accurate and timely information.

We are using all relevant electro-optical and SAR satellites as a virtual constellation in order to meet our customer's requirements with regard to coverage, resolution and monitoring frequency. Our dedicated order and planning support desk enables access to extensive archives and new collections.

In addition to providing imagery KSAT provides a variety of products derived from satellite data. These products span from stereo and tri-stereo products, to Digital Elevation Models (DEM's) and analysis reports focusing on human geography, infrastructure and change detection.



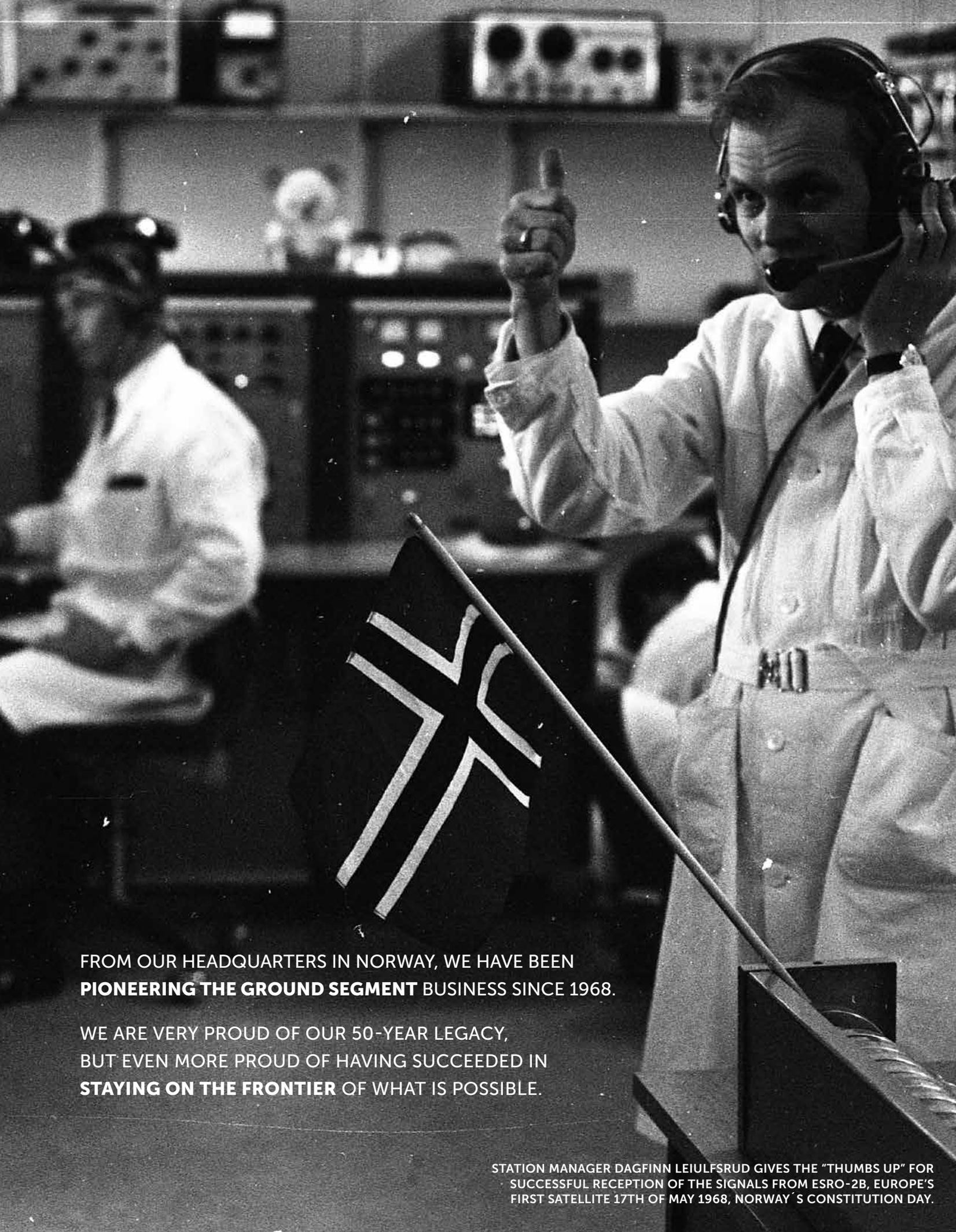
# GLOBAL INFRASTRUCTURE AND LAND MONITORING

**KSAT has developed specific solutions in the context of infrastructure and land monitoring.**

We can offer monitoring of assets, areas or regions of interest anywhere in the world and provides up-to-date information on changes and/or status information. Change detection is done

through automated processes as well as visual analytics performed by domain experts, providing information as a service.

We focus vast amounts of satellite data, turning it into usable information, and by combining different satellite sources, offering a flexible solution, adaptable to the end user requirements.



FROM OUR HEADQUARTERS IN NORWAY, WE HAVE BEEN  
**PIONEERING THE GROUND SEGMENT** BUSINESS SINCE 1968.

WE ARE VERY PROUD OF OUR 50-YEAR LEGACY,  
BUT EVEN MORE PROUD OF HAVING SUCCEEDED IN  
**STAYING ON THE FRONTIER** OF WHAT IS POSSIBLE.

STATION MANAGER DAGFINN LEIULFSRUD GIVES THE "THUMBS UP" FOR  
SUCCESSFUL RECEPTION OF THE SIGNALS FROM ESRO-2B, EUROPE'S  
FIRST SATELLITE 17TH OF MAY 1968, NORWAY'S CONSTITUTION DAY.



ACCESS YOUR SATELLITES  
ANYWHERE, ANYTIME.



KONGSBERG

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