

## A launch for the British MoD and for India

For its first launch of the year Arianespace will boost two payloads into orbit: the Skynet 5A military communications satellite for the British Ministry of Defence through Astrium subsidiary Paradigm, and the Insat 4B civil communications satellite for ISRO, the Indian Space Research Organization.

This launch reflects the strategic role played by Ariane, which guarantees independent access to space for European governments. It also shows that Arianespace continues to set the launch service standard for all telecom operators worldwide, whether military or civil.

Skynet 5A is being orbited on behalf of EADS Astrium, which is delivering the satellite in orbit for the private company Paradigm. The company Paradigm Secure Communications will offer secure communications services for the British armed forces, NATO and other countries.

Built by Astrium, the Skynet 5A satellite will weigh about 4,700 kg at launch.

Europe's Ariane launcher has already orbited the Skynet 4B, 4C, 4E and 4F satellites for the British MoD and NATO. Arianespace has two more MoD satellites in its launch backlog, Skynet 5B and Skynet 5C.

Skynet 5A is the 26th military payload entrusted to Ariane.

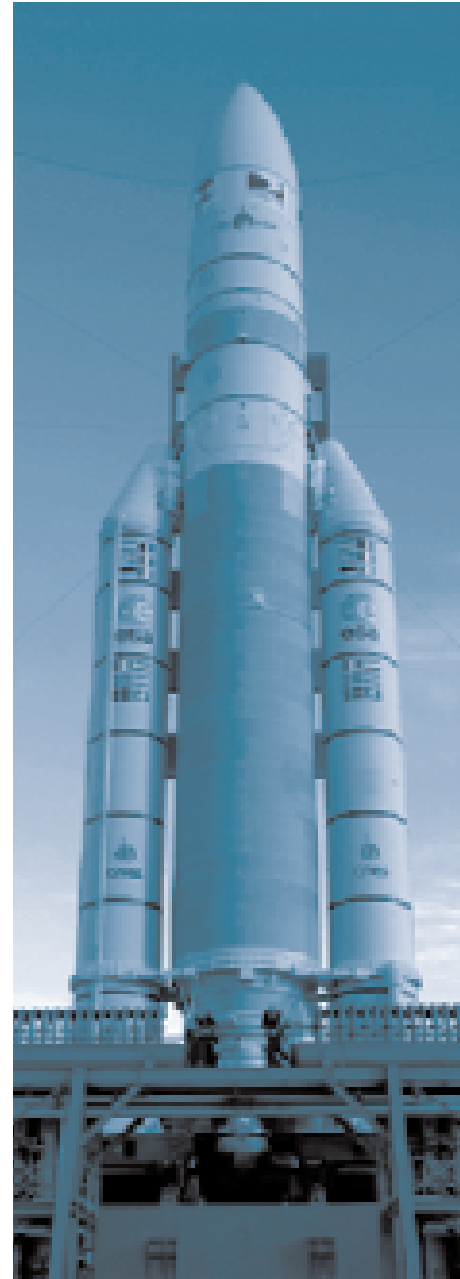
Insat 4B is the 13th ISRO satellite to use the European launcher. Since the launch of the experimental satellite Apple on Flight L03 in 1981, Arianespace has orbited a dozen Indian satellites.

Designed, assembled and integrated by the Indian Space Research Organization in Bangalore, Insat 4B will weigh about 3,000 kg at launch. Insat 4B is dedicated to television and telecommunications services, with 12 Ku-band transponders and 12 C-band transponders. It primarily covers the Indian sub-continent.

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## 1. Mission profile

The 175th Ariane launch will boost two satellites into orbit: Skynet 5A for Paradigm which provides services to the British Ministry of Defence, and Insat 4B for the Indian Space Research Organization (ISRO).

This will be the 31st Ariane 5 launch.

The launcher will be carrying a total payload of 8,600 kg, including 7,785 for the two satellites, which will be released separately into their targeted orbits.

The launch will be from Ariane Launch Complex No. 3 (ELA 3) in Kourou, French Guiana.

