# Boosting two communications satellites into orbit

**For its second launch of the year Arianespace will boost two communications satellites into orbit: Astra 1L for the Luxembourg-based operator SES Astra, and Galaxy 17 for the international operator Intelsat.**

Through proven reliability and availability, Arianespace and Ariane continue to set the launch service standard for the world's leading space communications operators.

Astra 1L is the ninth SES Astra satellite to be launched by Arianespace. SES Astra is the leading direct-to-home (DTH) broadcast system in Europe, serving more than 109 million households via DTH and cable networks.

Built by Lockheed Martin Commercial Space Systems (LMCSS) using an A2100 AX platform, Astra 1L will weigh about 4,500 kg at launch. It is equipped with 29 Ku-band active transponders and 2 Ka-band active transponders. Astra 1L will be positioned at 19.2 degrees, and provide high-power satellite services across Europe. Its design life is approximately 15 years.

Galaxy 17 is the 38th Intelsat satellite to use an Ariane launcher since 1983. More than 60% of the Intelsat satellites in service today were orbited by the European launch vehicle.

Built by Thales Alenia Space using a Spacebus 3000 B3 platform, Galaxy 17 is designed to provide television and telephony services for North America. Weighing about 4,100 kg at launch, it is fitted with 24 Ku-band and 24 C-band transponders. Its design life is 15 years.



Follow the launch live on the internet broadband
**at www.arianespace.com**
(starting 20 minutes before lift-off)

# 1. Mission profile

The 176th Ariane launch will boost two communications satellites into orbit: Astra 1L for the Luxembourg-based operator SES Astra, and Galaxy 17 for the international operator Intelsat.

This will be the 32nd Ariane 5 launch.

The launcher will be carrying a total payload of 9,405 kg, including 8,600 kg 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**

| | |
|---|---|
| *Perigee altitude* | **250 km** |
| *Apogee altitude* | **35 952 km at injection** |
| *Inclination* | **6° degrees** |

The lift-off is scheduled on the night of May 3 to 4, 2007 as soon as possible within the following launch window:

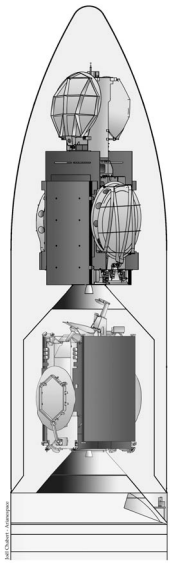
**Launch opportunity**

| | *Universal time (GMT)* | *Paris time* | *Washington time* | *Kourou time* |
|---|---|---|---|---|
| *Between* | *10:29 pm* | *00:29 am* | *06:29 pm* | *07:29 pm* |
| *and* | *11:13 pm* | *01:13 am* | *07:13 pm* | *08:13 pm* |
| *on* | *May 3, 2007* | *May 4, 2007* | *May 3, 2007* | *May 3, 2007* |

# Ariane payload configuration

The Astra 1L satellite was built by Lockheed Martin Commercial Space Systems (LMCSS) in Sunnyvale, California for the Luxembourg-based operator SES Astra.
*Orbital position: 19.2° East.*

The Galaxy 17 satellite was built by Thales Alenia Space in Cannes, France for the international operator Intelsat.
*Orbital position: 91° West (or 99° West)*



# 2. Range operations campaign: ARIANE 5 - ASTRA 1L/GALAXY 17

**Satellites and launch vehicle campaign calendar**

| Ariane activities | Dates | Satellites activities |
|---|---|---|
| *Campaign start review* | *March 7, 2007* | |
| *EPC Erection* | *March 7, 2007* | |
| *EAP transfer and positionning* | *March 8, 2007* | |
| *Integration EPC/EAP* | *March 9, 2007* | |
| *ESC-A Erection* | *March 14, 2007* | |
| *Integration equipement bay* | *March 15, 2007* | |
| | *March 23, 2007* | *Arrival in Kourou and begining of ASTRA 1L preparation campaign in building S5 C* |
| | *March 28, 2007* | *Arrival in Kourou and begining of GALAXY 17 preparation campaign in building S5 C* |
| *Roll-out from BIL to BAF* | *April 10, 2007* | |
| | *April 6-10, 2007* | *ASTRA 1L filling operations in S5A building* |
| | *April 16-17, 2007* | *GALAXY 17 filling operations in S5B building* |

