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LAUNCH KIT

JANUARY 2017

VS16

Hispasat 36W-1

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Flight VS16 – First-ever mission to geostationary orbit with Soyuz from the Guiana Space Center to launch Hispasat satellite

For its year-opening launch of 2017, Arianespace will orbit the Hispasat 36W-1 geostationary satellite for the Spanish operator Hispasat using a Soyuz launch vehicle.

Designated Flight VS16 in Arianespace's launcher family numbering system, this mission will be the first-ever mission to geostationary transfer orbit performed by Soyuz from the Guiana Space Center in French Guiana.

Hispasat 36W-1 is the first satellite to be built using Europe's new "SmallGEO" platform developed by OHB System AG (Germany) under ESA's ARTES (Advanced Research in Telecommunications Systems) program.

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Hispasat 36W-1

Hispasat 36W-1 is a telecommunications satellite for Hispasat, and the first to be built using Europe's new "SmallGEO" platform.

Hispasat is the Spanish satellite communications operator, a leader in the distribution of content in Spanish and Portuguese. With more than 25 years' experience, the Hispasat Group maintains an important presence on the Iberian Peninsula and in Latin America, where it is now the fourth-largest satellite operator.
Hispasat distributes more than 1,250 television and radio channels through its powerful fleet of satellites and is a key driver for the Spanish aerospace industry.

The Hispasat 36W-1 satellite features the innovative RedSAT regenerative payload, along with an antenna equipped with a processor that allows onboard beam reconfiguration. It is fitted with 20 Ku-band transponders and the additional capacity of three transponders in Ka band.

From its orbital position at 36 deg. West, Hispasat 36W-1 will allow Hispasat to provide a wide range of telecommunications services in Spain, Portugal, the Canary Islands and South America.

Hispasat 36W-1 was built by OHB System AG in Bremen, Germany, using a SmallGEO platform.

Developed by OHB System AG under ESA's ARTES (Advanced Research in Telecommunications Systems) program, the SmallGEO platform line offers satellite operators an entirely European solution in the smaller telecom satellite market by speeding up the production and testing processes, reducing costs and broadening the range of design options.

For Hispasat 36W-1, OHB System AG is in charge of satellite integration, in-orbit tests and satellite commissioning, before handing over operational responsibility to Hispasat.

Hispasat 36W-1 is the first GEO satellite built by OHB System AG, and the company's 15th satellite overall to be launched by Arianespace.

The Arianespace order book includes eleven more payloads built by OHB System AG:

- Three SmallGEO satellites : EDRS-C, MTG-I1 and MTG-S1,
- Along with eight Galileo FOC (Full Operational Capacity) satellites.

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MISSION DESCRIPTION

The 16th Soyuz launch from the Guiana Space Center (CSG) will place the satellite into a geostationary transfer orbit.

The launcher will be carrying a total payload of 3,343 kg.

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

DATE AND TIME

Liftoff is scheduled for **Friday, January 27, 2017** at exactly:

- **22:03:34 p.m.,** local time in French Guiana
- **20:03:34 p.m.,** in Washington, D.C.
- **01:03:34,** Universal Time (UTC) **on January 28,**
- **02:03:34 a.m.,** in Paris on January 28,
- **04:03:34 a.m.,** in Moscow on January 28.

MISSION DURATION

The nominal duration of the mission (from liftoff to separation of the satellite) is:

32 minutes, 10 seconds.

TARGETED ORBIT

Perigee	Altitude at the first Apogee	Inclined
250 km.	35,736 km.	5,44 degrees

THE LAUNCH AT A GLANCE

Following liftoff from the Guiana Space Center, the powered phase of the lower three Soyuz stages will last approximately nine minutes and 20 seconds. The launcher's third stage will then be separated from the upper composite, which comprises the Fregat upper stage and the Hispasat 36W-1 satellite. The three lower Soyuz stages and the payload fairing will fall back into the sea.

Fregat will perform an engine burn lasting about 18 minutes to reach the transfer orbit for separation of the satellite. Four minutes later, Hispasat 36W-1, will be deployed.

Hispasat 36W-1's separation will occur 32 minutes, 10 seconds after liftoff.

