arianespace
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LAUNCH KIT

June 2019

VA248

T-16

EUTELSAT 7C

esa

AT&T

eutelsat

cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

FLIGHT VA248: ARIANESPACE WILL ORBIT T-16 AND EUTELSAT 7C FOR TWO WORLD-CLASS SATELLITE OPERATORS

With its fifth launch of 2019, and the second this year using an Ariane 5 vehicle, Arianespace will serve two world-class satellite operators by orbiting T-16 for AT&T (DirecTV) and EUTELSAT 7C for Eutelsat. Both spacecraft will be deployed to Geostationary Transfer Orbit (GTO).

In performing this 104th Ariane 5 mission - the 71st with an Ariane 5 ECA version - Arianespace confirms its full capability in the geostationary launch services market segment.

CONTENTS

T-16

T-16 is the 11th satellite to be orbited by Arianespace for AT&T (DirecTV), following SKY Mexico-1 and DIRECTV 15, launched together on an Ariane 5 in May 2015; and SKY Brasil-1, launched in February 2017.

T-16 was manufactured by Airbus Defence and Space and will provide high-power broadcast services in Ku- and Ka-bands. Being flexible, the spacecraft can be operated from five orbital slots (from 99° West to 119° West) and will cover the continental United States, Alaska, Hawaii and Puerto Rico. T-16 is designed for a lifetime of 15 years.

Airbus Defence and Space France is prime contractor for T-16, which will be the 130th spacecraft from this constructor to be launched by Arianespace.

There currently are 21 Airbus satellites in Arianespace's backlog.

EUTELSAT 7C

EUTELSAT 7C will be Eutelsat's 33rd satellite to be launched by Arianespace since the first mission at its service, which deployed EUTELSAT-1 F1 in 1983.

Eutelsat Communications is established in Paris, with offices and teleports around the globe. Eutelsat provides capacity on nearly 40 satellites to clients that include broadcasters and broadcasting associations, pay-TV operators, video, data and internet service providers, enterprises and government agencies.

EUTELSAT 7C is a high-power broadcast satellite for markets in Africa, Europe, the Middle East and Turkey. It is equipped with 49 36-Mhz equivalent Ku-band transponders and will be located at Eutelsat's 7° East position, one of the operator's fastest-growing video neighbourhoods, which already broadcasts over 500 TV channels, and serves anchor clients across the region.

By significantly increasing capacity over Sub-Saharan Africa, EUTELSAT 7C will make room for several hundred additional digital channels to support the region's rapidly-expanding TV market.

More than half of Eutelsat's satellites have been orbited by Arianespace.
Arianespace has seven other Eutelsat satellites in its order book for future launches.

EUTELSAT 7C was built by Maxar Technologies in Palo Alto, California. Maxar is a leading provider of innovative spacecraft systems with deep experience in building and integrating some of the world's most powerful and comprehensive spacecraft.

EUTELSAT 7C will be the 66th satellite based on a Maxar's platform to be launched by Arianespace. It will also be the 56th based on Maxar's 1300 class platform to be launched by Arianespace.

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MISSION DESCRIPTION

Arianespace's second Ariane 5 ECA launch of 2019 will place its two satellite passengers into geostationary transfer orbit.
The launcher will be carrying a total payload of approximately 10,594 kg.

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

DATE AND TIME

Liftoff is planned on **Thursday, June 20, 2019** as early as possible within the following launch window:

- **Between 2:43 p.m. and 4:30 p.m.** El Segundo, California, USA time
- **Between 5:43 p.m. and 7:30 p.m.** Washington, D.C., USA time
- **Between 6:43 p.m. and 8:30 p.m.** Kourou, French Guiana time
- **Between 21:43 and 23:30** Universal Time (UTC)
- **Between 11:43 p.m. and 1:30 a.m.** Paris, France time during the night of June 20 to 21

MISSION DURATION

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

33 minutes, 59 seconds.

TARGETED GEOSTATIONARY ORBIT

Perigee altitude
250 km.

Apogee altitude
35,756 km.

Inclination
6.0 degrees

THE LAUNCH AT A GLANCE

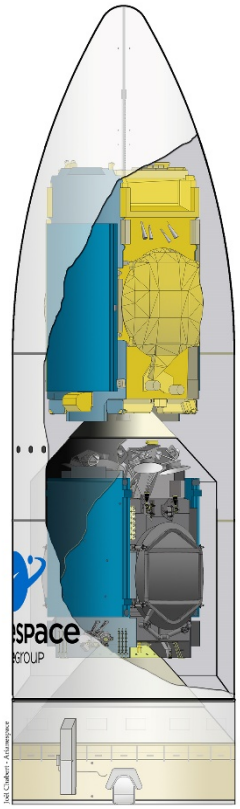
The launcher's attitude and trajectory are controlled by the two onboard computers located in the Ariane 5 vehicle equipment bay (VEB).

