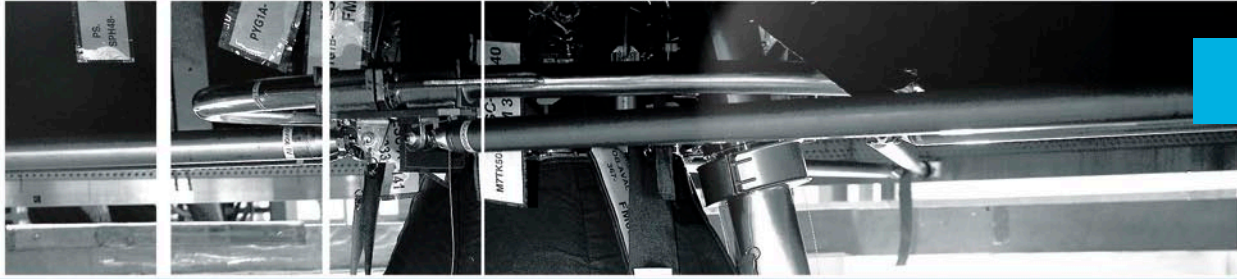


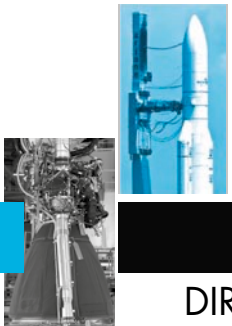
December
2014



VA 221

**DIRECTV-14
GSAT-16**





VA 221

DIRECTV-14 - GSAT-16

NEXT ARIANESPACE MISSION TO ORBIT SATELLITES FOR THE UNITED STATES AND INDIA

On the sixth Ariane 5 launch of the year, Arianespace will orbit two telecommunications satellites: DIRECTV-14, mainly intended for HD and Ultra-HD direct-to-home (DTH) TV broadcasting for the operator DIRECTV, and GSAT-16 for ISRO, the Indian Space Research Organisation.

Arianespace's selection by the world's leading satellite operators and manufacturers is clear international recognition of the company's excellence in launch services. Having launched 60% of the commercial satellites now in orbit, Arianespace continues to set the global launch standard for all players.

DIRECTV-14

The DIRECTV-14 satellite demonstrates DIRECTV's commitment to the latest in satellite technology including the development of a full broadcast payload for Reverse Band DBS spectrum and the leading edge delivery of 4K Ultra HD video services. Designed and built by Space Systems/Loral, DIRECTV 14 is a 20-kilowatt class Ka-band and reverse-band digital broadcast satellite equipped with 16 Ka-band transponders and 18 Reverse DBS transponders. The satellite will provide Ultra HD and other new consumer services and was designed with a very advanced beam-forming network to provide service across the U.S. including Alaska and Hawaii and Puerto Rico. DIRECTV-14 will weigh about 6,300 kg at launch and offers a design life of at least 15 years. It will be the seventh satellite launched by Arianespace for DIRECTV and the 46th satellite built by Space Systems/Loral to be launched by Arianespace.

GSAT-16

GSAT-16 is a multi-band telecommunications satellite designed, assembled and integrated by the Indian Space Research Organisation (ISRO) in Bangalore, southern India. It will weigh about 3,200 kg at launch and offers a design life exceeding 12 years. GSAT-16 is fitted with Ku and C-band transponders. From its orbital position at 55° East, its coverage zone includes the entire Indian sub-continent. GSAT-16 will be the 18th ISRO satellite to be launched by an Ariane rocket. Since the launch of the experimental Apple satellite on Flight L03 in 1981, Arianespace has already lofted 17 Indian satellites.

Arianespace has also launched two other Indian-designed satellites for the operators Eutelsat and Avanti Communications.

Collaboration between Arianespace and the Indian Space Research Organisation has been extended to include technological development aid for launcher operation.



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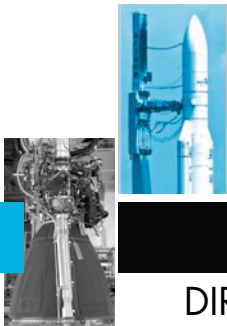


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VA 221

DIRECTV-14 - GSAT-16



MISSION DESCRIPTION

The 221st Arianespace launch will orbit two telecommunications satellites: DIRECTV-14 for the operator DIRECTV and GSAT-16 for ISRO (Indian Space Research Organisation).

This will be the 77th launch of an Ariane 5.

