

ARCHIVED REPORT

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SES SIRIUS AB

Outlook

- SES ASTRA acquired remaining 10 percent of SES SIRIUS in March 2010, becoming a 100 percent owner of the company
- In June 2010, SES SIRIUS and SES ASTRA were consolidated under the SES ASTRA name
- No new production is forecast for SES SIRIUS
- This report will be archived in 2012
- SIRIUS-4 renamed ASTRA 4A, SIRIUS-5, expected to launch in 2011, renamed ASTRA 4B

Orientation

Description. SES SIRIUS is a data, telecommunications, and direct-to-home TV broadcasting satellite system. (This is not the Sirius Satellite Radio system). SES SIRIUS was rolled into SES ASTRA in June 2010.

Sponsor. SES SIRIUS AB (formerly Nordiska Satellitaktiebolaget, or NSAB) of Stockholm, is a 100 percent-owned division of SES ASTRA (part of SES Global). It was formerly a joint venture of SES ASTRA and the Swedish Space Corp (SSC), and operates the SIRIUS satellite system.

Status. SIRIUS-4 is operational. SIRIUS-3 acts as a back-up to SIRIUS-4.

Total Produced. Four SIRIUS satellites and Tele-X.

Application. SIRIUS spacecraft supply commercial, direct broadcast satellite (DBS) service, complementing the Nordic and Eastern European capacities of SES ASTRA.

The experimental Tele-X satellite provided the baseline for a fully operational satellite communications network for the Nordic countries by way of the Nordic Telecommunications Satellite Organization (Notelsat).

Price Range. SIRIUS-2 cost about \$150 million, and SIRIUS-3 about \$75 million. SIRIUS-4 cost approximately \$125 million.

Contractors

Prime

Lockheed Martin Commercial Space Systems	http://www.lockheedmartin.com/ssc/CommercialSpace/ , 100 Campus Dr, Newtown, PA 18940 United States, Tel: + 1 (215) 497-1100, Fax: + 1 (215) 497-4004, Email: info.lmcsc@lmco.com , Prime
Boeing Satellite Development Center	http://www.boeing.com/defense-space/space/bss/ , 2260 E Imperial Hwy, El Segundo, CA 90245 United States, Tel: + 1 (951) 340-2492, Historical Prime (Boeing-376 Satellite Bus)
Thales Alenia Space	http://www.thaleson-line.com/space , 26 ave JF Champollion, BP 1187, Toulouse, 31037 France, Tel: + 33 05 34 35 36 37, Fax: + 33 05 61 44 49 90, Historical Prime (Spacebus 3000B Satellite Bus)

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Subcontractor

Aerojet-General Corp	http://www.aerojet.com , PO Box 13222, Sacramento, CA 95813 United States, Tel: + 1 (916) 355-4000, Fax: + 1 (916) 351-8667, Email: comments@aerojet.com (Hall Electric Thrusters)
Alliant Techsystems - Aerospace Systems	http://www.psi-pci.com , 6033 E Bandini Blvd, Commerce, CA 90040 United States, Tel: + 1 (213) 722-0222, Fax: + 1 (213) 721-6002 (Fuel, Oxidizer & Pressurant Tank)
COM DEV Ltd, Headquarters and Manufacturing Plant	http://www.comdev.ca , 155 Sheldon Dr, Cambridge, N1R 7H6 Ontario, Canada, Tel: + 1 (519) 622-2300, Fax: + 1 (519) 622-1961, Email: gary.calhoun@comdev.ca (Integrated Multiplexer & Switch Assembly)
Emcore Corp - Photovoltaics	http://www.emcore.com , 15251 Don Julian Rd, City of Industry, CA 91745-1002 United States, Tel: + 1 (626) 934-6541, Fax: + 1 (626) 333-5212 (Solar Array Drive, Antenna Pointing Mechanism)
Integral Systems Inc	http://www.integ.com , 5000 Philadelphia Way, Lanham, MD 20706-4417 United States, Tel: + 1 (301) 731-4233, Fax: + 1 (301) 731-9606 (EPOCH Integrated Product Suite)
Thales Electron Devices SA	http://www.thalesgroup.com/security/ , 2 bis, Rue Latecoere, Velizy-Villacoublay, 78941 France, Tel: + 33 1 3070 3500, Fax: + 33 1 3070 3535, Email: info-thales-ed@thalesgroup.com (Traveling Wave Tubes)

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Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features

SIRIUS-1. SIRIUS-1 was launched in 1989 by British BSB, and originally called Marco Polo 1. NSAB bought the satellite in 1993, transferred it to 5° E, and renamed it SIRIUS-1. In 2000, the satellite

was moved to 13° W and renamed SIRIUS W. In 2003, SIRIUS W was moved to a graveyard orbit and is no longer in service.