**Satellites and launch vehicle campaign final calendar**

| | | |
|---|---|---|
| *J-10* | *Tuesday, April 17* | *ASTRA 1L integration on adaptor (ACU)* |
| *J-9* | *Wednesday, April 18* | *ASTRA 1L transfer to Final Assembly Building (BAF)* |
| *J-8* | *Thursday, April 19* | *ASTRA 1L integration on Sylda and GALAXY 17 integration on adaptor* |
| *J-7* | *Friday, April 20* | *Fairing integration on Sylda* |
| *J-6* | *Monday, April 23* | *GALAXY 17 transfer to Final Assembly Building (BAF) - GALAXY 17 integration on launcher* |
| *J-5* | *Tuesday, April 24* | *Upper composite integration with ASTRA 1L on launcher* |
| *J-4* | *Wednesday, April 25* | *ESC-A final preparations and payloads control* |
| *J-3* | *Thursday, April 26* | *Launch rehearsal* |
| *J-3 bis* | *Friday, April 27* | *Arming of launch vehicle* |
| *J-2* | *Monday, April 30* | *Launch readiness review (RAL) and final preparation of launcher* |
| *J-1* | *Wednesday, May 2* | *Roll-out from BAF to Launch Area (ZL), launch vehicle connections* |
| | | *and filling of the EPC liquid Helium sphere* |
| *J-0* | *Thursday, May 3* | *Launch countdown including EPC and ESC-A filling with liquid oxygen and liquid hydrogen* |

