## ORBITING EARTH OBSERVATION SPACECRAFT

**For its second Soyuz launch from the Guiana Space Center in French Guiana, Arianespace will orbit the Pleiades satellite for French space agency CNES, along with four ELISA demonstrator satellites and the Chilean Earth observation satellite, SSOT.**


With the successful first Soyuz launch from the Guiana Space Center on October 21, 2011, and the planned launch of Vega, Europe's new light launcher, in 2012, Arianespace will offer the broadest range of commercial launch services in history.
Arianespace is now the only launch services provider in the world capable of launching all types of payloads to all orbits, from the smallest to the largest geostationary satellites, along with clusters of satellites for constellations and missions to support the International Space Station.

Arianespace continues its partnership with the French Ministry of Defense through this launch, which will help validate innovative satellite concepts in orbit.
Arianespace continues to set the standard in launch Service & Solutions for all civil and military operators, and guarantees access to space for military missions.
French space agency CNES (Centre National d'Etudes Spatiales) chose Arianespace to launch its two Earth observation satellites, Pleiades 1 and 2.

The French Ministry of Defense will be a preferred Pleiades satellite customer, with priority programming rights to about 50 images/day. Pleiades rounds out the current array of military space observation systems, and helps meet the MoD's growing requirement for space imaging. Pleiades 1 is a 1-ton class satellite built by Astrium at its plant in Toulouse. Thales Alenia Space supplied the high-resolution imaging instruments and image telemetry system. The Pleiades satellites offer a significant improvement in technology over previous generation satellites, based on their size, resolution, high degree of agility in orbit, and ground transmission capacity.

The four ELISA (Electronic Intelligence by Satellite) demonstrator satellites will enable French defense procurement agency DGA (Direction Générale de l'Armement) to test the space-based mapping of radar transmitters across the planet, while also determining the characteristics of these transmitters. The DGA and CNES are co-project authorities, and chose Astrium and Thales Airborne Systems to build the four satellites, each weighing about 120 kg, along with the ground control system and user ground segment.

SSOT (Sistema Satelital para Observaciòn de la Tierra) is a high-resolution Earth observation satellite for the Chilean armed forces. Built by Astrium in conjunction with CNES, using a Myriade platform, it will weigh about 120 kg at launch.
SSOT will give Chile very high quality images for various Earth observation applications, including mapping, agriculture and the management of natural resources, disasters and risks.

## MISSION DESCRIPTION

The second Soyuz launch from the Guiana Space Center (CSG) will place into circular orbit, at an altitude of about 7,000 km, the Pleiades 1 Earth observation satellite, the four ELISA demonstrator satellites, and the SSOT Earth observation satellite.

The launcher will be carrying a total payload of 2,191 kg, including about 1,400 for the Pleiades 1, ELISA and SSOT satellites, which will be released into their targeted orbits at an inclination of 98°.

The launch will be from the Soyuz Launch Complex (ELS) in Sinnamary, French Guiana.

**Orbit : circular**
**Altitude : 695 km for Pleiades - 700 km for ELISA - 610 km for SSOT**
**Inclination : 98 degrees**

Liftoff is scheduled for **Friday, December 16, 2011** at precisely:

11:03:08 pm (Local Time in French Guiana)
11:03:08 pm (in Santiago, Chili)
09:03:08 pm (in Washington, DC)
02:03:08 am (UTC) on Saturday, December 17, 2011
03:03:08 am (in Paris)
06:03:08 am (in Moscow)

### Launch at a glance

Following liftoff from the Guiana Space Center, the powered phase of the lower three Soyuz stages will last 8 minutes and 47 seconds. The third stage of the launcher will then be separated from the upper composite, comprising the Fregat upper stage, the ASAP-S payload adapter and the Pleiades 1, ELISA and SSOT satellites. The three lower stages will fall back to Earth.

The Fregat upper stage will ignite its engine a first time, operating for about four minutes, followed by a ballistic phase lasting 25 minutes. It will then restart its engine, for another four-minute burn.

The Pleiades 1 satellite will be released 55 minutes after liftoff, followed four minutes later by the simultaneous release of the four ELISA satellites. The Fregat stage will then fire its engine two more times to reach the orbit required to release the SSOT satellite, 3 hours and 26 minutes after liftoff.