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Body	2.2 x 7.5 m	7.2 x 15.8 ft
Weight		
Mass in orbit	660 kg	1,455 lb
Performance		
Transponders (BSS)	5 Ku-band	
Frequency band	11.7-12.5 GHz (downlink)	
Transponder bandwidth	27 MHz	
Polarization	Right-hand circular	
Operational lifetime	10 yr (13 yr at current inclined orbit)	

SIRIUS-2. When this satellite was boosted into orbit in 1997, it was the largest European satellite ever launched. In its 11 years of service, SIRIUS-2 (ASTRA 5A) provided direct-to-home (DTH) transmissions, as well as video and data communication services in both the analog and digital. Based on the Spacebus 3000B three-axis stabilized bus, it had two main beams, each with 13 transponders for transmission

of TV channels. One beam was directed at Nordic countries, while the other concentrated on Central and Southern Europe. A third beam provided video and data communications and consisted of six transponders, with coverage aimed at Northern and Central Europe. The spacecraft suffered a technical anomaly in January 2009 leading to the end of its mission.

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	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Body	1.8 x 2.3 x 2.86 m	6 x 7.5 x 9.3 ft
Weight		
Mass in orbit	1,240 kg	2,730 lb
Performance		
Transponders (BSS)	26 Ku-band	
Transponders (FSS)	6 Ku-band	
Frequency band (BSS)	11.7-12.5 GHz (downlink)	
Frequency band (FSS)	12.5-12.75 GHz (downlink)	
Transponder bandwidth	33 MHz (BSS), 36 MHz (FSS)	
Polarization	Linear (horizontal and vertical)	
Operational lifetime	15 yr	

SIRIUS-3. SIRIUS-3 was launched in 1998. It orbits at 5° E as a back-up to SIRIUS-4. Satellite signal power is approximately the same as for SIRIUS-2, and, of its 15 active transponders, five replaced those on SIRIUS W.

SIRIUS-3 is geared toward providing TV broadcasting, in analog and digital standards. It is also used to provide Internet and multimedia services.

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Body	2.2 x 7.8 m	7.2 x 15.9 ft
Weight		
Mass in orbit (BOL on-station)	806 kg	1,777 lb
Performance		
Transponders (BSS)	15 Ku-band	
Frequency band	11.7-12.5 GHz (downlink)	
Transponder bandwidth	33 MHz	
Polarization	Linear (horizontal and vertical)	
Operational lifetime	12 yr	

SIRIUS-4. SIRIUS-4 was launched in November 2007 and now operates at 4.8° E. All channels from SIRIUS-2 and SIRIUS-3 have been transferred to

SIRIUS-4. The satellite primarily serves the HDTV and other television broadcasting needs in Scandinavia, the Baltic, and Eastern Europe.

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Body	2 x 3 x 8.3 m	6.5 x 9.8 x 27.2 ft
Solar panel span	26.8 m	87.9 ft
Weight		
Liftoff mass	4,600 kg	10,141 lbs
Performance		
Transponders (BSS)	40 Ku-band	
Transponders (FSS)	12 Ku-band	
Transponders (Ka-band)	2 Ka-band	
Downlink Frequency band (BSS)	11.7-12.5 GHz	
Downlink Frequency band (FSS)	12.5-12.75 GHz	
Downlink Frequency band (Ka-band)	29.5-30.0/18.8-19.3 GHz	
Transponder bandwidth (BSS)	40 x 33 MHz	
Transponder bandwidth (FSS Africa)	6 x 36 MHz	
Transponder bandwidth (FSS Europe)	6 x 72 MHz	
Transponder bandwidth (Ka Interactive)	2 x 125 MHz	
Transponder bandwidth (Ka Interconnect)	250 MHz	
Polarization	Linear (horizontal and vertical)	
Operational lifetime	15 yr	

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A Lockheed Martin A2100 AX is used for the SIRIUS-4 platform.

Source: Lockheed Martin

Variants/Upgrades

SIRIUS-4. Contracted for production in January 2005, the SIRIUS-4 is being built on the Lockheed Martin A2100AX satellite bus. SIRIUS-4 is a multi-role Ku/Ka-band satellite with a minimum service life of

15 years. An International Launch Services Proton launched SIRIUS-4 to the orbital position of 5° E in 2007.

Program Review

Background. Norway and Sweden began developing proposals for an advanced Scandinavian TV and data broadcasting system in the early 1980s. The two nations finally agreed on a telecommunications system via satellite, and the idea developed into the experimental Tele-X satellite, an extension of the Franco-German TDF-1/TV-SAT projects. Tele-X would provide direct-to-home TV broadcasting and new, specialized data and video services. It was to be run on a semi-operational basis from early 1989. A follow-on mission, Nordsat/Notelsat, was defined as well.