SOYUZ PAYLOAD CONFIGURATION

- **Payload:** Hispasat 36W-1
  Mass at liftoff: 3,220 kg.
- **ST Fairing**
- **Adaptor (carrying structure and deployment system) for the payload, developed and built by RUAG Space.**

Hispasat 36W-1 satellite

CUSTOMER	Hispasat
MANUFACTURER	OHB System AG
MISSION	Telecommunications
PAYLOAD	20 transponders in Ku band and additional capacity of three transponders in Ka band
LIFTOFF MASS	Mass at liftoff: 3,220 kg.
DIMENSIONS	3.1 m. x 2.47 m. x 4.95 m. (under the fairing) - 7.5 m. x 20.8 m. x 4.95 m. (deployed)
STABILISATION	3 axis
LIFETIME	15 years
AVAILABLE POWER	More than 6 kW
ORBIT	36° West
COVERAGE	Spain, Portugal, Canary Islands and South America

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SOYUZ LAUNCH VEHICLE

The Soyuz launch vehicle family has provided reliable and efficient launch services since the start of space exploration. Soyuz rockets, which launched both the first artificial satellite and the first human into space, have performed more than 1,865 launches to date. Today, Soyuz is used for manned and unmanned flights to the International Space Station, as well as Russian government launches, and commercial launches with Arianespace as launch operator.

Introduced in 1966, Soyuz has been the workhorse of the Soviet/Russian space program. As the only manned launch vehicle in Russia and the former Soviet Union, Soyuz meets very high standards of reliability and robustness.

The first launch of the Soyuz 2-1a version on November 8, 2004 from the Plesetsk Cosmodrome represented a major step in the Soyuz launch vehicle's development program. This modernized version, also used to successfully launch MetOp-A on October 19, 2006 from the Baikonur Cosmodrome, features a digital control system providing additional mission flexibility; it also enables control of the launch vehicle fitted with the 4.1-meter ST payload fairing. This was a necessary step towards the next-generation Soyuz 2-1b launcher, the culmination of a joint European/Russian upgrade program. It adds a more powerful third stage engine, significantly increasing the launcher's overall performance.

The upgraded Soyuz 2-1b launch vehicle's inaugural flight was successfully performed from Baikonur Cosmodrome on December 27, 2006, orbiting the Corot scientific spacecraft for the French CNES space agency.

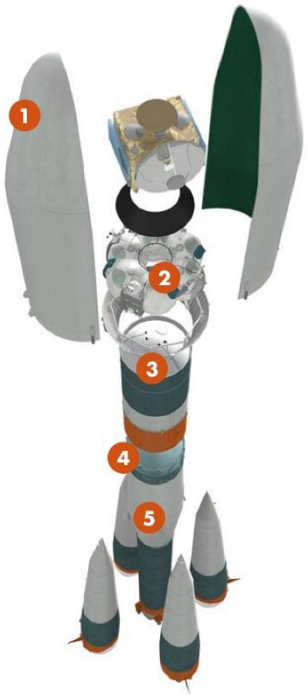
The decision of the European Space Agency to introduce Soyuz launch capability at the Guiana Space Center (CSG) in French Guiana marked a major step forward in expanding the range of missions. With the introduction of Soyuz at CSG, this famed medium-lift Russian launch vehicle is now an integral part of the European launcher fleet, together with the heavy-lift Ariane 5 and the lightweight Vega. Offered exclusively by Arianespace to the commercial market for launches from CSG, Soyuz becomes Europe's standard medium launcher for both government and commercial missions.

On October 21, 2011 Arianespace successfully launched the first Soyuz rocket from the Guiana Space Center, orbiting the initial two satellites in the Galileo constellation.

The Samara Space Center in Russia continues to produce Soyuz launchers. Because of sustained demand from the Russian government, International Space Station requirements and Arianespace's commercial orders, Soyuz is being produced at an average rate of 15 to 20 launchers per year. The manufacturer can also rapidly scale up to accommodate market demand. In fact, annual Soyuz production peaked in the early 1980s at 60 vehicles per year.

