



LAUNCH KIT

January 2018

# VA241

SES-14

Al Yah 3





**VA241**

**SES-14  
Al Yah 3**



# ARIANESPACE TO LAUNCH SES-14 AND AL YAH 3 FOR SES AND YAHSAT TO SERVE THEIR AMBITIOUS GOALS

For its first launch of 2018, Arianespace will use an Ariane 5 from the Guiana Space Center (CSG) in French Guiana to launch the SES-14 and Al Yah 3 satellites for operators SES and Yahsat (Al Yah Satellite Communications Company).

With this 295th mission of its launcher family – the 241st utilizing an Ariane launcher – Arianespace serves the ambitions of leading satellite operators, both globally and regionally.

## SES-14

SES-14 will be the 53rd satellite launched by Arianespace for the operator SES (Société Européenne de Satellites), reaching back to Spacenet 1, orbited in May 1984.

SES, a leading global satellite operator, is the first company to operate a scalable GEO-MEO fleet with over 50 satellites in geostationary orbit (GEO) and 12 in medium Earth orbit (MEO). SES provides satellite communications services to broadcasters, content and Internet service providers, operators of fixed and mobile networks, governments and institutions and businesses from around the world.

The SES fleet also includes the ASTRA and O3b satellite systems.

SES-14 is one of the company's three hybrid satellites, combining wide beams and high throughput (HTS) spot beams. Its hybrid payload offers both C- and Ku-band wide beams, plus Ku- and Ka-band HTS capacity.

Positioned at 47.5° West, SES-14 will fulfill two primary missions: its C-band wide beams are specifically designed for SES's expanding cable neighborhood in Latin America, while its Ku-band HTS spot beams will provide expansion capacity to serve the dynamic aeronautical and maritime markets and other traffic-intensive applications, such as cellular backhaul or broadband delivery services.

The Ku-band wide beams on SES-14 will augment SES's ability to serve direct-to-home customers and provide connectivity in the Americas and the North Atlantic. The satellite will provide replacement and expansion capacity for NSS-806.

SES-14 will feature a digital transparent processor (DTP) that will provide more flexibility to route the spot beams and also offer customized connectivity solutions that best fit customers' needs. The satellite is equipped with an electric propulsion system for orbital maneuvers and orbit raising duties.

SES-14 also carries the Global-Scale Observations of the Limb and Disk (GOLD), a hosted payload for NASA, whose goal is to improve the understanding of the thermosphere-ionosphere. GOLD will transmit data from a geostationary orbit at a fast pace, to build up a full-disk view every half hour, providing detailed large-scale measurements of the response of the upper atmosphere to forcing from the Sun, the magnetosphere, and the lower atmosphere.

Arianespace currently has nine more SES satellites in its order book: SES-17, four O3b 13 - 16 satellites and four O3b 17-20 satellites.

SES-14 was built by Airbus Defence and Space in its plant in Toulouse, France, using the E3000 EOR platform. It is the 119th satellite from this manufacturer to be launched by Arianespace, and also is the second based on the Eurostar E3000 EOR platform.

Twenty other Airbus-built satellites are in Arianespace's order book. Furthermore, Airbus is a partner in the construction of the 650 satellites in the OneWeb constellation, to be deployed by Arianespace.

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### Al Yah 3

Al Yah 3 will be the second satellite launched by Arianespace for the United Arab Emirates operator Yahsat (Al Yah Satellite Communications Company), following Al Yah 1, launched in 2011.

Yahsat is a leading global satellite operator, providing multipurpose satellite solutions (broadband, broadcast, government and communication use) across the Middle East, Africa, Europe and Central and Southwest Asia. Headquartered in the United Arab Emirates at Abu Dhabi, it is wholly-owned by the Mubadala Investment Company, the Abu Dhabi government's investment vehicle.

Yahsat is the first company in the Middle East and Africa to offer Ka-band services – including YahClick, Yahsat Government Solutions, YahLink and Yahlive – via its Al Yah 1 and Al Yah 2 satellites.

With the launch of Al Yah 3, Yahsat's commercial Ka-band coverage will be extended to an additional 20 markets, reaching 60% of Africa's population and over 95% of Brazil's population. Al Yah 3 will be positioned at 20° West Longitude.

The Al Yah 3 satellite carries 53 active Ka-band user beams and four gateway beams, and produces approximately 8.0 kilowatts of payload electrical power. The Ka-band spot beams provide two-way communications services to facilitate high-speed delivery of data to end-user applications such as broadband Internet and corporate networking as well as IP backhaul for telecommunications service providers.

