

= Tromsø Satellite Station =

Tromsø Satellite Station ( Norwegian : Tromsø Satellittstasjon , TSS ) , until 1988 known as Tromsø Telemetry Station ( Norwegian : Tromsø telemetristasjon ) , is a satellite earth station located in Tromsø , Norway . The facility is owned by Kongsberg Satellite Services ( KSAT ) , a joint venture between the Kongsberg Group and the Norwegian Space Centre ( NSC ) . In addition to hosting its own antennas serving thirty satellites , TSS acts as the center @-@ point of KSAT 's operations and provides backbone services for the high Arctic Svalbard Satellite Station ( SvalSat ) and the Antarctic Troll Satellite Station ( TrollSat ) .

Originally proposed in 1965 , the station was established by the Royal Norwegian Council for Scientific and Industrial Research ( NTNF ) in 1967 in close cooperation with the Norwegian Defence Research Establishment ( NDRE ) and located adjacent to Tromsø Geophysical Observatory . From its inception until 1974 , it served low @-@ Earth orbit ( LEO ) satellites operated by the European Space Research Organization ( ESRO ) . To a lesser extent it was also used by Canadian Space Agency and National Aeronautics and Space Administration ( NASA ) LEO satellites . Norway 's non @-@ membership in ESRO and later the European Space Agency ( ESA ) caused Tromsø to not become a ground station for Landsat . A gradual increase in operations occurred from 1982 , such as for the International Cospas @-@ Sarsat Programme and the European Remote @-@ Sensing Satellite . TSS became part of NSC in 1990 , although it was partially sold to the Swedish Space Corporation ( SSC ) in 1995 . SvalSat merged with TSS in 2002 to form KSAT .

= = History = =

= = = Establishment and use by ESRO = = =

The first proposals for a telemetry station in Tromsø were made in early 1964 . The concept was to build a real @-@ time telemetry station which would allow for simultaneous observations of the ionosphere from both satellites and sounding rockets . The idea was backed by Norway 's Space Research Committee . Ideas for a real @-@ time telemetry station also arose in ESRO and NTNF included the project in its five @-@ year space program in 1965 . Similar proposals were made in northern Sweden and a race started between Norwegian and Swedish interests to gain ESRO 's support for a station . Norway had budgetary limitations prohibiting a full @-@ scale station , and instead support was gained from the United States and Canada . The project was also backed by NDRE .

The choice of Tromsø as a location for a telemetry stations was in part tied to the Tromsø Geophysical Observatory ? which had been located in Tromsø since 1928 ? and the planned University of Tromsø . The Canadian Space Agency was at the time working on the Alouette 2 program and were seen by NDRE as a natural cooperation partner . The NASA 's International Satellite for Ionospheric Studies was also being designed and NASA therefore decided to supply equipment for a telemetry station in Tromsø to be operational by August 1966 .

Parallel to NDRE 's work , NTNF was working with ESRO to gain support for a telemetry station . There was a degree of urgency as ESRO wanted the facility completed by 1967 in time for the launch of the spacecraft ESRO @-@ 2 . NTNF and ESRO were also working on the establishment of Kongsfjord Telemetry Station in Ny @-@ Ålesund . The agreement to build the station was approved by the Parliament of Norway in mid 1966 . Part of the reason for the Norwegian support was the opportunity of training Norwegians in pulse @-@ code modulation and digital computing . For NDRE the station was a chance to apply its latest minicomputer , the Simulation for Automatic Machinery ( SAM ) .

A major planning issue was the need for a minicomputer at the station . NDRE argued that it was fully capable of delivering such a system , but NTNF instead wanted to minimize risk by buying the PDP @-@ 8 from Digital Equipment Corporation in the United States . However , NDRE was

awarded the contract , in part because of NTNF 's obligation to support Norwegian technology and in part because NDRE agreed to purchase a suitable foreign computer if they could not successfully manufacture one themselves . A new minicomputer , SAM @-@ 2 , was built at NDRE and completed in April 1967 . It was the first computer built in Europe and among the first three in the world which used integrated circuits . SAM @-@ 2 was so successful that the developers established Norsk Data to commercialize the technology .

The contract with ESRO resulted in TSS providing telemetry for ESRO @-@ IA , ESRO @-@ IB , ESRO @-@ 2B , HEOS @-@ 1 , HEOS @-@ 2 , TD @-@ 1A and ESRO @-@ 4 , all of which had low @-@ Earth orbits . The two telemetry stations used a large portion of the Norwegian space budget , but became platforms which allowed for development of technology . Tromsø Satellite Station worked well in tandem with Andøya Rocket Range and became an international center for study of the auroral zone . The University of Tromsø was established in 1968 and started teaching in 1972 . The same year , it took over the geophysical observatory and cosmic geophysics became one of the university 's fields of excellence .

The original contract with ESRO lasted until 1 July 1974 , when their low @-@ Earth orbit program terminated . NTNF proposed closing Tromsø Telemetry Station as the remaining customers did not provide sufficient revenue to keep operations viable . Norway also declined to join the European Space Agency ( ESA ) , which resulted in little hope in ESA choosing to cooperate with a Norwegian earth station . NTNF also looked into outright selling the station to ESA , but the offer was turned down . Kongsfjord Telemetry Station was closed in 1974 .