Soyuz is a reliable, efficient, and cost-effective solution for a full range of missions, from LEO (Low Earth Orbit) to interplanetary trajectories to Mars or Venus. Offering an unrivaled heritage, Soyuz already has performed almost every type of mission, from launching telecommunications, Earth observation, weather and scientific satellites to manned spacecraft. It is a very scalable and flexible launch vehicle.

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



SOYUZ

1 - Fairing
2 - Fregat upper stage
3 - Third stage
4 - Central core (2nd stage)
5 - Boosters (1st stage)

BOOSTERS (FIRST STAGE)

The four cylindrical-conical boosters are assembled around the central core. The booster's RD-107A engines are powered by liquid oxygen and kerosene, which are the same propellants used on each of the lower three stages. The kerosene tanks are located in the cylindrical part and the liquid oxygen tanks in the conical section. Each engine has four combustion chambers and four nozzles. Three-axis flight control is provided by aerofins (one per booster) and steerable vernier thrusters (two per booster). Following liftoff, the boosters burn for approximately 118 seconds and are then jettisoned. Thrust is transferred to the vehicle through a ball joint located at the top of the conical structure of the booster, which is attached to the central core by two rear struts.

CENTRAL CORE (SECOND STAGE)

The central core is similar in construction to the four boosters, with a special shape to accommodate the boosters. A stiffening ring is located at the interface between the boosters and the core. This stage is fitted with an RD-108A engine, also comprising four combustion chambers and four nozzles. It also has four vernier thrusters, used for three-axis flight control once the boosters have separated. The core stage has a nominal burn time of 286 seconds. The core and boosters are ignited simultaneously on the launch pad, 20 seconds before liftoff. Thrust is first adjusted to an intermediate level to check engine readings. The engines are then gradually throttled up, until the launcher develops sufficient thrust for liftoff.

THIRD STAGE

The third stage is linked to the central core by a latticework structure. Ignition of the third stage's engine occurs approximately two seconds before shutdown of the central core engine. The third stage engine's thrust enables the stage to separate directly from the central core. Between the oxidizer and fuel tanks is a dry section where the launcher's avionics systems are located. The third stage uses either a RD-0110 engine in the Soyuz ST-A version, or a RD-0124 engine in the ST-B version.

FREGAT UPPER STAGE (FOURTH STAGE)

Flight qualified in 2000, the Fregat upper stage is an autonomous and flexible stage that is designed to operate as an orbital vehicle. It extends the Soyuz launcher's capability, now covering a full range of orbits (LEO, SSO, MEO, GTO, GEO and Earth escape). To ensure high reliability for the Fregat stage from the outset, various flight-proven subsystems and components from previous spacecraft and rockets are used. The upper stage consists of six spherical tanks (four for propellants, two for avionics) arranged in a circle and welded together. A set of eight struts through the tanks provide an attachment point for the payload, and also transfer thrust loads to the launcher. The upper stage is independent from the lower three stages, as Fregat has its own guidance, navigation, attitude control, tracking, and telemetry systems. The stage's engine uses storable propellants – UDMH (unsymmetrical dimethyl hydrazine) and NTO (nitrogen tetroxide) – and can be restarted up to 20 times in flight, thus enabling it to carry out complex missions. It can provide the customer with three-axis or spin stabilization of their spacecraft.

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

THE FAIRING

Soyuz launchers operated by Arianespace at the Guiana Space Center use the ST fairing in a standard configuration, with an external diameter of 4.1 meters and a length of 11.4 meters.

ROSCOSMOS AND THE RUSSIAN LAUNCHER INDUSTRY

The Roscosmos State Corporation for space activities is responsible for license allocations and intergovernmental relations. It is the launch authority in charge of range operations. RKTs-Progress (the Samara Space Center) is responsible for the design, development, and manufacture of launch vehicles, including the Soyuz launch vehicle's first, second, third stages and fairing. It also integrates vehicle stages and handles flight operations. NPO Lavochkin manufactures and integrates the Fregat upper stage, and is responsible for its launch operations. TsENKI is in charge of launch planning and the provision of associated services, including systems engineering, the design, and technical and operational management of the launch pad and associated facilities dedicated to the Soyuz launcher.