### Mission length

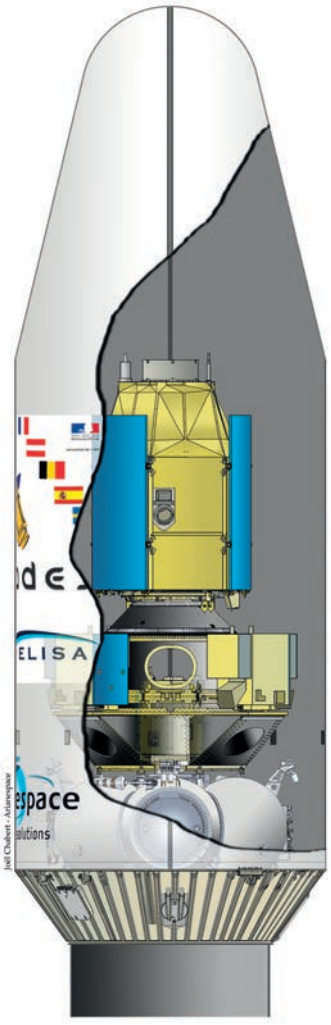
The nominal length of the mission, from liftoff to separation of all satellites, is 3 hours and 26 minutes.

### Soyuz payload configuration

The CNES Pleiades 1 Earth observation satellite was built by Astrium Satellites in Toulouse, on behalf of the French Ministry of Defense.

The four ELISA 1 demonstrator satellites were built by Astrium and Thales Alenia Space for the French defense procurement agency DGA and the French space agency CNES.

The SSOT high-resolution optical observation satellite was built by Astrium, in collaboration with CNES, for the Chilean armed forces.



## 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 and of the four boosters, for a liftoff at the targeted time.

| Events | Time (s) |
|---|---|
| Beginning of the State Commission meeting for launcher fueling authorization | -04:20:00 |
| Beginning of Launch Vehicle fuelling with propellant components. | -04:00:00 |
| Launch Vehicle is fuelled with all propellant components | -01:45:00 |
| Mobile gantry withdrawal | -01:00:00 |
| Key on start (beginning of Soyuz synchronised sequence) | -00:06:10 |
| Fregat transfer to onboard power supply | -00:05:00 |
| Upper Composite umbilical drop off command. | -00:02:25 |
| Ground-board | -00:00:40 |
| Lower stage mast retraction | -00:00:20 |
| Ignition | -00:00:17 |
| Preliminary thrust level | -00:00:15 |
| Full thrust level | -00:00:03 |
| **Lift-off** | **00:00:00** |
| Jettisoning of boosters | +00:01:58 |
| Jettisoning of fairing | +00:03:29 |
| Separation of main stage | +00:04:47 |
| Separation of 3rd stage | +00:08:47 |
| Fregat 1st burn | +00:09:47 |
| Fregat shut-down and beginning of ballistic phase | +00:13:27 |
| Fregat 2nd burn | +00:41:56 |
| Fregat shut-down | +00:46:05 |
| **Separation of PLEIADES 1** | **+00:55:00** |
| **Separation of ELISA** | **+00:59:05** |
| Fregat 3rd burn | +02:03:25 |
| Fregat shut-down | +02:03:37 |
| Fregat 4th burn | +03:08:37 |
| Fregat shut-down | +03:08:47 |
| Separation of ASAP-S | +03:12:07 |
| **Separation of SSOT** | **+03:26:00** |