Al Yah 3 is designed to ensure high throughput and high availability for all target segments – including consumers – with small, cost-efficient terminals.

Al Yah 3 was built by Orbital ATK using its new GEOSTAR-3 hybrid platform, the first application of this platform.

It is the 27th Orbital ATK satellite to be launched by Arianespace, a series that started with the TOPEX-Poseidon mission in 1992.

Arianespace's order book includes three other Orbital ATK satellites.



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## MISSION DESCRIPTION

Arianespace's first Ariane 5 ECA launch of the year will place both of its satellite passengers into geostationary transfer orbit.

The launcher will be carrying a total payload of approximately 9,123 kg.

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

### DATE AND TIME



Liftoff is planned on **Thursday, January 25, 2018** as early as possible within the following launch window:

- > Between 5:20 p.m. and 6:05 p.m., Washington, D.C. time
- > Between 7:20 p.m. and 8:05 p.m., in Kourou, French Guiana
- > Between 22:20. and 23:05., Universal Time (UTC)
- > Between 11:20 p.m. and 00:05 a.m., Paris time during the night of January 25 to 26
- > Between 2:20 a.m. and 3:05 a.m., Abu Dhabi time on January 26

### MISSION DURATION



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

**35 minutes, 07 seconds.**

### TARGETED ORBIT



Perigee altitude  
**250 km.**



Apogee altitude  
**45,000 km.**



Inclination  
**3 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 13 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.

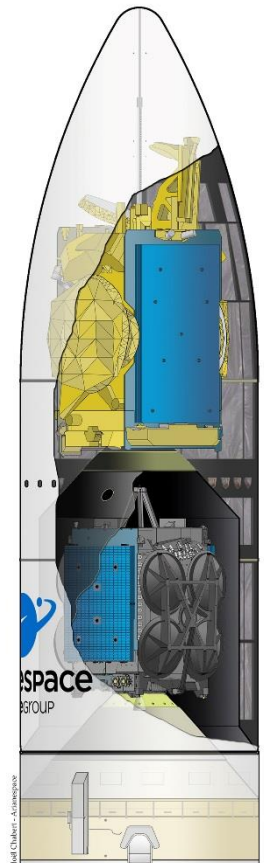
The fairing protecting the payload is jettisoned at T+198 seconds.

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). At orbital injection, the launcher will have attained a velocity of approximately 9,498 meters/second, and will be at an altitude of 639 kilometers.

### PAYLOAD CONFIGURATION

- > **Upper payload (CUH): SES-14**  
Mass at liftoff: 4,423 kg.
- > **Lower payload (CUB): Al Yah 3**  
Mass at liftoff: 3,795 kg.
- > Long version of the payload fairing
- > **SYLDA (SYstème de Lancement Double Ariane)**