LAUNCH CAMPAIGN:

CAMPAIGN CALENDAR FOR THE SATELLITE AND LAUNCH VEHICLE

DATE	ACTIVITIES WITH THE SATELLITE	LAUNCH VEHICLE ACTIVITIES
September 5, 2016		Campaign start review
September 5 to 14, 2016		Integration of the 1st and 2nd Soyuz stages in the MIK facility
November 9 to 26, 2016		Fregat upper stage preparation at the Soyuz launcher preparation building (MIK)
November 26, 2016		Transfer of the Fregat upper stage to the FCube building for fueling operations
November 28 to December 14, 2016		Fregat upper stage fueling operations in the FCube building
December 1, 2016	Arrival in Kourou of the Hispasat 36W-1	
January 9, 2017	Hispasat 36W-1 transfer from the S1 building to the S3B building	
January 9 to 12, 2017		Pneumatic tests on the lower three Soyuz stages in the MIK
January 13 to 16, 2017	Hispasat 36W-1 fueling operations	
January 13 to 19, 2017		Pneumatic tests on the lower three Soyuz stages in the MIK
January 14, 2017		3rd Soyuz stage integration in the MIK facility
January 19, 2017		Fregat upper stage transfer to the S3B building
January 20, 2017	Hispasat 36W-1 integration on the Fregat upper stage	
January 21, 2017		Fregat upper stage final preparation; Encapsulation in the payload fairing

FINAL CAMPAIGN CALENDAR FOR THE SATELLITE AND LAUNCH VEHICLE

DATE	ACTIVITIES WITH THE SATELLITE	LAUNCH VEHICLE ACTIVITIES
Monday, January 23, 2017		Final preparations of the lower three Soyuz stages in the MIK and the upper composite in the S3B building
Tuesday, January 24, 2017	Rollout of the payload upper composite from S3B to the launch zone; Integration on the launcher	Rollout from MIK to the launch zone; Launch rehearsal at the Spaceport facilities
Wednesday, January 25, 2017	Upper composite functional tests and checks	Final launcher verification
Thursday, January 26, 2017		Preparation for fueling operations; Launch rehearsal – Payload checks Launch readiness review (RAL)
Friday, January 27, 2017		Launcher final preparations; Launch countdown; Launch vehicle fueling operations

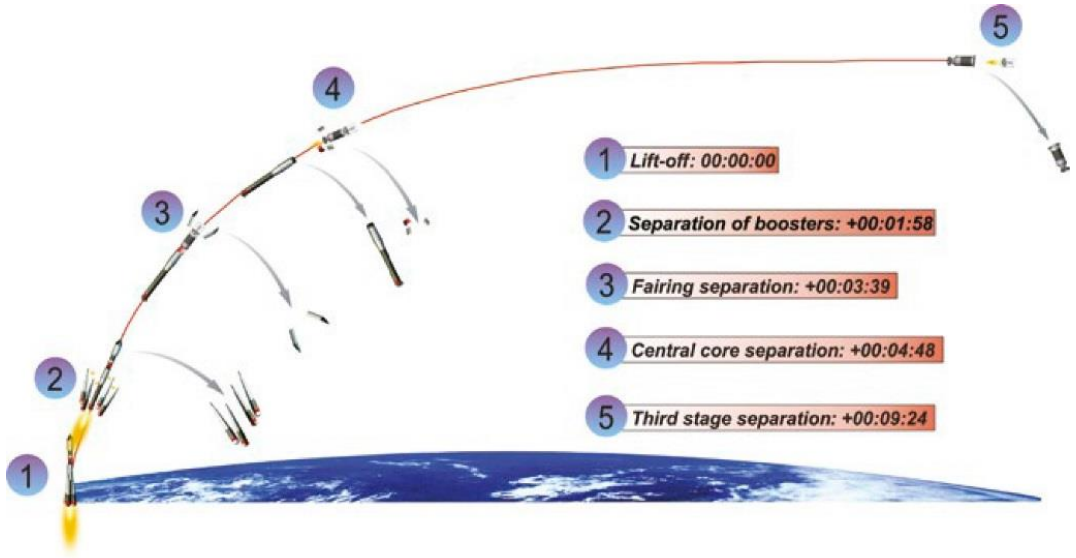
COUNTDOWN AND FLIGHT SEQUENCE

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 core stage engine and the four boosters.