# 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.

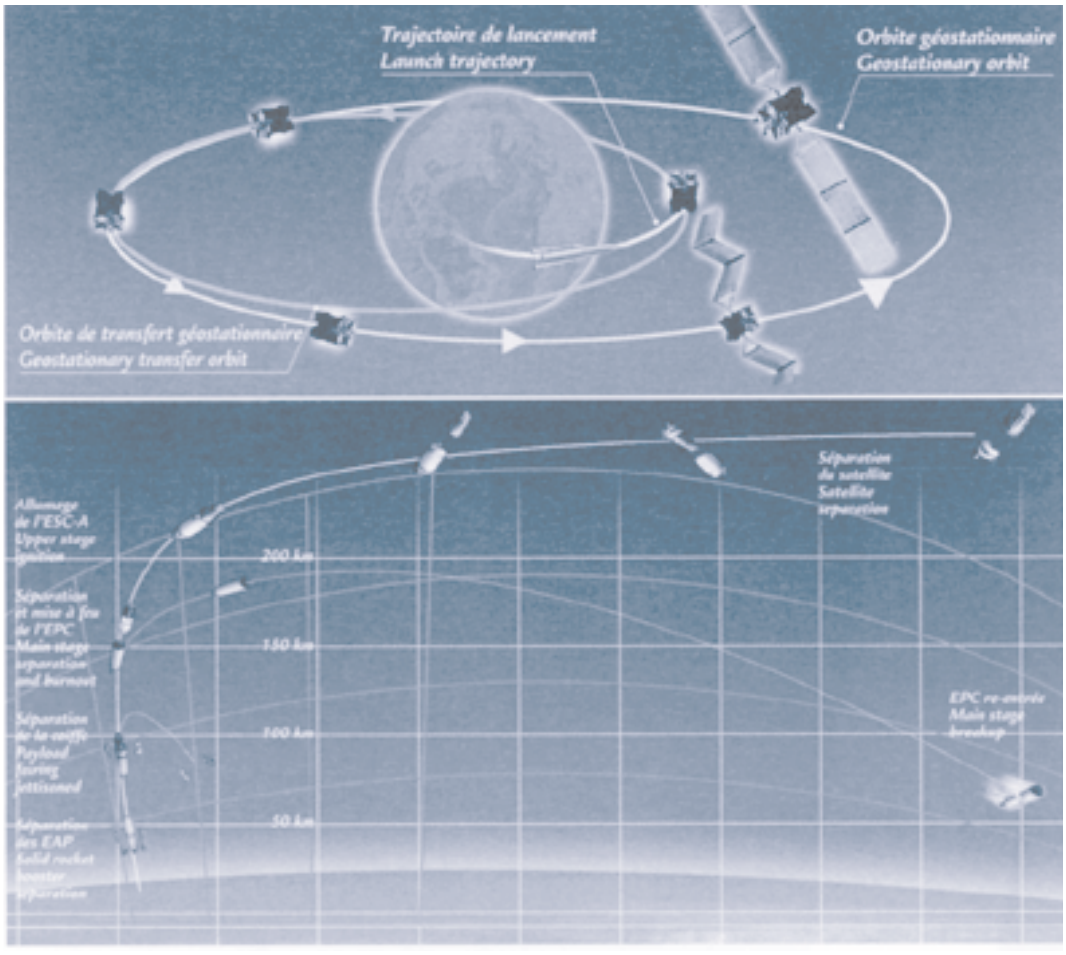
| Time | | Events |
|---|---|---|
| *– 11 h* | *30 mn* | *Start of final countdown* |
| *– 7 h* | *30 mn* | *Check of electrical systems* |
| *– 4 h* | *50 mn* | *Start of filling of main cryogenic stage with liquid oxygen and hydrogen* |
| *– 3 h* | *20 mn* | *Chilldown of Vulcain main stage engine* |
| *– 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)* | *0.94* | *36* |
| | *+ 17 s* | *Beginning of roll manoeuvre* | *0.337* | *74* |
| *+ 2 mn* | *20 s* | *Jettisoning of solid boosters* | *66.6* | *1988* |
| *+ 3 mn* | *11 s* | *Jettisoning of fairing* | *105.1* | *2203* |
| *+ 7 mn* | *36 s* | *Acquisition by Natal tracking station* | *169.0* | *5062* |
| *+ 8 mn* | *57 s* | *Shut-down of main cryogenic stage* | *166.3* | *6875* |
| *+ 9 mn* | *03 s* | *Separation of main cryogenic stage* | *166.4* | *6902* |
| *+ 9 mn* | *07 s* | *Ignition of upper cryogenic stage (ESC-A)* | *167.1* | *6904* |
| *+ 13 mn* | *41 s* | *Acquisition by Ascension tracking station* | *155.2* | *7574* |
| *+ 18 mn* | *18 s* | *Acquisition by Libreville tracking station* | *181.5* | *8330* |
| *+ 23 mn* | *20 s* | *Acquisition by Malindi tracking station* | *440.2* | *9130* |
| *+ 24 mn* | *58 s* | *Shut-down of ESC-A / Injection* | *622.6* | *9878* |
| *+ 27 mn* | *15 s* | *Separation of ASTRA 1L satellite* | *956.0* | *9104* |
| *+ 29 mn* | *36 s* | *Separation of Sylda 5* | *1378.1* | *8775* |
| *+ 32 mn* | *54 s* | *Separation of GALAXY 17 satellite* | *2076.0* | *8281* |
| *+ 41 mn* | *03 s* | *End of Arianespace Flight mission* | *4067.2* | *4879* |