About seven seconds after start of the 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 12.4 seconds, then rotates towards the East. It maintains an attitude that ensures the axis of the launcher remains parallel to its velocity vector to minimize aerodynamic loads throughout the entire atmospheric phase until the solid boosters are jettisoned.

The fairing protecting the payload is jettisoned at T+202.3 seconds.

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.

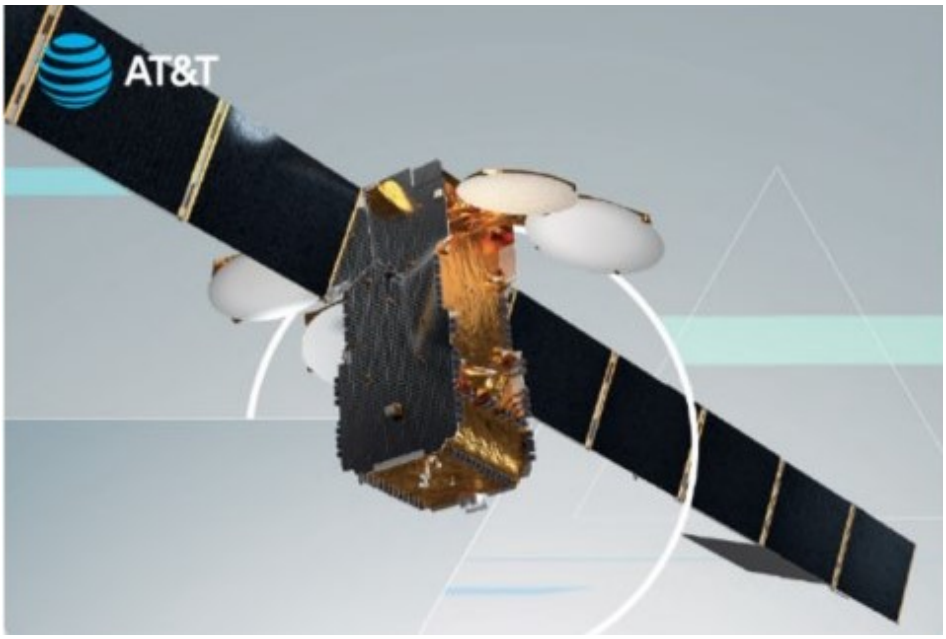
The main stage splashes down off the coast of Africa in the Atlantic Ocean (in the Gulf of Guinea).



PAYLOAD CONFIGURATION

- **Upper payload (CUH): T-16**
  Mass at liftoff: 6,330 kg.
- **Lower payload (CUB): EUTELSAT 7C**
  Mass at liftoff: 3,400 kg.
- **Long version of the payload fairing**
- **SYLDA (SYstème de Lancement Double Ariane)**

T-16 satellite



CUSTOMERS	**AT&T**
MANUFACTURER	Airbus Defence and Space
MISSIONS	High-power broadcast satellite
MASS AT LAUNCH	6,330 kg.
PLATFORM	Eurostar 3000 LX Hybrid
ORBITAL POSITION	Five different orbital slots (from 99.2°W to 119°W)
PROPULSION	Hybrid (chemical propulsion for orbit raising; electrical propulsion for station-keeping)
PAYLOAD	Ku- and Ka-band transponders and reverse bands
COVERAGE AREA	Continental United States, Alaska, Hawaii and Puerto Rico
DESIGN LIFE	15 years

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EUTELSAT 7C satellite

CUSTOMER	**Eutelsat**
MANUFACTURER	Maxar Technologies
MISSION	Telecommunications
MASS AT LAUNCH	3,400 kg.
ORBITAL POSITION	7° East
PLATFORM	1300 -140” All-Electric
STABILIZATION	3 axis
PROPULSION	All-electric (Xenon)
PAYLOAD	Ku-band transponders
DESIGN LIFE	More than 15 years
COVERAGE AREA	Africa, Europe, Middle East and Turkey