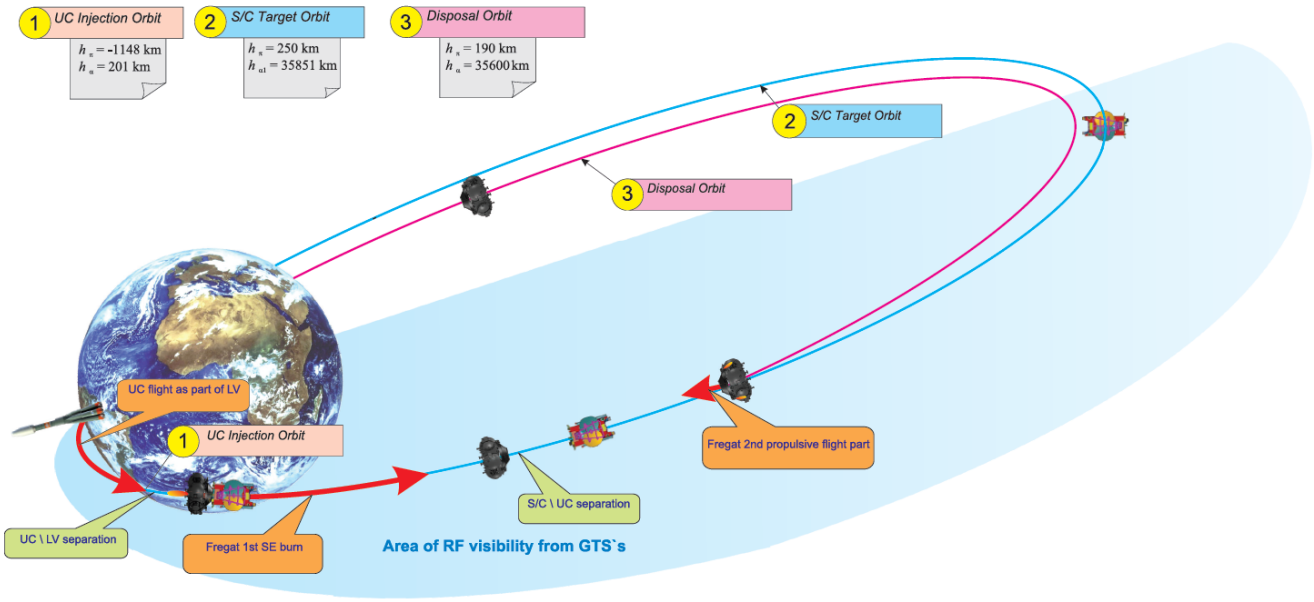
TIME			ÉVÉNT
- 5 hrs.			Beginning of the meeting for launcher fueling authorization (BTR)
- 4 hrs.	30 min.		Launch vehicle fueling begins
- 1 hr.	35 min.		End of fueling operations
- 1 hr.	10 min.		Mobile gantry withdrawal
	- 5 min.	10 s	Key on start
	- 5 min.		Fregat transfer to onboard power supply
	-2 min.	25 s	Upper composite umbilical drop-off command
		- 40 s	Ground-onboard power transfer
		- 28 s	Lower stage umbilical mast retraction
		- 16 s	Ignition
		- 14 s	Preliminary thrust level
		- 01 s	Full thrust level
HO		00 s	Liftoff
	+ 1 mn	58 s	Jettisoning of boosters
	+ 3 mn	33 s	Jettisoning of fairing
	+ 4 mn	47 s	Separation of central core (second stage)
	+ 9 mn	23 s	Separation of 3rd stage
	+ 10 mn	23 s	First Fregat burn
	+ 28 mn	00 s	Fregat shut-down and beginning of ballistic phase
	+ 32 mn	10 s	**Hispasat 36W-1 separation**
+ 2 h	04 mn	59 s	End of the Arianespace mission