### Injection orbit

<i>Perigee altitude</i>	<b>250 km</b>
<i>Apogee altitude</i>	<b>35 970 km at injection</b>
<i>Inclination</i>	<b>4,5° degrees</b>

The lift-off is scheduled on the night of March 10 to 11, 2007 as soon as possible within the following launch window:

### Launch opportunity

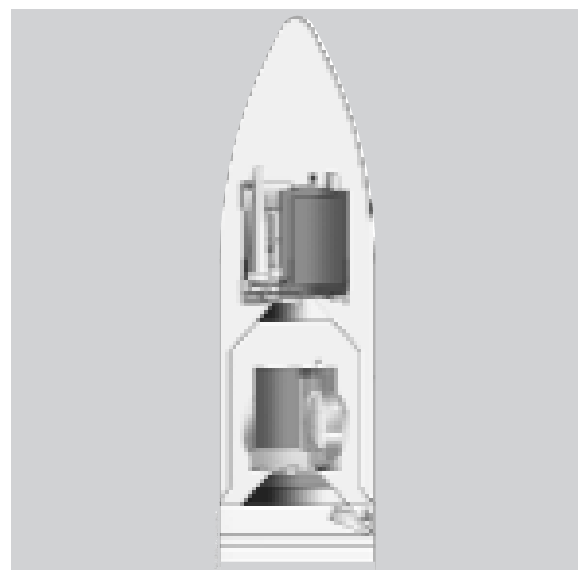
<i>Universal time (GMT)</i>	<i>Paris</i>	<i>Washington time</i>	<i>Kourou time</i>	<i>Bangalore time</i>
<i>Between 10:25 pm</i>	<i>11:25 pm</i>	<i>05:25 pm</i>	<i>07:25 pm</i>	<i>03:55 am</i>
<i>and 10:58 pm</i>	<i>11:58 pm</i>	<i>05:58 pm</i>	<i>07:58 pm</i>	<i>04:28 am</i>
<i>on March 10, 2007</i>	<i>March 10, 2007</i>	<i>March 10, 2007</i>	<i>March 10, 2007</i>	<i>March 11, 2007</i>

## Ariane payload configuration

The Skynet 5A satellite was built by Astrium, on behalf of Paradigm which provides services to the British Ministry of Defence.

The Insat 4B satellite was designed, assembled and integrated by and for the Indian Space Research Organization in Bangalore.

*Orbital position: 93.5° East, over the Indian Ocean.*



## 2. Range operations campaign: ARIANE 5 - SKYNET 5A/INSAT 4B

### Satellites and launch vehicle campaign calendar

Ariane activities	Dates	Satellites activities
<i>Campaign start review</i>	<i>January 4, 2007</i>	
<i>EPC Erection</i>	<i>January 4, 2007</i>	
<i>EAP transfer and positioning</i>	<i>January 5, 2007</i>	
<i>Integration EPC/EAP</i>	<i>January 8, 2007</i>	
	<i>January 10, 2007</i>	<i>Arrival in Kourou and beginning of SKYNET 5A preparation campaign in building S5 C</i>
<i>ESC-A Erection</i>	<i>January 11, 2007</i>	
<i>Integration equipment bay</i>	<i>January 12, 2007</i>	
	<i>January 31, 2007</i>	<i>Arrival in Kourou and beginning of INSAT 4B preparation campaign in building S5 C</i>
<i>Roll-out from BIL to BAF</i>	<i>February 20, 2007</i>	
	<i>February 17-21, 2007</i>	<i>SKYNET 5A filling operations in S5A building</i>
	<i>February 21-23, 2007</i>	<i>INSAT 4B filling operations in S5B building</i>

### Satellites and launch vehicle campaign final calendar

<i>J-10</i>	<i>Saturday, Feb. 24</i>	<i>SKYNET 5A integration on adaptor (ACU)</i>
<i>J-9</i>	<i>Monday, Feb. 26</i>	<i>SKYNET 5A transfer to Final Assembly Building (BAF)</i>
<i>J-8</i>	<i>Tuesday, Feb. 27</i>	<i>SKYNET 5A integration on Sylda and INSAT 4B integration on adaptor</i>
<i>J-7</i>	<i>Thursday, March 1</i>	<i>Fairing integration on Sylda</i>
<i>J-6</i>	<i>Friday, March 2</i>	<i>INSAT 4B transfer to Final Assembly Building (BAF) - INSAT 4B integration on launcher</i>
<i>J-5</i>	<i>Saturday, March 3</i>	<i>Upper composite integration with SKYNET 5A on launcher</i>
<i>J-4</i>	<i>Monday, March 5</i>	<i>ESC-A final preparations and payloads control</i>
<i>J-3</i>	<i>Tuesday, March 6</i>	<i>Launch rehearsal</i>
<i>J-3 bis</i>	<i>Wednesday, March 7</i>	<i>Arming of launch vehicle</i>
<i>J-2</i>	<i>Thursday, March 8</i>	<i>Launch readiness review (RAL) and final preparation of launcher</i>
<i>J-1</i>	<i>Friday, March 9</i>	<i>Roll-out from BAF to Launch Area (ZL), launch vehicle connections and filling of the EPC liquid Helium sphere</i>
<i>J-0</i>	<i>Saturday, March 10</i>	<i>Launch countdown including EPC and ESC-A filling with liquid oxygen and liquid hydrogen</i>

### 3. Launch countdown and flight events

The countdown comprises all final preparation steps for the launcher, the satellites and the launch site. If it proceeds as planned, the countdown leads to the ignition of the main stage engine, then the two boosters, for a liftoff at the targeted time, as early as possible in the satellites launch window.