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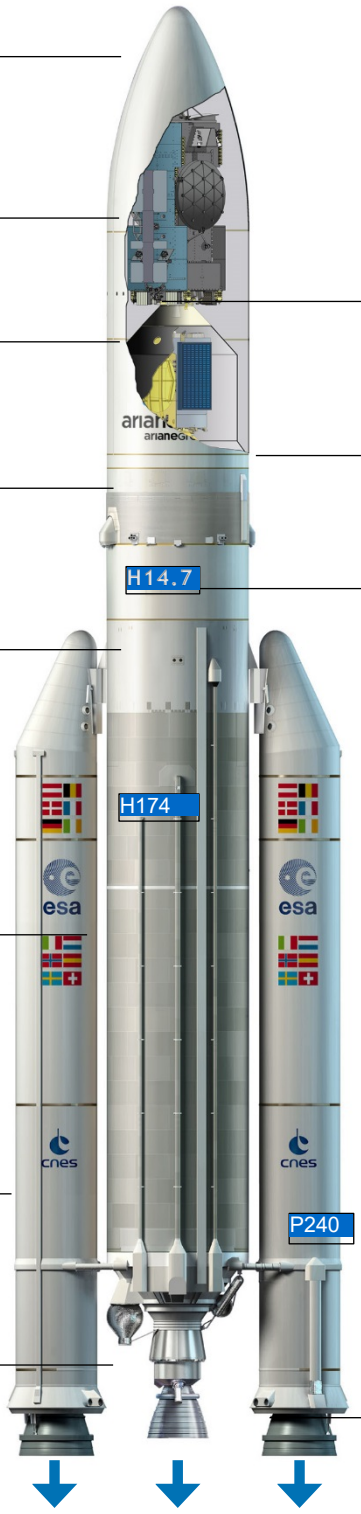
ARIANE 5 ECA LAUNCH VEHICLE

The launcher is delivered to Arianespace by ArianeGroup as production prime contractor.

51.03 m.



Fairing

(RUAG Schweiz AG): 17 m.
Mass: 2.4 t.

T-16

Mass: 6,330 kg.

EUTELSAT 7C

Eutelsat
Mass: 3,400 kg.

Vehicle Equipment Bay

Height: 1.13 m.
Mass: 970 kg.

HM-7B engine

Thrust: 67 kN (in vacuum)
945 sec. of propulsion

EPC - Cryogenic main stage

Height: 31 m.
Mass: 188 t.

EAP - Solid rocket boosters

Height: 31.6 m.
Mass: 277 t. approx.

Vulcain 2 engine

Thrust: 1,410 kN (in vacuum)
540 sec. of propulsion

780 metric tons
(total mass at liftoff)

PA - Payload adaptor (2)

(*Airbus Defence and Space - SAU*)
(RUAG Space AB)
Mass: approx. 220 kg.

SYLDA - Internal structure

Mass: 440 kg.

ESC-A - Cryogenic upper stage

Height: 4.71 m.
Mass: 19 t.

Propellants (in metric tons) at T-O
H: Cryogenic
P: Solid

MPS - Solid Rocket Motor (SRM)

Average thrust: 5,060 kN
Maximum thrust: 7,080 kN (in vacuum)
130 sec. of propulsion

13,000 kN at liftoff
(at T+7.3 sec.)

LAUNCH CAMPAIGN - ARIANE 5
T-16
EUTELSAT 7C

SATELLITE AND LAUNCH VEHICLE CAMPAIGN CALENDAR

DATE	SATELLITES ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
April 23 to 24, 2019		Campaign start review EPC unpacking and erection
April 24 to 25, 2019		EAP 1 & 2 transfer to the BIL (Launcher Integration Building)
April 26 to May 3, 2019		EPC/EAP integration
May 14, 2019	Arrival of T-16 in French Guiana and transfer by road to the Spaceport's S5C payload preparation facility	
May 15, 2019		Erection of ESC-A and vehicle equipment bay installation
May 29, 2019	Arrival of EUTELSAT 7C in French Guiana and transfer by road to the Spaceport's S5C payload preparation facility	
May 28 to June 3, 2019	T-16-fueling operations	
May 31, 2019		Transfer from BIL to BAF (Final Integration Building)
June 5, 2019	T-16-integration on payload adaptor	
June 6, 2019	T-16 transfer to the BAF	
June 7, 2019	T-16 integration on SYLDA	