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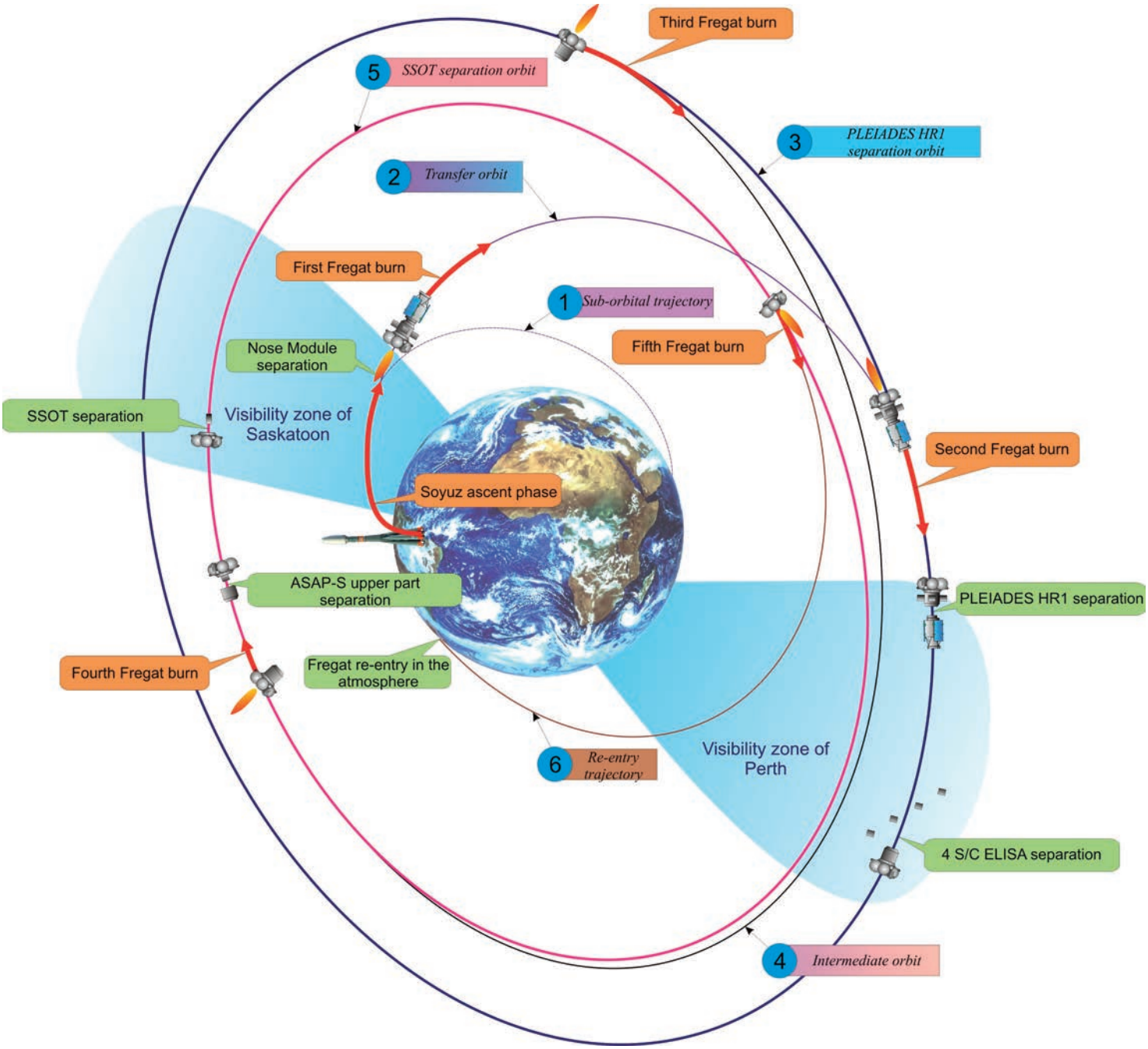
# PROFILE OF THE PLEIADES 1, ELISA, SSOT MISSION

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# THE SOYUZ LAUNCH VEHICLE

**The Soyuz launch vehicle family has provided reliable and efficient launch services since the birth of the space program. Vehicles in this family, which launched both the first satellite and first man into space, have been credited with more than 1780 launches to this date. Today, this vehicle is used for manned and unmanned flights to the International Space Station and commercial launches managed by Arianespace.**

The Soyuz configuration introduced in 1966 has been the workhorse of the Soviet/Russian space program. As the only manned launch vehicle in Russia and in the former Soviet Union, the Soyuz benefits from very high standards in both reliability and robustness.

In 1999, Soyuz allowed Starsem, Arianespace's affiliate, to launch 24 satellites of the Globalstar constellation in 6 launches. Following this success, Starsem introduced the flexible, restartable Fregat upper stage, thus opening up a full range of missions (LEO, SSO, MEO, GTO, GEO and escape).

The introduction in 2004 of the Soyuz 2-1a launch vehicle performed represents a major step in the launch vehicle evolution program. This modernized version of Soyuz, which was also used to successfully launch MetOp-A on October 19, 2006, implements a digital control system providing additional mission flexibility and will enable control of the launch vehicle with the 4.1 m ST fairing. It represents a necessary milestone towards the next generation evolved Soyuz 2-1b launcher as the latest step in a cooperative European/Russian evolution program. In addition to the 2-1a version's features, it utilizes the more powerful third stage engine, significantly increasing the overall launch vehicle performance.

The inaugural flight of the upgraded Soyuz 2-1b launch vehicle was successfully performed on December 27, 2006, launching the Corot scientific spacecraft for the French Centre National d'Etudes Spatiales.