The countdown culminates in a synchronized sequence (see appendix 3), which is managed by the control station and onboard computers starting at T-7 minutes.

If an interruption in the countdown means that T-0 falls outside the launch window, then the launch will be delayed by one, two or more days, depending on the problem involved, and the solution developed.

Time	Events
- 11 h 30 mn	Start of final countdown
- 7 h 30 mn	Check of electrical systems
- 4 h 50 mn	Start of filling of main cryogenic stage with liquid oxygen and hydrogen
- 3 h 20 mn	Chilldown of Vulcain main stage engine
- 1 h 10 mn	Check of connections between launcher and telemetry, tracking and command systems
- 7 mn 00 s	"All systems go" report, allowing start of synchronized sequence
- 4 mn 00 s	Tanks pressurized for flight
- 1 mn 00 s	Switch to onboard power mode
- 05,5 s	Command issued for opening of cryogenic arms
- 04 s	Onboard systems take over
- 03 s	Unlocking of guidance systems to flight mode

HO	Ignition of the cryogenic main stage engine (EPC)	ALT (km)	V. rel. (m/s)
+ 7,0 s	Ignition of solid boosters	0	0
+ 7,3 s	Liftoff	0	0
+ 12,5 s	End of vertical climb and beginning of pitch rotation (10 seconds duration)	0.88	36
+ 17 s	Beginning of roll manoeuvre	0.325	74
+ 2 mn 19 s	Jettisoning of solid boosters	67.3	1952
+ 3 mn 16 s	Jettisoning of fairing	105.1	2213
+ 8 mn 13 s	Acquisition by Natal tracking station	152.5	5696
+ 8 mn 58 s	Shut-down of main cryogenic stage	153.1	6830
+ 9 mn 04 s	Separation of main cryogenic stage	153.7	6856
+ 9 mn 08 s	Ignition of upper cryogenic stage (ESC-A)	154.0	6858
+ 13 mn 40 s	Acquisition by Ascension tracking station	163.1	7525
+ 18 mn 09 s	Acquisition by Libreville tracking station	215.7	8260
+ 23 mn 13 s	Acquisition by Malindi tracking station	495.1	9076
+ 24 mn 47 s	Shut-down of ESC-A / Injection	678.8	9332
+ 26 mn 40 s	Separation of SKYNET 5A satellite	987.4	9121
+ 28 mn 58 s	Separation of Sylva 5	1397.1	8819
+ 31 mn 02 s	Separation of INSAT 4B satellite	1809.6	8536
+ 45 mn 05 s	End of Arianespace Flight mission	5259.6	6754

## 4. Flight trajectory

The launcher's attitude and trajectory are totally controlled by the two onboard computers, located in the Ariane 5 vehicle equipment bay (VEB).

7.05 seconds after ignition of the main stage cryogenic engine at T-0, the two solid-propellant boosters are ignited, enabling liftoff. The launcher first climbs vertically for 6 seconds, then rotates towards the East. It maintains an attitude that ensures the axis of the launcher remains parallel to its velocity vector, in order to minimize aerodynamic loads throughout the entire atmospheric phase, until the solid boosters are jettisoned.