SATELLITE AND LAUNCH VEHICLE CAMPAIGN FINAL CALENDAR

DATE	SATELLITES ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
Friday, June 7, 2019	EUTELSAT 7C integration on payload adaptor,	
Saturday, June 8, 2019	Payload fairing encapsulation on SYLDA (with T-16 inside) EUTELSAT 7C transfer to the BAF	HM7B pre-lubrification
Tuesday, June 11, 2019	EUTELSAT 7C integration on launch vehicle and final preparation before fairing encapsulation	HM7B engine final inspection
Wednesday, June 12, 2019	Composite (T-16 under fairing) integration on launch vehicle	
Thursday, June 13, 2019		Finalization of the composite/launcher integration
Friday, June 14, 2019		Dress rehearsal
Monday, June 17, 2019		Arming of launch vehicle
Tuesday, June 18, 2019		Launch readiness review (LRR), final preparation of launcher and BAF for chronology
Wednesday, June 19, 2019		Roll-out from BAF to the launch pad, launch vehicle connections and filling of the EPC liquid helium tank
Thursday, June 20, 2019		Start of launch countdown, EPC and ESC-A filling with liquid oxygen and liquid hydrogen

COUNTDOWN AND FLIGHT SEQUENCE

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

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

If an interruption in the countdown results in the T-0 moving 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	EVENT
- 11 h 23 min	Start of final countdown
- 10 h 33 min	Check of electrical systems
- 04 h 38 min	Start of filling of EPC with liquid oxygen and liquid hydrogen
- 03 h 28 min	Start of filling of ESC-A with liquid oxygen and liquid hydrogen
- 03 h 18 min	Chilldown of Vulcain main stage engine
- 01 h 15 min	Check of connections between launcher and the telemetry, tracking and command systems
- 7 min	“All systems go” report, allowing start of synchronized sequence
- 4 min	Tanks pressurized for flight
-1 min	Switch to onboard power mode
- 05 s	Opening command for the cryogenic arms
- 04 s	Onboard systems take over

T-0	Reference time
+ 01 s	Ignition of the cryogenic main stage (EPC)
+ 07.05 s	Ignition of solid boosters (EAP)
+ 07.03 s	Liftoff
+ 12.41 s	End of vertical climb, beginning of pitch motion
+ 17.05 s	Beginning of roll maneuver
+ 32.05 s	End of roll maneuver
+ 2 min 21 s	EAP separation
+ 3 min 22 s	Fairing jettisoned
+ 7 min 33 s	Acquisition by Natal tracking station
+ 8 min 39 s	End of EPC thrust phase
+ 8 min 45 s	EPC separation
+ 8 min 49 s	Ignition of ESC-A stage
+ 13 min 14 s	Acquisition by Ascension tracking station
+ 18 min 04 s	Acquisition by Libreville tracking station
+ 23 min 04 s	Acquisition by Malindi tracking station
+ 25 min 02 s	Extinction of ESC-A stage
+ 25 min 04 s	Injection
+ 27 min 43 s	**T-16 satellite separation**
+ 29 min 23 s	SYLDA separation
+ 33 min 59 s	**EUTELSAT 7C satellite separation**

ARIANE 5 ECA MISSION PROFILE

The launcher's attitude and trajectory are entirely controlled by the two onboard computers in the Ariane 5 Vehicle Equipment Bay (VEB).