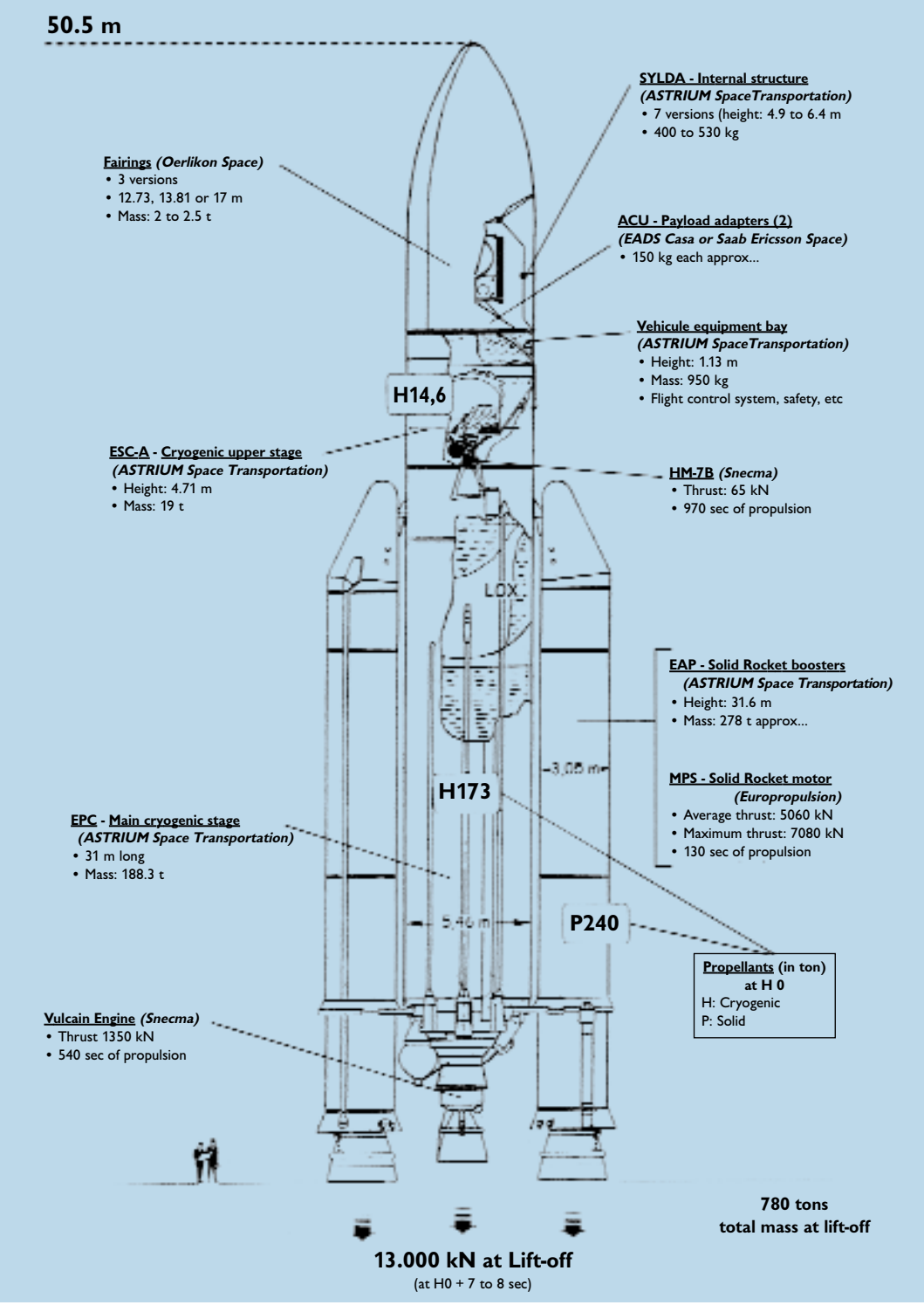
# 4. Flight trajectory

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 9878 meters/second, and will be at an altitude of about 623 kilometers.
The fairing protecting the ASTRA 1L/GALAXY 17 spacecraft is jettisoned shortly after the boosters are jettisoned at about T+191 seconds.