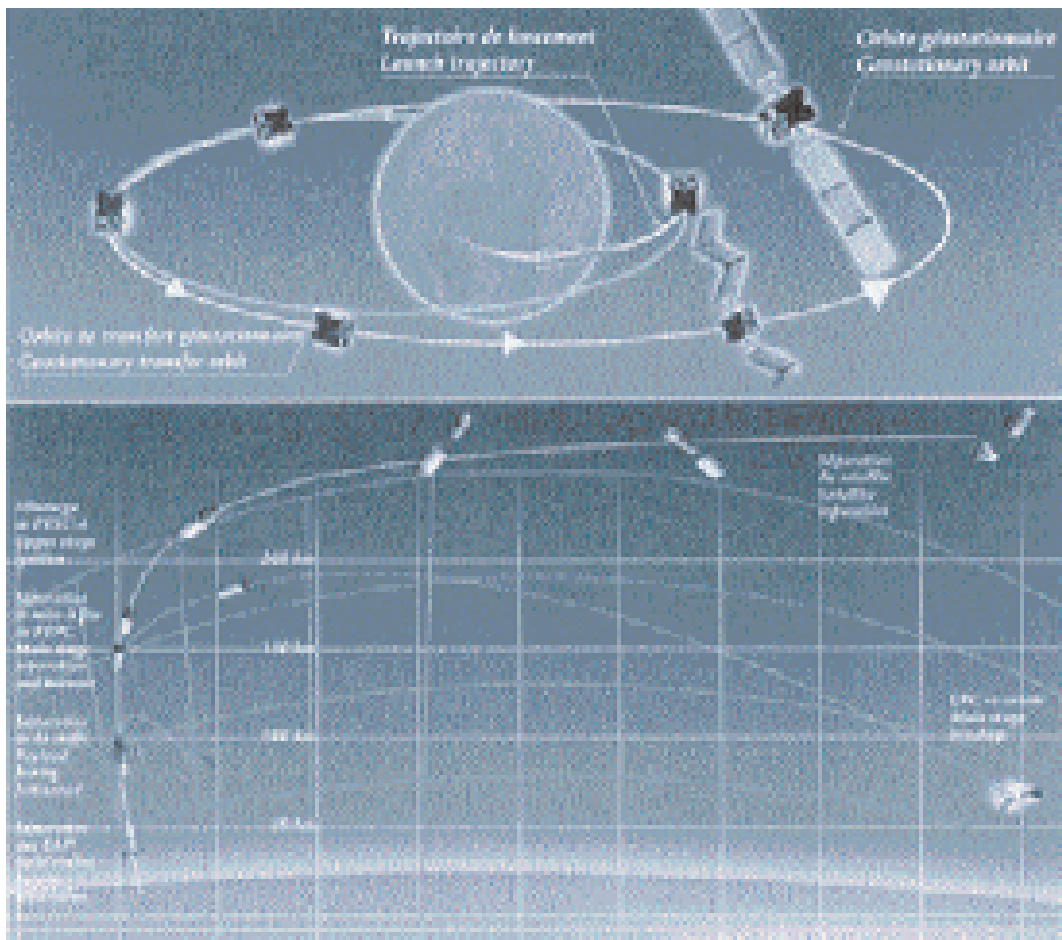
Once this first part of the flight is completed, the onboard computers optimize the trajectory in real time, minimizing propellant consumption to bring the launcher first to the intermediate orbit targeted at the end of the main stage propulsion phase, and then the final orbit at the end of the flight of the cryogenic upper stage.

The main stage falls back off the coast of Africa in the Atlantic Ocean (in the Gulf of Guinea).