On October 21, Arianespace successfully launched the first Soyuz rocket from the Guiana Space Center (CSG) in French Guiana, orbiting the first two satellites in the Galileo constellation.
The decision of the European Space Agency to introduce the Soyuz launch capability at the Guiana Space Center (CSG) is a major step in widening the range of accessible missions. With the introduction of the Soyuz at CSG, this famed Russian launch vehicle becomes an integral part of the European launcher fleet, together with the heavy-lift Ariane 5 and the light Vega. To be offered exclusively by Arianespace to the commercial market, the Soyuz at CSG is Europe's reference medium-class launch vehicle for governmental and commercial missions.

The Samara Space Center continues to mass-produce the Soyuz in Samara, Russia. As a result of continued demand from the Russian government, International Space Station activity, and Arianespace's commercial orders, the Soyuz is in uninterrupted production at an average rate of 15 to 20 launch vehicles per year with a capability to rapidly scale up to accommodate user's needs. In fact, peak production of the Soyuz in the early 1980's reached 60 vehicles per year.
The Soyuz is a reliable, efficient, and cost effective solution for a full range of missions from LEO to Mars. In its unequalled flight history, the Soyuz has already performed almost every mission profile, including orbiting satellites for telecommunications, Earth observation, weather monitoring, scientific missions and manned flights. It is a highly responsive and flexible launch vehicle.

The Soyuz currently offered by Arianespace is a four-stage launch vehicle. The vehicle consists of four boosters (first stage), a central core (second stage), a third stage, and the restartable Fregat upper stage (fourth stage). Each vehicle also includes a payload adapter/dispenser and fairing.

## THE BOOSTERS (FIRST STAGE)

The four boosters are assembled around the central core and are tapered cylinders with the oxidizer tank in the tapered portion and the kerosene tank in the cylindrical portion. The booster's RD-107A engines are powered by liquid oxygen and kerosene, the same propellants which are used on each of the lower three stages. Each engine has four combustion chambers and nozzles. Three-axis flight control is carried out by aerofins (one per booster) and movable vernier thrusters (two per booster). Following lift-off, the boosters burn for 118 seconds and are then discarded. The separation time is determined by comparing the velocity with a predefined value. Thrust is transferred through a ball joint located at the top of the cone-shaped structure of the booster, which is attached to the central core by two rear struts.

## THE CENTRAL CORE (SECOND STAGE)

The central core is similar in construction to the four boosters, with a hammer-head shape to accommodate the boosters. A stiffening ring is located at the interface between the boosters and the core. This stage has a RD-108A engine with four combustion chambers and nozzles and four vernier thrusters. The verniers are used for three-axis flight control once the boosters have separated. The core stage nominally burns for 286 seconds. Ignition of the central core and boosters occurs at an intermediate level of thrust on the launch pad 20 seconds before lift-off in order to monitor engine health parameters before the engines are throttled up and the vehicle leaves the pad.

## THE THIRD STAGE

The third stage is linked to the central core by a lattice-work structure. Ignition of the third stage's main engine occurs approximately 2 seconds before shutdown of the central core. The third stage engine's thrust directly separates the stage from the central core. In between the oxidizer and fuel tanks is an intermediate bay where avionics systems are located. This stage uses the powerful RD-0110 engine with four combustion chambers and nozzles. The RD-0110 engine is a staged combustion engine powered by a multi-stage turbo pump spun by gas from combustion of the main propellants in a gas generator. These oxygen-rich combustion gases are recovered to feed the four main combustion chambers where kerosene, coming from the regenerative cooling circuit, is injected. Attitude control is provided by main engine activation along one axis in two planes. LOX and kerosene tanks are pressurized by the heating and evaporation of helium coming from storage vessels located in the LOX tank.

## THE FREGAT UPPER STAGE (FOURTH STAGE)

Flight qualified in 2000, the Fregat upper stage is an autonomous and flexible upper stage that is designed to operate as an orbital vehicle. It extends the capability of the lower three stages of the Soyuz vehicle to provide access to a full range of orbits (LEO, SSO, MEO, GTO, GEO and escape). In order to provide the Fregat with high initial reliability, several flight-proven subsystems and components from previous spacecraft and rockets are incorporated into the upper stage. The upper stage consists of 6 spherical tanks (4 for propellants, 2 for avionics) arrayed in a circle, with trusses passing through the tanks to provide structural support. The stage is independent from the lower three stages, having its own guidance, navigation, control, tracking, and telemetry systems. The stage uses storable propellants (UDMH/NTO) and can be restarted up to 20 times in flight, thus enabling it to carry out complex mission profiles. It can provide the customer with 3-axis stabilization or spin-up of their spacecraft.

## PAYLOAD ACCOMMODATION

The current Soyuz flies the ST-type fairing, with external diameter of 4.1 m and a length of 11.4 m.