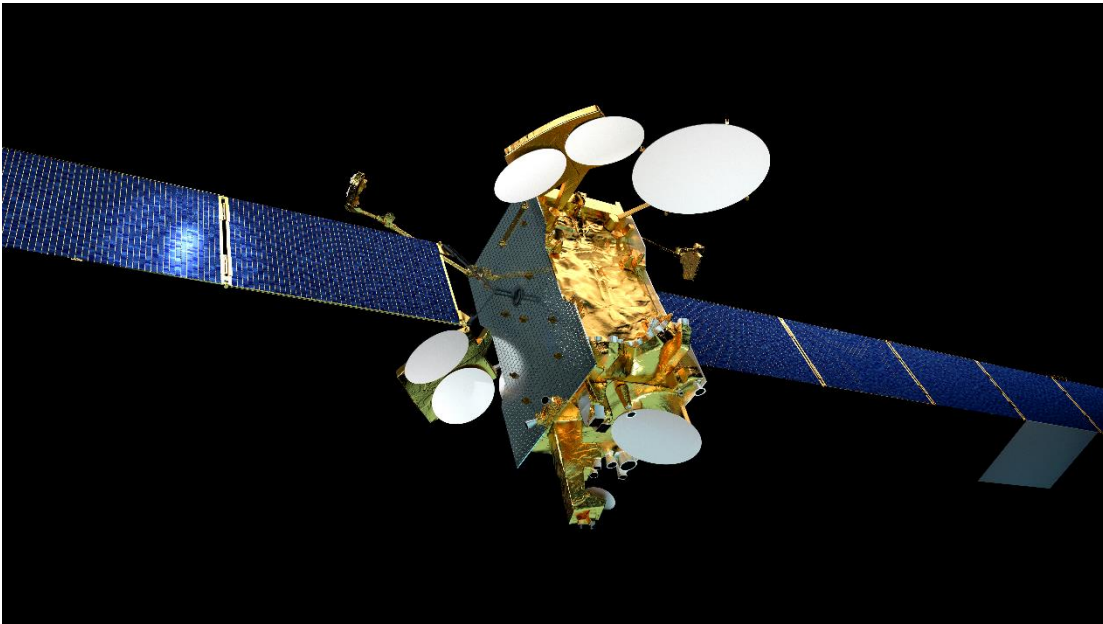


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## SES-14 SATELLITE



<b>CUSTOMER</b>	<b>SES</b>
<b>PRIME CONTRACTOR</b>	Airbus Defence and Space
<b>MISSION</b>	DTH (Direct to Home) and cable broadcasting services, aeronautical and maritime connectivity, broadband internet and cellular backhaul services. SES-14 hosts a NASA-funded payload, GOLD (Global-Scale Observation of the Limb and Disk).
<b>MASS AT LAUNCH</b>	4,423 kg.
<b>STABILIZATION</b>	3 axis
<b>DIMENSIONS</b>	7 m x 5.4 m x 2.7 m
<b>PLATFORM</b>	Eurostar E3000 EOR
<b>PAYLOAD</b>	C- and Ku-band wide beams, HTS (high throughput Satellites) spot beams capacity in Ku-band.
<b>ONBOARD POWER</b>	16 kW (end of life)
<b>DESIGN LIFE</b>	More than 15 years
<b>ORBITAL POSITION</b>	47.5° West
<b>COVERAGE AREA</b>	Latin America, North America, The Caribbean, North Atlantic, Western Europe and The Mediterranean

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## Al Yah 3 SATELLITE



<b>CUSTOMER</b>	Yahsat
<b>PRIME CONTRACTOR</b>	Orbital ATK
<b>MISSION</b>	Broadband and connectivity services, Fixed satellites Services (FSS) communications
<b>MASS</b>	3,795 kg. at liftoff
<b>STABILIZATION</b>	3 axis
<b>DIMENSIONS</b>	5.18 m x 3.35 m x 2.87 m
<b>PLATFORM</b>	GEOSTar™-3
<b>PAYLOAD</b>	Ka-band High-Throughput Satellite (HTS) with 53 Operational User Beams and 4 Operational Gateway Beams
<b>ONBOARD POWER</b>	8.0 kW (end of life)
<b>DESIGN LIFE</b>	15 years
<b>ORBITAL POSITION</b>	20° West Longitude
<b>COVERAGE AREA</b>	Brazil and Africa

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# ARIANE 5 ECA LAUNCH VEHICLE

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

54.8 m

### Fairing

(RUAG Space): 17 m.  
Mass: 2.4 t.

**780 tons**  
(total mass at liftoff)

### SES-14

(SES)  
Mass: 4,423 kg.

### PA - Payload adaptor (2)

(RUAG Space or Airbus)  
Mass: approx. 140 kg. each

### Al Yah 3

(Yahsat)  
Mass: 3,795 kg.

### SYLDA - Internal structure

7 versions (Height: 4.9 to 6.4 m)  
Mass: 400 to 530 kg.

### Vehicle Equipment Bay

Height: 1.13 m.  
Mass: 970 kg.

### ESC-A - Cryogenic upper stage

Height: 4.71 m.  
Mass: 19 t.

### HM-7B engine

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

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

### EPC - Cryogenic main stage

Height: 31 m.  
Mass: 188 t.