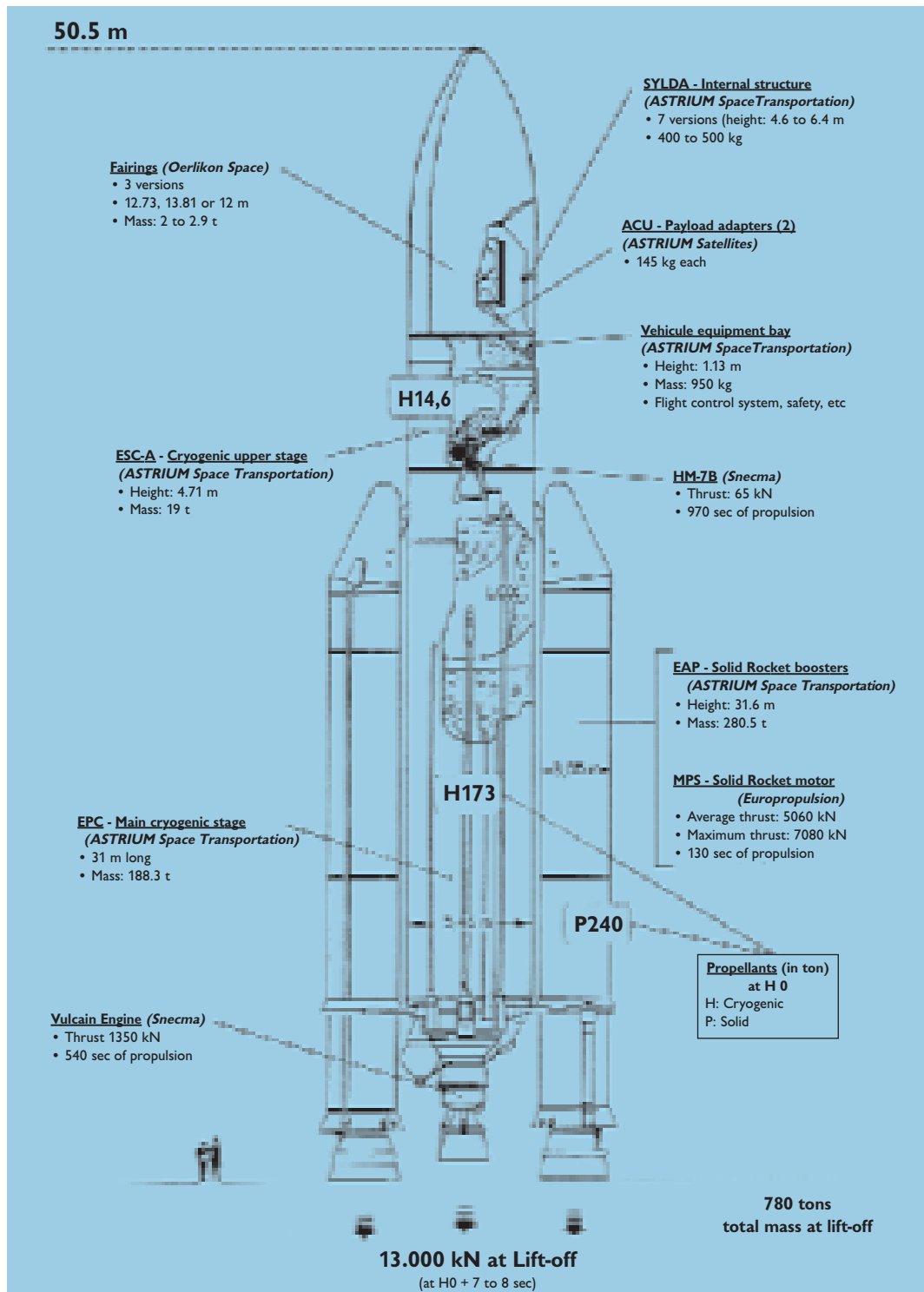
On orbital injection, the launcher will have attained a velocity of approximately 9332 meters/second, and will be at an altitude of about 679 kilometers.

The fairing protecting the SKYNET 5A/INSAT 4B spacecraft is jettisoned shortly after the boosters are jettisoned at about T+196 seconds.

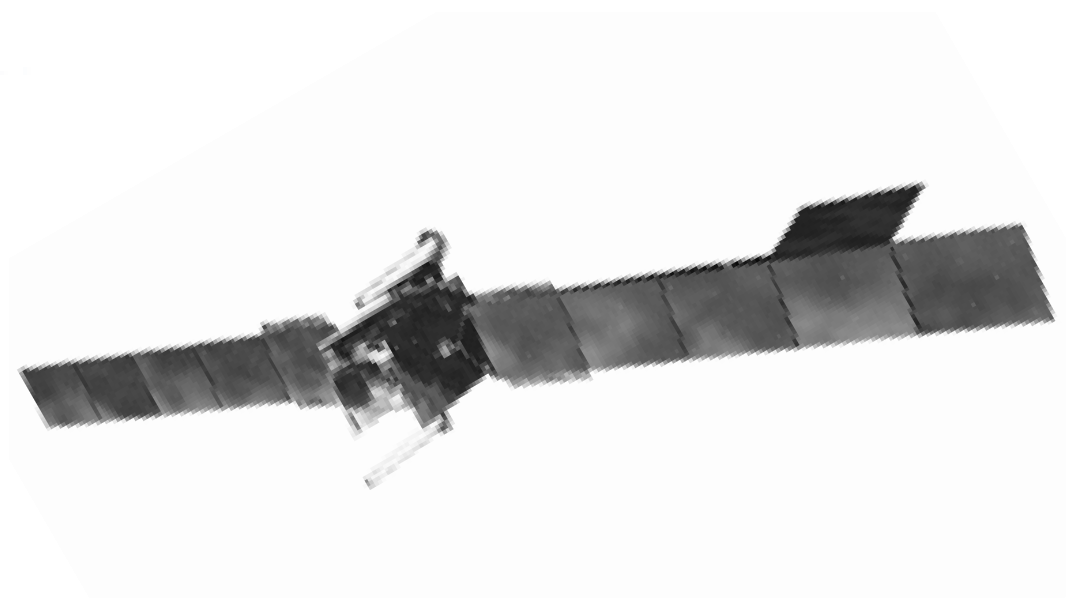
### Standard Ariane 5 trajectory for geostationary transfer orbit