VS16 MISSION PROFILE

MISSION PROFILE FOR THE THREE SOYUZ STAGES



THE FREGAT MISSION PROFILE



ARIANESPACE AND THE GUIANA SPACE CENTER

ARIANESPACE: THE WORLD'S FIRST LAUNCH SERVICES COMPANY

Arianespace was founded in 1980 as the world's first launch Services & Solutions company. Arianespace now has 18 shareholders from 10 European countries including Airbus Safran Launchers (74% share) participating in the production of Ariane and Vega launchers. Since the outset, Arianespace has signed over 530 launch contracts and launched 540-plus satellites. More than half of the commercial satellites now in service around the globe were launched by Arianespace. The company posted sales of approximately 1.4 billion euros in 2015.

The company's activities are worldwide with the headquarters in Evry (near Paris); the Guiana Space Center in French Guiana, where the Ariane, Soyuz and Vega launch pads are located; and offices in Washington, D.C., Tokyo and Singapore. Arianespace offers launch services to satellite operators from around the world, including private companies and government agencies. These services call on three launch vehicles:

> The Ariane 5 heavy-lift launcher, operated from the Guiana Space Center in French Guiana.

> The Soyuz medium-lift launcher, currently in operation at the Guiana Space Center and the Baikonur Cosmodrome in Kazakhstan.

> The Vega light-lift launcher, also operated from the Guiana Space Center.

Building on its complete family of launchers, Arianespace has won over half of the commercial launch contracts up for bid worldwide in the past two years. Arianespace now has a backlog of more than 70 satellites to be launched.

THE GUIANA SPACE CENTER: EUROPE'S SPACEPORT

For more than 40 years, the Guiana Space Center (CSG), Europe's Spaceport in French Guiana, has offered a complete array of facilities for rocket launches. It primarily comprises the following:

> The CNES/CSG technical center, including various resources and facilities that are critical to launch base operations, such as radars, telecom network, weather station, receiving sites for launcher telemetry, etc.

> Payload processing facilities (ECPU), in particular the S5 facility.

> Ariane, Soyuz and Vega launch complexes, comprising the launch zones and launcher integration buildings.

> Various industrial facilities, including those operated by Regulus, Europropulsion, Air Liquide Spatial Guyane and Airbus Safran Launchers - all involved in the production of Ariane 5 components. A total of 40 European manufacturers and local companies are involved in the launcher operations.

Europe's commitment to independent access to space is based on actions by three key players: the European Space Agency (ESA), the French CNES space agency and Arianespace. ESA is responsible for the Ariane, Soyuz and Vega development programs. Once these launch systems are qualified, ESA transfers responsibility to Arianespace as the operator. 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 the CNES/CSG fixed expenses, and also helps finance the fixed costs for the ELA launch complexes.

The French CNES space agency has several main responsibilities at the Guiana Space Center. It designs all infrastructure and, on behalf of the French government, is responsible for safety and security. It provides the resources needed to prepare the satellites and launchers for missions. Whether during tests or actual launches, CNES is also responsible for overall coordination of operations and it collects and processes all data transmitted from the launcher via a network of receiving stations to track Ariane, Soyuz and Vega rockets throughout their trajectories.

ARIANESPACE IN FRENCH GUIANA

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

For Soyuz, Arianespace supervises the launcher's integration and functional checks in the MIK facility, carried out by RKTs-Progress for the three lower stages, and by NPO-Lavochkin for the Fregat upper stage. It also coordinates Fregat propellant loading operations in the Fregat Fueling Facility (FCube), and satellite preparations in the EPCU payload preparation facility operated by CNES/CSG. Arianespace then integrates the satellite(s) on the Fregat stage in the S3B building, transfers the launcher and upper composite to the Soyuz launch zone and, along with the Russian entities in charge of the launcher, conducts the final countdown and liftoff operations from the Soyuz Launch Center (CDLS). Arianespace deploys a top-flight team and technical facilities to prepare launchers and satellites for their missions.

Building on this unrivalled expertise and outstanding local facilities, Arianespace is now the undisputed benchmark in the global launch services market.