In 1983, the Nordic Satellite Company (NSAB) was established as a joint venture between Sweden (85 percent) and Norway (15 percent) to deploy and operate the Tele-X satellite. The Eurosatellite organization was selected as prime contractor. Four years later, Saab Space and Ericsson Radio Systems teamed with Kongsberg Vapenfabrikk (now NFT) and the newly formed AME Space in a collaborative venture to coordinate industrial activities for the Notelsat network.

Tele-X Abandoned, Sweden Takes Over

The Tele-X collaboration program was officially abandoned by the Nordic states in 1989. The Ministers

of Culture of Sweden, Norway, and Finland concluded that the blueprint to operate three inter-Nordic TV channels on the spacecraft was too expensive and no longer viable.

Sweden and Norway then had to decide what to do with the satellite. Norway's solution was to drop out of the NSAB venture just days before Tele-X's launch from Kourou, exchanging its 15 percent stake in NSAB for an eight-year rental of one Tele-X TV channel. Sweden became 100 percent owner of NSAB and solely responsible for the satellite's future. Tele-X was launched as planned on the last Ariane 2 booster in 1989, and commenced broadcasting in 1990. Sweden entrusted its operation to the Swedish Space Corporation (SSC), which purchased 100 percent ownership of NSAB three years later.

SIRIUS Joins Tele-X, More Satellites Follow

In 1993, NSAB purchased the orbiting Marco Polo 1 satellite, a Hughes HS-376 direct broadcast satellite operated by the former British Satellite Broadcasting. Renamed SIRIUS-1 (the Dog Star), the satellite was moved from its original position at 31° W to co-orbit at 5° E with Tele-X. It was later moved to 13° W and renamed SIRIUS W.

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Meanwhile, Teracom bought a 50 percent share in NSAB. Tele Danmark later purchased a portion of both firms' shares, gaining a 25 percent interest in NSAB.

SIRIUS-2 Launched. GE American Communications Inc and NSAB agreed in 1995 to jointly develop both GE pan-European and NSAB Nordic satellite services on a common satellite, a Spacebus 3000B from Aerospatiale's space unit (now part of Alcatel Space). Dubbed SIRIUS-2, the satellite features 32 transponders and was launched with Indonesia's Cakrawarta-1 on an Ariane 44L in 1997. SIRIUS-2 experienced a solar array power shortfall on 1999, but performance was unaffected by the problem.

SIRIUS-3. NSAB decided to augment further its DTH capabilities, and selected Hughes Space and Communications (now Boeing Satellite Systems) in 1997 to provide the SIRIUS-3 satellite and ground station support services. An HS-376 high-power model, the SIRIUS-3 craft was launched with Eutelsat W2 on an Ariane 44L rocket in 1998.

SES Acquires Half of NSAB. Société Européenne des Satellites SA (SES) and SSC agreed in October 2000 to a \$138 million deal that gave SES a 50 percent stake in NSAB. SES acquired the 37.5 percent share of NSAB owned by Teracom AB and 12.5 percent of Tele Danmark's shares. In turn, SSC bought Tele Danmark's remaining 12.5 percent stake in NSAB.

The firm considered adding a fourth SIRIUS satellite to its network but decided against that plan in July 2001.

SES SA Buys GE Americom. SES SA's \$4.3 billion purchase of GE Americom in November 2001 made it the world's leading global satellite operator. The new entity became known as SES Global. Its European faction was renamed SES ASTRA, and the new U.S. faction, SES Americom.

At the time, SES Global held an interest in five satellite operating firms, including NSAB, and acted as the strategic manager for all of them. Through a series of agreements, SES ASTRA incorporated NSAB's SIRIUS satellite services to meet the needs of and provide services to other SES affiliates in an effort to expand its broadband coverage.

SIRIUS Helps Usher Baltics into the Digital Era

The Baltic region's first digital satellite TV and radio platform, Riga Skyport, was launched in March 2002. This new platform links into the SIRIUS satellite system to export Baltic TV programming abroad, and can receive and transmit 30 TV and radio channels. NSAB has invested more than \$2 million in the Skyport, and

provides ASTRA-NET IP broadband satellite services through its SIRIUS satellites, allowing telecom and media companies to transmit high-speed Internet and other broadband services throughout the Nordic and Baltic markets. Users require a 45- to 60-centimeter receiver dish, pointed at 5° E.

SES ASTRA Increases Stake. In December 2003, SES ASTRA acquired an additional 25 percent of NSAB, raising its total stake in the company to 75 percent. SSC retained a 25 percent stake in NSAB.