## 5. The Ariane 5-ECA (Industrial prime contractor: ASTRIUM Space Transportation)



## 6. The SKYNET 5A satellite

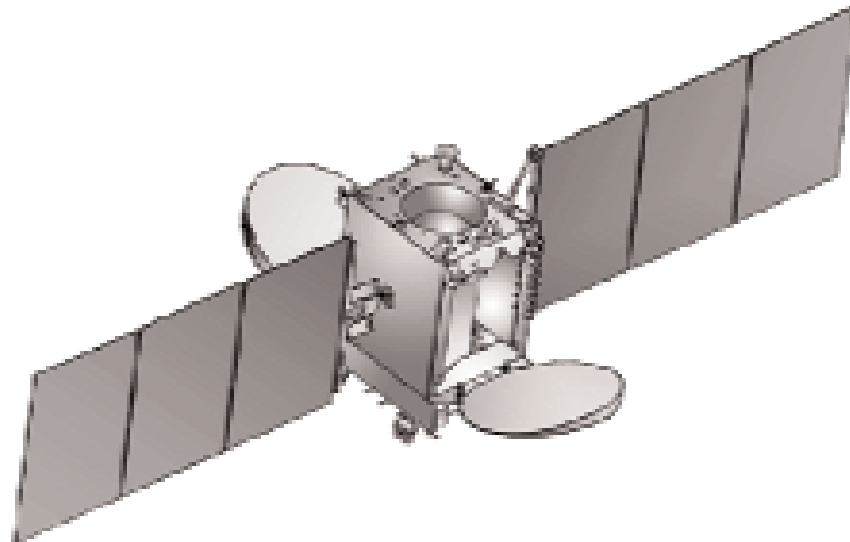


<b>Customer</b>	<b>EADS - Astrium Ltd</b>	
<i>Prime contractor</i>	<i>Astrium satellites</i>	
<i>Mission</i>	<i>Secure military communications</i>	
<i>Mass</i>	<i>Total mass at lift-off</i>	<i>4,700 kg</i>
<i>Stabilization</i>	<i>3 axis stabilized</i>	
<i>Dimensions</i>	<i>4.5 x 2.9 x 3.7 m</i>	
<i>Span in orbit</i>	<i>34 m</i>	
<i>Platform</i>	<i>EUROSTAR E3000S</i>	
<i>On-board power</i>	<i>&gt; 6 kW (end of life)</i>	
<i>Life time</i>	<i>15 years</i>	

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## 7. The INSAT 4B satellite



<b>Customer</b>	<b>Indian Space Research Organisation (ISRO)</b>	
<i>Prime contractor</i>	<i>ISRO/ISAC</i>	
<i>Mission</i>	<i>Television and Telecommunications satellite</i>	
<i>Mass</i>	<i>Total mass at lift-off</i>	<i>3.028 kg</i>
	<i>Dry mass</i>	<i>1.335 kg</i>
<i>Stabilization</i>	<i>3 axis stabilized</i>	
<i>Dimensions</i>	<i>3.10 x 1.77 x 2.0 m</i>	
<i>Span in orbit</i>	<i>15.4 m</i>	
<i>Payload</i>	<i>12 C band transponders and 12 Ku band transponders</i>	
<i>On-board power</i>	<i>5500 W (end of life)</i>	
<i>Life time</i>	<i>12 years minimum</i>	
<i>Orbital position</i>	<i>93.5° East over the Indian Ocean</i>	
<i>Coverage area</i>	<i>India</i>	

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## Appendix 1. Arianespace SKYNET 5A/INSAT 4B launch key personnel

### In charge of the launch campaign

<i>Mission Director</i>	<i>(CM)</i>	<i>Jean-Marc DURAND</i>	<i>ARIANESPACE</i>
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### In charge of the launch service contract

<i>Ariane Payload Manager</i>	<i>(RCUA)</i>	<i>Alexandre MADEMBA-SY</i>	<i>ARIANESPACE</i>
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<i>Ariane Deputy Mission Manager</i>	<i>(RCUA/A)</i>	<i>Christophe BARDOU</i>	<i>ARIANESPACE</i>
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### In charge of SKYNET 5A satellite

<i>Satellite Mission Director</i>	<i>(DMS)</i>	<i>Alan WHYTE</i>	<i>EADS ASTRIUM</i>
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<i>System prime Director</i>	<i>(SPD)</i>	<i>Patrick WOOD</i>	<i>EADS ASTRIUM</i>
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<i>Launcher - Satellite interface Manager</i>	<i>(LIS)</i>	<i>Dennis WILLIAMS</i>	<i>EADS ASTRIUM</i>
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<i>Satellite Preparation Manager</i>	<i>(RPS)</i>	<i>Philippe GREMILLON</i>	<i>EADS ASTRIUM</i>
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### In charge of INSAT 4B satellite