### EAP - Solid rocket boosters

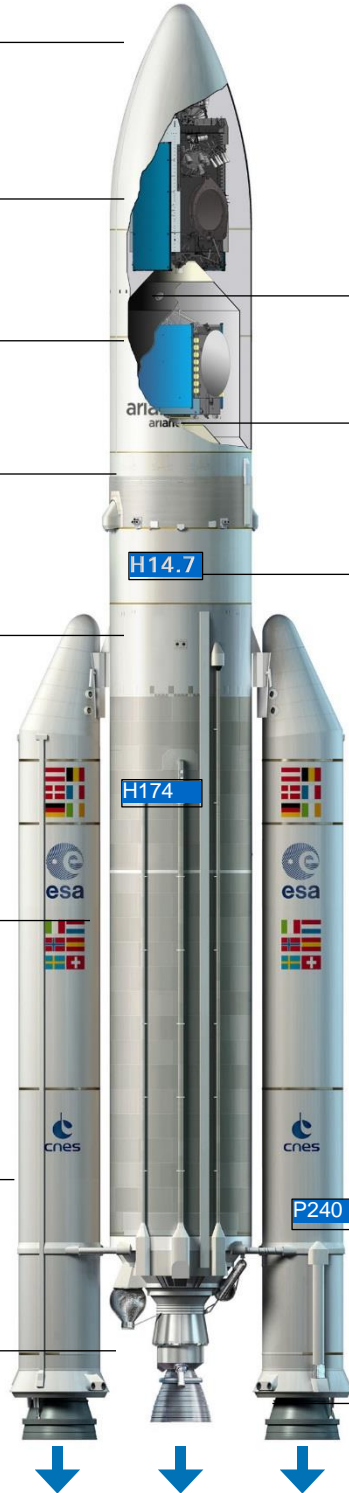
Height: 31.6 m.  
Mass: 277 t. approx.

### Vulcain 2 engine

Thrust: 1,390 kN (in vacuum)  
540 sec. of propulsion

### 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.)

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# LAUNCH CAMPAIGN - ARIANE 5

## SES-14 – Al Yah 3

### SATELLITE AND LAUNCH VEHICLE CAMPAIGN CALENDAR

DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
November 27, 2017		Campaign start review EPC unpacking - EAP 2 transfer- EPC erection
November 28, 2017		EAP1 transfer - EPC/EAP integration
November 29, 2017	Arrival in French Guiana of Al Yah 3 and transportation to the S5C	
December 1, 2017		Erection of ESC-A and vehicle equipment bay installation
December 13 to 15, 2017	Al Yah 3 fueling operations	
December 22, 2017	Arrival in French Guiana of SES-14 and transportation to the S5C	
January 8, 2018		Transfer from BIL-BAF
January 3 to 5, 2018	SES-14 fueling operations	
January 10, 2018	SES-14 integration on payload adaptor	
January 11, 2018	SES-14 transfer to the Final Assembly Building (BAF)	
January 12, 2017	Al Yah 3 integration on payload adaptor SES-14 integration on SYLDA	

### SATELLITE AND LAUNCH VEHICLE CAMPAIGN FINAL CALENDAR

DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
Monday, January 15, 2018	Al Yah 3 transfer to the Final Assembly Building (BAF) SES-14 encapsulation in the payload fairing	
Tuesday, January 16, 2018	Al Yah 3 integration on launch vehicle	HM7B engine final inspection
Wednesday, January 17, 2018	Completion of composite integration on launcher and payload checks	
Thursday, January 18, 2018		Finalization of the composite/launcher integration, and payload checks
Friday, January 19, 2018		Launch rehearsal
Monday, January 22, 2018		Arming of launch vehicle
Tuesday, January 23, 2018		Launch readiness review (LRR), final preparation of launcher and BAF for the chronology
Wednesday, January 24, 2018		Rollout from BAF to Launch Zone, launch vehicle connections and filling of the EPC liquid helium tank
Thursday, January 25, 2018		Start of launch countdown, EPC and ESC-A filling with liquid oxygen and liquid hydrogen





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## COUNTDOWN AND FLIGHT SEQUENCE

The countdown comprises all final preparation steps for the launcher, the satellites/spacecraft and the launch site. 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 means that T-0 shifts outside of 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)
+ 07.3 s	Liftoff
+ 12.4 s	End of vertical climb, beginning of pitch motion
+ 17 s	Beginning of roll maneuver
+ 2 min 19 s	EAP separation
+ 3 min 18 s	Fairing jettisoned
+ 7 min 21 s	Acquisition by Natal tracking station
+ 8 min 51 s	End of EPC thrust phase
+ 8 min 58 s	EPC separation
+ 9 min 01 s	Ignition of ESC-A stage
+ 13 min 36 s	Acquisition by Ascension tracking station
+ 18 min 19 s	Data acquisition by Libreville tracking station
+ 22 min 56 s	Acquisition by Malindi tracking station
+ 24 min 46 s	Injection
+ 27 min 05 s	<b>SES-14 satellite separation</b>
+ 33 min 22 s	SYLDA separation
+ 35 min 07 s	<b>Al Yah 3 satellite separation</b>



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# 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:

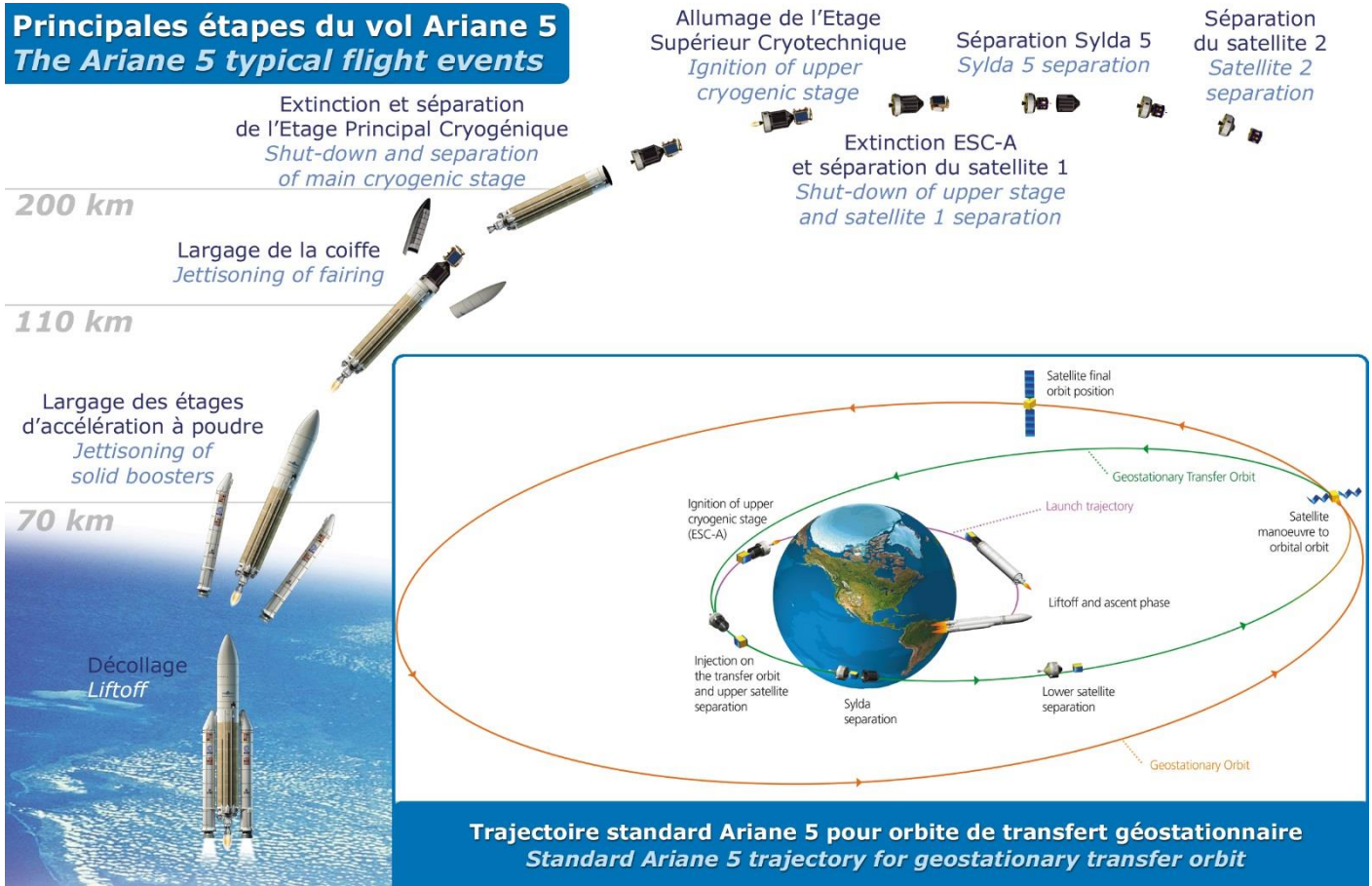
- > Startup of water injection in the flame trenches and exhaust guide (T-30 sec).
- > Hydrogen aspiration for chilldown of the Vulcain engine in the exhaust guide (T-18 sec).
- > Burn-off of hydrogen used for chilldown (T-5.5 sec).

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.

## Principales étapes du vol Ariane 5 The Ariane 5 typical flight events



Trajectoire standard Ariane 5 pour orbite de transfert géostationnaire  
Standard Ariane 5 trajectory for geostationary transfer orbit



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## 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 17 other shareholders from the European launcher industry.

Since the outset, Arianespace has signed over 530 launch contracts and launched 550-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 1.3 billion euros in 2017.

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 now has a backlog of more than 700 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 (EPCU), 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.