**Standard Ariane 5 trajectory for geostationary transfer orbit**



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



# 6. The ASTRA 1L satellite

| Customer | SES ASTRA | |
|---|---|---|
| *Prime contractor* | *Lockheed Martin Commercial Space Systems (LMCSS)* | |
| *Mission* | *HD direct broadcast satellite* | |
| *Mass* | *Total mass at lift-off* | *4 497.5 kg* |
| | *Dry mass* | *2 253 kg* |
| *Stabilization* | *3 axis stabilized* | |
| *Dimensions* | *7.7 x 2.62 x 3.62 m* | |
| *Span in orbit* | *27 m* | |
| *Platform* | *A2100 AX* | |
| *Payload* | *29 Ku band active transponders + 2 Ka band active transponders* | |
| *On-board power* | *11 KW (end of life)* | |
| *Life time* | *15 years* | |
| *Orbital position* | *19.2° East* | |
| *Coverage area* | *Europe* | |

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# 7. The GALAXY 17 satellite

| Customer | INTELSAT | |
|---|---|---|
| *Prime contractor* | *Thales Alenia Space* | |
| *Mission* | *Television and Telecommunications satellite* | |
| *Mass* | *Total mass at lift-off* | *4 100 kg* |
| | *Dry mass* | *1 749 kg* |
| *Stabilization* | *3 axis stabilized* | |
| *Dimensions* | *3.75 x 1.8 x 2.3 m* | |
| *Span in orbit* | *36.9 m* | |
| *Payload* | *24 C band transponders and 24 Ku band transponders* | |
| *On-board power* | *8.6 KW (end of life)* | |
| *Life time* | *15 years minimum* | |
| *Orbital position* | *91° West or 99° West* | |
| *Coverage area* | *North America* | |

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## Appendix 1. Arianespace ASTRA 1L/GALAXY17 launch key personnel

| | | | |
|---|---|---|---|
| **In charge of the launch campaign** | | | |
| *Mission Director* | *(CM)* | *Philippe ROLLAND* | *ARIANESPACE* |
| **In charge of the launch service contract** | | | |
| *Ariane Payload Manager* | *(RCUA)* | *Christophe BARDOU* | *ARIANESPACE* |
| *Ariane Deputy Mission Manager* | *(RCUA/A)* | *Alexandre MADEMBA-SY* | *ARIANESPACE* |
| **In charge of ASTRA 1L satellite** | | | |
| *Satellite Mission Director* | *(DMS)* | *Martin HALLIWELL* | *SES ASTRA* |
| *System Program Manager* | *(CPS)* | *Rick STARKOVS* | *SES ASTRA* |
| *Satelitte Preparation Manager* | *(RPS)* | *Roy WELLER* | *LMCSS* |
| **In charge of GALAXY 17 satellite** | | | |
| *Satellite Mission Director* | *(DMS)* | *Richard LAURIE* | *INTELSAT* |
| *Satellite Program Manager* | *(CPS)* | *Richard MACARIO* | *INTELSAT* |
| *Satellite Preparation Manager* | *(RPS)* | *Jean-Pierre PROST* | *THALES ALENIA SPACE* |
| **In charge of the launch vehicle** | | | |
| *Launch Site Operations Manager* | *(COEL)* | *Jean-Pierre BARLET* | *ARIANESPACE* |
| *Ariane Production Project Manager* | *(CPAP)* | *Bernard DONAT* | *ARIANESPACE* |
| **In charge of the Guiana Space Center (CSG)** | | | |
| *Range Operations Manager* | *(DDO)* | *Thierry VALLEE* | *CNES/CSG* |
| *Flight Safety Officer* | *(RSV)* | *Hervé POUSSIN* | *CNES/CSG* |

## 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 beforre 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 reduntant 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 (ECPU), 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.