<i>INSAT Program Director</i>	<i>(DP)</i>	<i>V.R. KATTI</i>	<i>ISRO</i>
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<i>Satellite Mission Director</i>	<i>(DMS)</i>	<i>R.K. RAJANGAM</i>	<i>ISRO</i>
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<i>Satellite Program Manager</i>	<i>(CPS)</i>	<i>A. BHASKARANANARAYANA</i>	<i>ISRO</i>
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### In charge of the launch vehicle

<i>Launch Site Operations Manager</i>	<i>(COEL)</i>	<i>Patrick LUCET</i>	<i>ARIANESPACE</i>
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<i>Ariane Production Project Manager</i>	<i>(CPAP)</i>	<i>Franck VASSEUR</i>	<i>ARIANESPACE</i>
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### In charge of the Guiana Space Center (CSG)

<i>Range Operations Manager</i>	<i>(DDO)</i>	<i>Pierre RIBARDIERE</i>	<i>CNES/CSG</i>
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<i>Flight Safety Officer</i>	<i>(RSV)</i>	<i>Stéphane LOUVEL</i>	<i>CNES/CSG</i>
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## Appendix 2. Launch environment conditions

Acceptable wind speed limits at lift-off range from between 7.5 m/s to 9.5 m/s according to the wind direction. The most critical is a northerly wind. For safety reasons, the wind's speed on the ground (Kourou), and at a high altitude (between 10,000 and 20,000 m) is also taken into account.

## Appendix 3. The synchronized sequence

The synchronized sequence starts 7 mn before ignition (T-0), it is primarily designed to perform the final operations on the launcher prior to launch, along with the ultimate checks needed following switchover to flight configuration. As its name indicates, it is fully automatic, and is performed concurrently by the onboard computer and by two redundant computers at the ELA 3 launch complex until T-4 seconds.

The computers command the final electrical operations (startup of the flight program, servocontrols, switching from ground power supply to onboard batteries, etc.) and associated checks. They also place the propellant and fluid systems in flight configuration and perform associated checks. In addition, it handles the final ground system configurations, namely:

- Startup of water injection in the flame trenches and jet guide (T-30 sec).
- Hydrogen aspiration for chilldown of the Vulcain engine in the jet guide (T-18 sec).
- Burnoff of hydrogen used for chilldown (T-5.5 sec).

At T-4 seconds, the onboard computer takes over control of final engine startup and lift-off operations:

- It starts the ignition sequence for the Vulcain main stage engine (T-0).
- It checks engine operation (from T+4.5 to T+7.3 sec).
- It commands ignition of the solid boosters for immediate lift-off at T+7.3 seconds.

**Any shutdown of the synchronized sequence after T-7 mn automatically places the launcher back in its T-7 min configuration.**



## Appendix 4. Arianespace, its relations with ESA and CNES

**From a production base in Europe, Arianespace, a private company, serves customers all over the world.**

Arianespace is the world's first commercial space transportation company, created in 1980 by 36 leading European aerospace and electronics corporations, 13 major banks and the French space agency CNES (Centre National d'Etudes Spatiales).

The shareholder partners in Arianespace represent the scientific, technical, financial and political capabilities of 12 countries: Belgium, Denmark, Germany, France, Great Britain, Ireland, Italy, Netherlands, Norway, Spain, Switzerland and Sweden.

In order to meet the market needs, Arianespace is present throughout the world: in Europe, with its head office located near Paris, France at Evry, in North America with its subsidiary in Washington D.C. and in the Pacific Region, with its representative offices in Tokyo, Japan, and in Singapore.

Arianespace employs a staff of 250. Share capital totals 395,010 €.

Arianespace is in charge of these main areas:

- markets launch services to customers throughout the world ;
- finances and supervises the construction of Ariane expendable launch vehicle ;
- conducts launches from Europe's Spaceport of Kourou in French Guiana.

Personalized reliable service forms an integral part of Arianespace launch package. It includes the assignment of a permanent team of experts to each mission for the full launch campaign.

Today, Arianespace's offer is mainly based on Ariane 5. With its proven experience, demonstrated business model and unquestioned credibility, Arianespace has been committed for more than 24 years to providing its customers - satellite operators around the world - a technically and economically reliable means offer to place their satellites on the targeted orbit at the right moment. This offer is strengthened by the flexibility provided by the three launcher fleet - Ariane 5, Soyuz and Vega - and by the Launch Services Alliance, which gives customers mission back-up aboard alternative launch systems.