Fleet Expansion. In January 2005, Lockheed Martin was contracted by NSAB to build the next satellite in the Scandinavian operator's fleet. Known as SIRIUS-4, the satellite is based on the highly reliable Lockheed Martin A2100AX. SIRIUS-4 was launched in 2007 and is located at the company's 5° E orbital position. Terms of the contract have been kept confidential.

NSAB Changes Name

Nordic Satellite AB changed its name to SES SIRIUS AB in late 2005. The change of name to SES SIRIUS AB is part of the company's development into an expanded market and reflects the assumption of new tasks. At the same time, the name reinforces the link with the principal owner, SES ASTRA.

SES ASTRA Increases Stake, Again

In January 2008, SSC exercised a "put option" to transfer to SES ASTRA an additional 15 percent equity stake in SES Sirius. The transaction increased SES ASTRA's stake to 90 percent. SES has been a shareholder of SES Sirius since October 2000. SES ASTRA acquired the remaining 10 percent stake in SES SIRIUS from SSC in March 2010, making it a 100 percent owner of SES SIRIUS.

Following this purchase, SES ASTRA rebranded SES SIRIUS to SES ASTRA, reflecting the merger of the two companies. The move also represents SES SIRIUS' expansion from a Scandinavian DTH operator to a full satellite services company that serves Scandinavia, Eastern Europe, and Africa.

As part of the move, SIRIUS-4 has been re-designated ASTRA 4A, while the upcoming SIRIUS-5 has been re-designated ASTRA 4B.

SIRIUS-5. SES SIRIUS ordered a new satellite in 2008 and plans to launch it in late 2011. The satellite, dubbed SIRIUS-5 (now changed to ASTRA 4B) will provide DTH broadcasting, broadband, point-to-point, and VSAT services to Eastern Europe and Africa. ASTRA 4B, which will carry 36 Ku-band and 24 C-band transponders, will operate at 5° E. The satellite also includes an L-band payload as part of the European

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Union's European Geostationary Navigation Overlay Service (EGNOS), which will supplement global satellite navigation systems. ASTRA 4B was selected to carry the payload in March 2009.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Apr	1989	Tele-X launches on an Ariane 2
Aug	1993	SSC assumes total ownership of NSAB from Swedish government
Autumn	1993	NSAB purchases Marco Polo 1 on-orbit
Jul	1995	NSAB orders SIRIUS-2 from Aerospatiale
Nov	1997	SIRIUS-2 launched on Ariane 44L
	1997	NSAB orders SIRIUS-3 from Hughes Space and Communications
Oct	1998	SIRIUS-3 launched on Ariane 44L
Oct	2000	SES SA acquires 50 percent share in NSAB
May	2003	SIRIUS W moved to graveyard orbit
Dec	2005	NSAB changes name to SES SIRIUS AB
Nov	2007	SIRIUS-4 launched on Proton
Mar	2010	SES ASTRA becomes 100 percent owner of SES SIRIUS
Jun	2010	SES SIRIUS name changed to SES ASTRA
	2011	Planned launch of SIRIUS-5

Forecast Rationale

With SES ASTRA's purchase of the remaining 10 percent of SES SIRIUS from SSC, SES SIRIUS has been fully integrated into SES ASTRA's European satellite network. To reflect this change, SES SIRIUS was renamed SES ASTRA in June 2010. This is the final step in SES ASTRA'S efforts to integrate with SES SIRIUS. It also represents SES SIRIUS' growth outside of Scandinavia and beyond direct-to-home (DTH) services.

SES SIRIUS' one satellite, SIRIUS-4, will continue operating at 5° East. The satellite will be renamed ASTRA 4A. It will serve growing markets in Eastern Europe and Africa. In 2008, SES SIRIUS awarded Space Systems/Loral a contract for a new satellite, which it dubbed SIRIUS-5. The satellite is still planned to launch in late 2011 or early 2012, under the new name, ASTRA 4B.

The new satellite will also include a hosted payload for the European Union as part of its European Geostationary Navigation Overlay Service (EGNOS) program. The EGNOS program will supplement GPS, and later also GLONASS and GALILEO navigation systems by reporting and improving the reliability and accuracy of the signals. Under the terms of the contract, SES will supply the EU with a tailor-made payload and related ground infrastructure.

With SES SIRIUS and SES ASTRA officially consolidated under SES ASTRA's name, all new satellites purchased to serve regions formerly covered by SES SIRIUS will be done so by SES ASTRA. To reflect this changed corporate structure, Forecast International will archive this report in 2012. All future satellite production will be included in the "SES Global" report.

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