= = = Commercialization = = =

In 1973 NTNF started planning to use the station for downloading from NASA 's Landsat program . Sufficient funding from the government was secured in mid 1976 , after a successful lobby operation which emphasized the possibility of environmental observation in Norway 's territorial waters . 7 @.@ 5 million Norwegian krone ( NOK ) was granted for upgrades in 1977 . Norway entered negotiations with the US , but soon ESA and NASA started discussions regarding two European telemetry stations for Landsat to serve all ESA members . ESA and Sweden pushed for Kiruna , Sweden , to be the location of ESA 's northern telemetry station and Tromsø was discarded because of Norway 's decision to not join ESA .

Norway expanded its exclusive economic zone to 200 nautical miles ( 370 km ; 230 mi ) in 1977 , increasing the country 's land and sea area by more than one million square kilometers ( 400 @,@ 000 sq mi ) . Because of the reserves of fish and oil it became imperative for the Norwegian government to conduct surveillance . NTNF therefore commenced work to establish an earth station for NASA 's Seasat , which was approved by Parliament in early 1977 . A processing computer was developed as a cooperation between the Norwegian Institute of Technology , NDRE , NTNF and Norsk Data , which was tailored to analyze Seasat 's synthetic aperture radar ( SAR ) and named Computer of Experimental SAR . Seasat A failed after 104 days and Tromsø had by that time been used for telemetry for two minutes .

TSS did not became operational again until 1982 , when the International Cospas @-@ Sarsat Programme made use of the station . The Ministry of Trade and Industry took a renewed interest in the satellite station in the early in 1980s and proposed in 1982 that Norway join ESA 's European Remote @-@ Sensing Satellite ( ERS ) program . This started the process of Norway becoming a full member of ESA in 1987 . The telemetry station received investments of NOK 100 million during the 1980s and was organized as a foundation in 1984 . It took the name Tromsø Satellite Station in 1988 . Part of the goal of the project was to create technical spin @-@ offs ; the one successful company was Spacetec , which had 45 employees at the time it was bought by Kongsberg Defence & Aerospace in 1994 . By then it had become a global manufacturer of Earth observation ground stations .

The Norwegian Space Centre was established as a foundation on 5 July 1987 , under the protection of the Ministry of Trade and Industry . It immediately took over Andøya Rocket Range and TSS followed suit in 1990 . TSS was upgraded in 1991 to be able to operate with ERS @-@ 1 . In

1995 NRS established a subsidiary , Norwegian Space Centre Property , to own the facilities in Tromsø and Longyearbyen . The same year , TSS was converted to a limited company , of which half was sold to the Swedish Space Corporation ( SSC ) . The aim was that TSS would operate as a fully commercial enterprise . Its first major contract was with the Canadian Radarsat .

After Rolf Skår was appointed director of NSC , plans were launched to try to win the ground station contract for NASA 's planned Earth Observing System ( EOS ) . NASA was considering locating the ground station in Greenland , at McMurdo Station in Antarctica or at ESRANGE in Sweden . Skår invited a NASA delegation to visit Svalbard , and from 1996 NSC and NASA started negotiating a contract to establish a ground station at Longyearbyen . The first satellite to use SvalSat was Landsat 7 , which was launched on 15 April 1999 . NSC bought SSC 's ownership in TSS and Lockheed Martin 's ownership in SvalSat in 2001 . On 1 February 2002 , NSC and Kongsberg Spaceteq merged their interests in satellite technology and operations into Kongsberg Satellite Services , which became the sole owner of both SvalSat and TSS . Legally , Kongsberg Satellite Services is a continuation of the operating company of TSS . KSAT opened Troll Satellite Station in 2007 .

= = Operations = =

TSS is owned and operated by Kongsberg Satellite Services ( KSAT ) , which is again equally owned by Kongsberg Defence and Aerospace and the Norwegian Space Centre , the latter which is an agency of the Ministry of Trade and Industry . KSAT is not tied to a particular operator of satellites and the antennas communicate with multiple satellites , thus reducing costs compared to dedicated ground stations . For a typical satellite , data is delivered to the end customer no more than thirty minutes after downloading .

The site is only able to communicate with LEO satellites in ten of their fourteen orbits , unlike SvalSat and TrollSat which can communicate in all orbits . All three stations are interconnected and communicate with the Tromsø Network Operations Center , which is part of the TSS complex . This allows for redundancy as TSS , SvalSat and TrollSat can be used to communicate with all satellites connected to the system . The operation center is responsible for backup , scheduling and conflict resolution , in addition to network planning , customer support and ground station control . The facilities use interoperability and shared ground services , such as a common protocol for communication and similar design of the antennas , to increase flexibility and reduce costs and risk .

The antennas at TSS serve more than thirty missions and contain both a multi @-@ frequency uplink and L , S and X band downlink . In addition there are customer @-@ owned reception , telemetry , tracking and control systems . TSS acts as a local user terminal for the Cospas @-@ Sarsat system used for search and rescue . By using a combination of SvalSat and TrollSat , customers can download data twice per orbit , twenty @-@ six times per day , with only a forty @-@ minute maximum delay . These are the only two ground stations able to communicate with all orbits of LEO satellites . Tromsø is connected to SvalSat via the Svalbard Undersea Cable System .