The Fregat upper stage is encapsulated in the fairing with the payload and a payload adapter/dispenser.

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# PLEIADES 1, ELISA AND SSOT SATELLITES PROFILES

**Pleiades 1** is the first of two dual-use, very-high-resolution satellites in the Pleiades Earth observation system. Both are built by Astrium Satellites in Toulouse for French space agency CNES. The first satellite will be joined by its twin brother Pleiades 2 within a year.

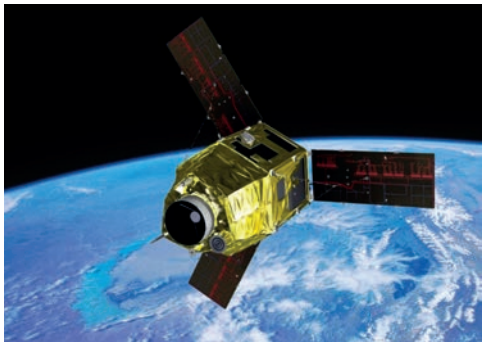
Orbit: sun-synchronous, 695 km altitude

Weight at launch: 970 kg

Electrical power: 1,500 W

Design life: 5 years

Pleiades 1 will deliver images offering 70 cm resolution, as well as sampled products with 50 cm resolution after processing.



**ELISA** - The four ELISA demonstrator satellites, part of a joint program between French defense procurement agency DGA and space agency CNES, were produced by a partnership between Astrium Satellites and Thales Airborne Systems.

Orbit: sun-synchronous, 700 km altitude

Weight at launch: 120 kg each

Platform: Myriade, designed by CNES

Design life: over 3 years

The ELISA project will be used to map radar transmitters across the planet, and determine their characteristics.

**SSOT** - "Sistema Satelital para la Observación de la Tierra" is an Earth observation satellite built by Astrium Satellites for Chilean armed forces.

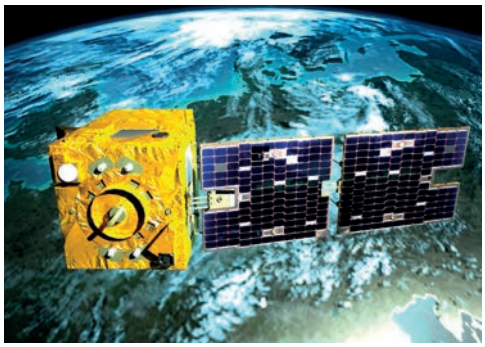
Orbit: sun-synchronous, 610 km altitude

Weight at launch: 117 kg

Platform: Myriade, designed by CNES

Design life: 5 years

SSOT will give Chile 1.45-meter resolution images for various Earth observation applications, including mapping, agriculture and the management of natural resources, disasters and risks.



For more information

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# ARIANESPACE AND THE GUIANA SPACE CENTER

Arianespace was founded in 1980 as the world's first launch service & solutions company. Today, Arianespace has 21 shareholders from ten European countries (including French space agency CNES with 34%, Astrium with 30%, and all European companies participating in the construction of Ariane launchers).

Since the outset, Arianespace has signed more than 300 launch contracts and launched 298 satellites. More than two-thirds of the commercial satellites now in service worldwide were launched by Arianespace.

The company posted sales exceeding 900 million Euros in 2010.

Arianespace offers launch Service & Solutions to satellite operators from around the world, including private companies and government agencies. These Service & Solutions call on three launch vehicles:
- The Ariane 5 heavy launcher, operated from the Guiana Space Center in Kourou, French Guiana.
- The Soyuz medium launcher
- The Vega light launcher, to be launched from the Guiana Space Center starting in 2012.

With its family of launchers Arianespace won over half of the commercial launch contracts up for bid worldwide in the last two years. Arianespace now has a backlog of more than 40 satellites to be launched.

## 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.

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

## Roscosmos and the Russian companies

ROSCOSMOS (Russian Federal Space Agency) is responsible for the oversight for licensing and intergovernmental relations, launch range operations and launch authority.

TsSKB-Progress (Samara Space Center) is responsible for the design, development, and manufacture of space launch vehicles including the Soyuz launch vehicle's first, second, third stages and fairing, integrates vehicle stages and performs flight operations.

NPO Lavochkin is responsible for the Fregat upper stage manufacture, integration and launch operations.

TsENKI, is responsible for launch planning and provision of launch services comprised of systems engineering, launch range operations and launch authority; and for the design, technical and operation management of the launch pad and associated facilities dedicated to the Soyuz Launch Vehicle.