### Relations between ESA, CNES and ARIANESPACE

Development of the Ariane launcher was undertaken by the European Space Agency in 1973. ESA assumed overall direction of the ARIANE 1 development program, delegating the technical direction and financial management to CNES. The ARIANE 1 launcher was declared qualified and operational in January 1982. At the end of the development phase which included four launchers, ESA started the production of five further ARIANE 1 launchers. This program, known as the "promotion series", was carried out with a management arrangement similar to that for the ARIANE 1 development program.

In January 1980 ESA decided to entrust the commercialization, production and launching of operational launchers to a private-law industrial structure, in the form of ARIANESPACE company, placing at its disposal the facilities, equipment and tooling needed of producing and launching the ARIANE launchers. ARIANE follow-on development programs have been undertaken by ESA since 1980. They include a program for developing updated versions of the launcher: Ariane 2 and Ariane 3 (qualified in August 1984) ; the program for building a second ARIANE launch site (ELA 2) (validated in August 1985) ; the Ariane 4 launcher development program (qualified on June 15th, 1988) ; and the preparatory and development program of the Ariane 5 launcher and its new launch facilities: ELA 3 (qualified on November, 1997). All these programs are run under the overall direction of ESA, which has appointed CNES as prime contractor. In general, as soon as an updated version of the launcher has been qualified 5 oct, 1998, ESA makes the results of the development program together with the corresponding production and launch facilities available to ARIANESPACE. ESA is responsible (as design authority) for development work on the Ariane launchers. The Agency owns all the assets produced under these development programs. It entrusts technical direction and financial management of the development work to CNES, which writes the program specifications and places the industrial contracts on its behalf. The Agency retains the role of monitoring the work and reporting to the participating States.

Since Flight 9 Arianespace has been responsible for building and launching the operational Ariane launchers (as production authority), and for industrial production management, for placing the launcher manufacturing contracts, initiating procurements, marketing and providing Ariane launch services, and directing launch operations.

### The Guiana Space Center: Europe's Spaceport

For over 30 years, the Guiana Space Center (CSG), Europe's Spaceport in French Guiana, has offered a complete array of facilities for rocket launches. It mainly comprises the following:

- CNES/CSG technical center, including various resources and facilities that are critical to launch bas operation, such as radars, telecom network, weather station, receiving sites for launcher telemetry, etc.
- Payload processing facilities (EPCU), in particular the new S5 facility.
- Ariane launch complexes (ELA), comprising the launch zone and launcher integration buildings.
- Various industrial facilities, including those operated by Regulus, Europropulsion, Air Liquide Spacial Guyane and EADS, which contribute to the production of Ariane 5 elements. A total of 40 European manufacturers and local companies are involved in operations.

Europe's commitment to independent access to space is based on actions by three key players: the European space Agency (ESA), French space agency CNES and Arianespace.

ESA has helped change the role of the Guiana Space Center, in particular by funding the construction of the launch complexes, payload processing buildings and associated facilities. Initially used for the French space program, the Guiana Space Center has gradually become Europe's own spaceport, according to the terms of an agreement between ESA and the french government.

To ensure that the Spaceport is available for its programs, ESA takes charge of the lion's share of CNES/CSG fixed expenses, and also helps finance the fixed costs for the ELA launch complexes.

French space agency CNES plays several roles at the Space Center.

- It designs all infrastructures and, on behalf of the French government, is responsible for safety and security.
- It provides the resources needed to prepare the satellites and launcher for missions.

Whether during tests or actual launches, CNES is also responsible for overall coordination of operations. It collects and processes all data transmitted from the launcher via a network of receiving stations, to track Ariane rockets throughout their trajectory.

In French Guiana, Arianespace is the contracting authority in charge of operating the family of three launchers, Ariane, Soyuz and Vega.

For the Ariane launcher, Arianespace: calls on Astrium Space Transportation, launcher integration prime contractor, for all launcher integration and functional checks in the Launcher Integration Building (BIL), coordinates satellite preparation in the Payload Preparation Complex (EPCU), operated by the Guiana Space Center (CSG), handles final assembly of the launcher and integration of satellites in the Final Assembly Building (BAF), handles transfer of the launcher to Launch Zone No. 3, then oversees final countdown and launch from Launch Center No. 3.

Arianespace has created a top-flight team and array of technical resources to get launchers and satellites ready for their missions. Building on this unrivalled expertise and outstanding local facilities, Arianespace is now the undisputed benchmark in the global launch services market.