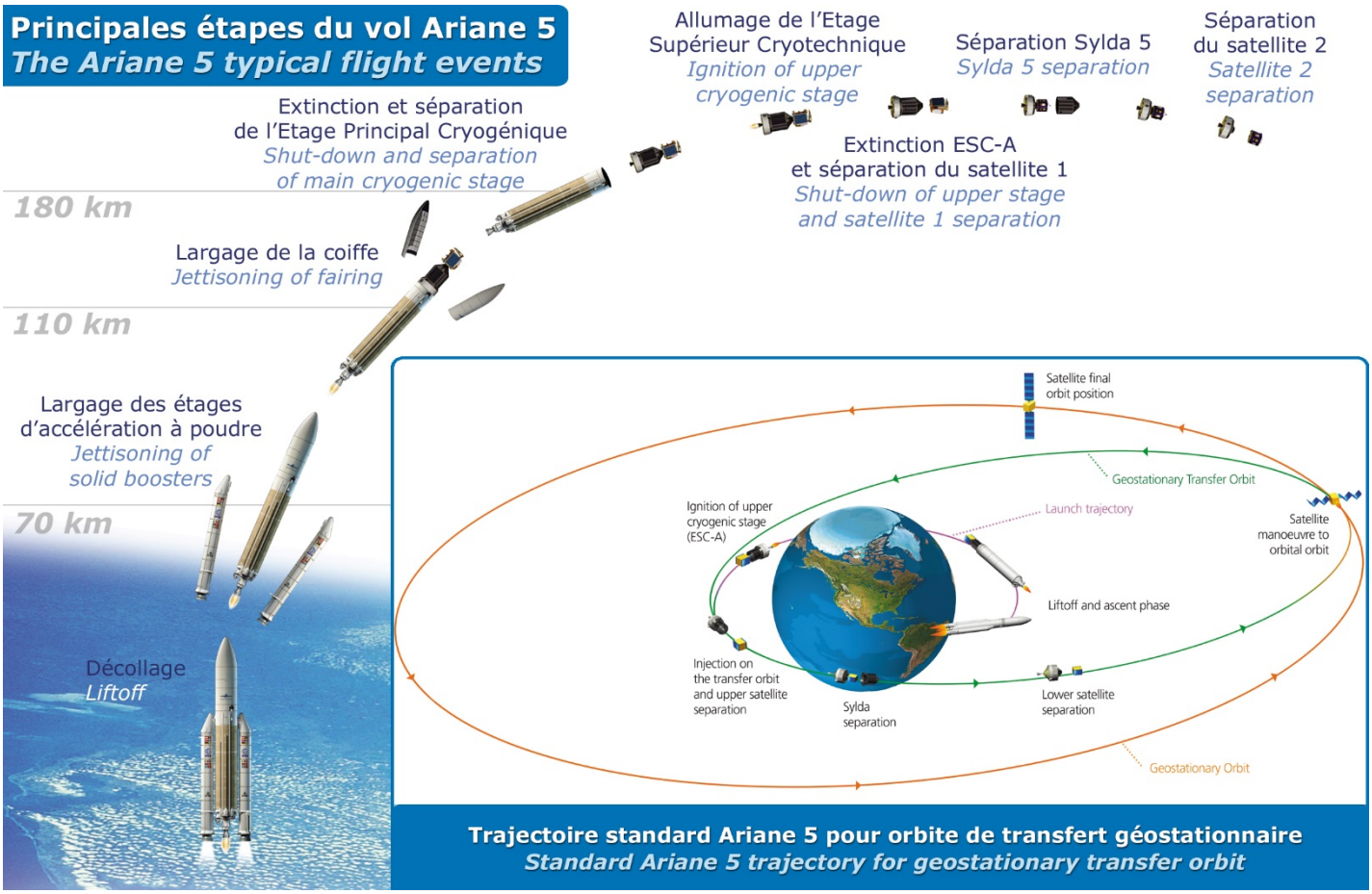
The synchronized sequence starts seven minutes before ignition (T-0). It is primarily designed to perform the final operations on the launcher prior to launch, along with the ultimate checks needed following switchover to flight configuration. As its name indicates, the sequence is fully automatic, and 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, they handle the final ground system configurations, namely:

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

At T-4 seconds, the onboard computer takes over control of final engine startup and liftoff operations. It:

- Starts the ignition sequence for the Vulcain main stage engine (T-0).
- Checks engine operation (from T+4.5 to T+6.9 sec).
- Commands ignition for the solid boosters at T+7.05 sec for liftoff at T+7.3 seconds.

Any shutdown of the synchronized sequence after T-7 minutes automatically places the launcher back in its T-7-minute configuration.



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 is a subsidiary of ArianeGroup, which holds 74% of its share capital; the balance is held by 15 other shareholders from the European launcher industry.

Since the outset, Arianespace has signed over 580 launch contracts and launched more than 600 satellites. More than half of the commercial satellites now in service around the globe were launched by Arianespace. The company posted sales of approximately 1.3 billion euros in 2018.

The company's activities are worldwide, with the headquarters in Evry, France (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 currently has a backlog of more than 710 satellites to be launched.

THE GUIANA SPACE CENTER: EUROPE'S SPACEPORT

For more than 50 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 ArianeGroup – all participate 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 France's space program, the Guiana Space Center has evolved into 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.

Arianespace supervises the integration and checks of the Ariane launcher – which is built under ArianeGroup responsibility as the production prime contractor; coordinates the satellite preparations that are performed in parallel inside the Payload Preparation Complex (EPCU) [which is operated by the Guiana Space Center - CNES/CSG], followed by the payload's integration on the launcher in the Final Assembly Building (BAF); and also works with ArianeGroup teams in charge of the launcher to conduct the final countdown and launch from Launch Control Center no. 3 (CDL3).

Arianespace deploys a top-flight team and technical facilities to ensure the launchers and their satellite payloads are 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.