The launcher will be carrying a total payload of 10,210 kg, including 9,480 kg for the DIRECTV-14 and GSAT-16 satellites, which will be released into their targeted orbits.

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

Targeted orbit

- Perigee altitude** : 250 km
- Apogee altitude** : 35,786 km
- Inclination** : 6 degrees

Liftoff is planned on **Thursday, December 4, 2014** as soon as possible within the following launch windows:

- between 05:38 pm and 06:48 pm, Kourou,
- between 03:38 pm and 04:48 pm, Washington DC time,
- between 08:38 pm and 09:48 pm, Universal time (GMT),
- between 09:38 pm and 10:48 pm, Paris time.
- between 02:08 am and 03:18 am, Bangalore time, December 5, 2014.

The launch at a glance

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 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 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 9,320 meters/second, and will be at an altitude of about 694.9 kilometers.

The fairing protecting the DIRECTV-14 and GSAT-16 spacecraft is jettisoned shortly after the boosters are jettisoned at about T+199 seconds.

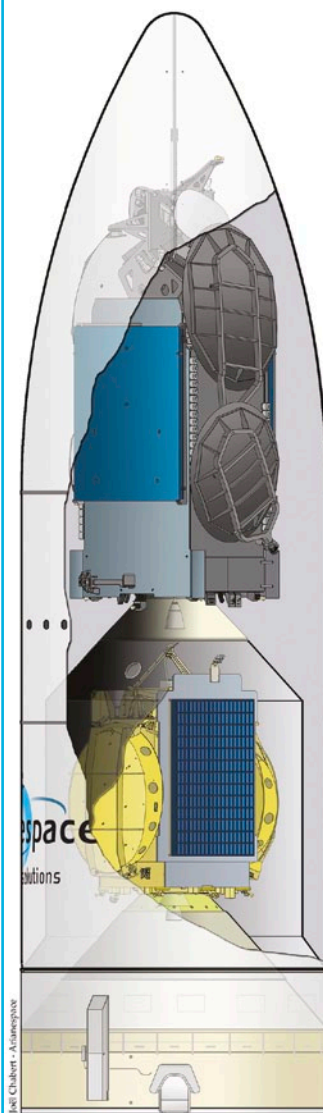
Payload configuration

The DIRECTV-14 satellite was built by Space Systems/Loral in Palo Alto, California (United States) for the operator DIRECTV.

Orbital position: 99° West

The GSAT-16 satellite was built by ISRO (Indian Space Research Organisation) in Bangalore (India) for its own account.

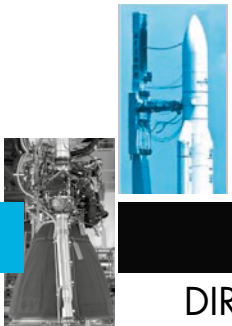
Orbital position: 55° East



Mission length

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

32 minutes and 20 seconds.



VA 221

DIRECTV-14 - GSAT-16



THE DIRECTV-14 SATELLITE



Customer	DIRECTV
Prime contractor	SPACE SYSTEMS/LORAL
Mission	HD and Ultra-HD direct-to-home (DTH) TV broadcasting
Mass	Total mass at lift-off approx. 6,300 kg
Stabilization	3 axis
Dimensions	5.0 x 2.2 x 2.4 m
Span in orbit	32.5 m
Platform	SSL 1300
Payload	76 Ka band spot beam transponders for HD local channels and 18 National Reverse transponders
On-board power	20 kW (end of life)
Life time	15 years
Orbital position	99° West
Coverage area	United States including Alaska, Hawaii and Puerto Rico

PRESS CONTACT:

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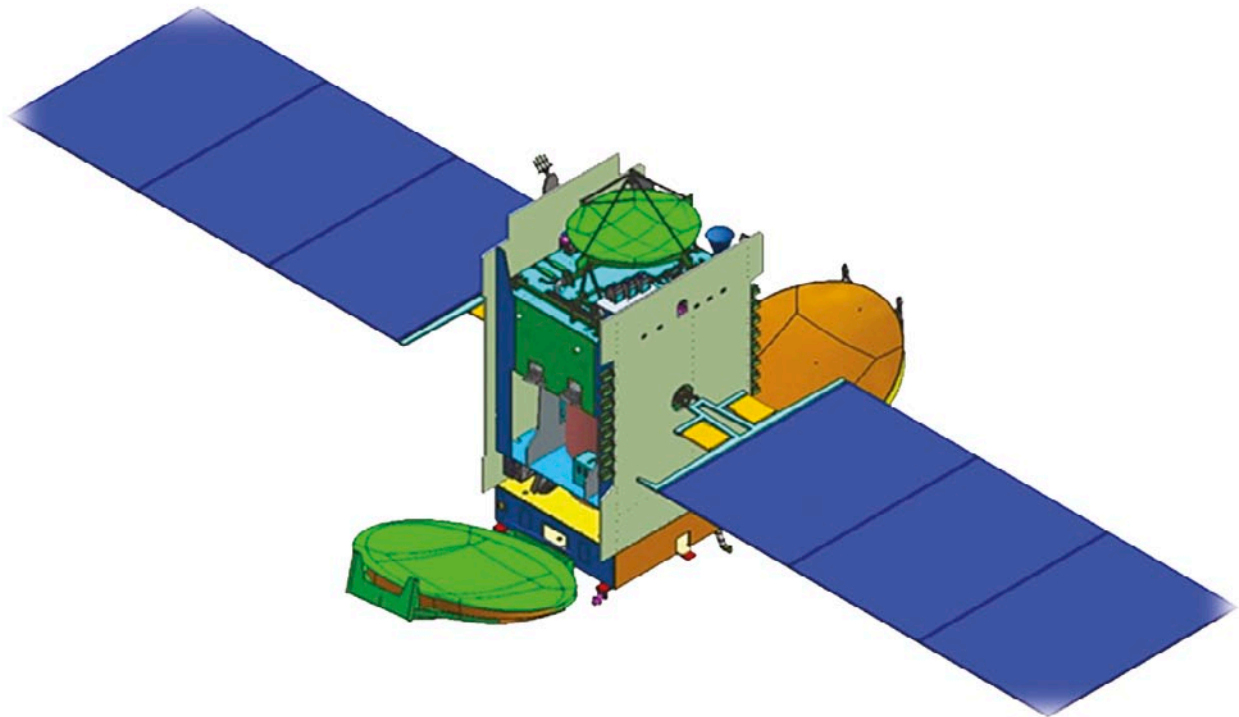


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DIRECTV-14 - GSAT-16



THE GSAT-16 SATELLITE



Customer	ISRO
Prime contractor	ISRO/ISAC
Mission	Telecommunications
Mass	Total mass at lift-off 3,180 kg
Stabilization	3 axis
Dimensions	3.1 m x 1.7 m x 2.0 m
Span in orbit	15.4 m
Platform	I-3K Bus
Payload	12 Ku and 24 C band transponders
On-board power	5.6 kW (end of life)
Life time	12 years
Orbital position	55° East
Coverage area	Indian Subcontinent

PRESS CONTACT:

Deviprasad Karnik

Director, P and PR

ISRO Headquarters

New BEL Road, Bangalore 560 095

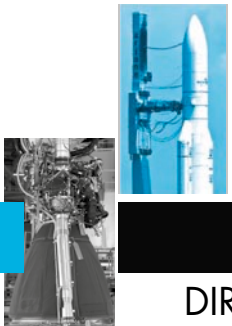
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VA 221

DIRECTV-14 - GSAT-16



ARIANE 5-ECA LAUNCH VEHICLE

54.8 m

Fairing

- (RUAG Space)
- ▼ 17 m
- ▼ Mass: 2.4 t

DIRECTV-14

- (Space Systems/Loral)
- ▼ Mass: 6.3 t

GSAT-16

- (ISRO)
- ▼ Mass: 3.18 t

Vehicle Equipment Bay

- (Airbus Defence and Space)
- ▼ Height: 1.13 m
- ▼ Mass: 970 kg

ESC-A - Cryogenic upper stage

- (Airbus Defence and Space)
- ▼ Height: 4.71 m
- ▼ Mass: 19 t

EPC - Main Cryogenic stage

- (Airbus Defence and Space)
- ▼ Height: 31 m
- ▼ Mass: 188 t

EAP - Solid Rocket Boosters

- (Airbus Defence and Space)
- ▼ Height: 31.6 m
- ▼ Mass: 277 t approx.

Vulcain 2 Engine

- (Snecma)
- ▼ Thrust: 1,390 kN (in the vacuum)
- ▼ 540 sec of propulsion

780 tons

(total mass at liftoff)

ACU - Payload adaptor (2)

- (RUAG Space ou Airbus Defence and Space)
- ▼ Mass: 140 kg each approx.

SYLDA - Internal structure

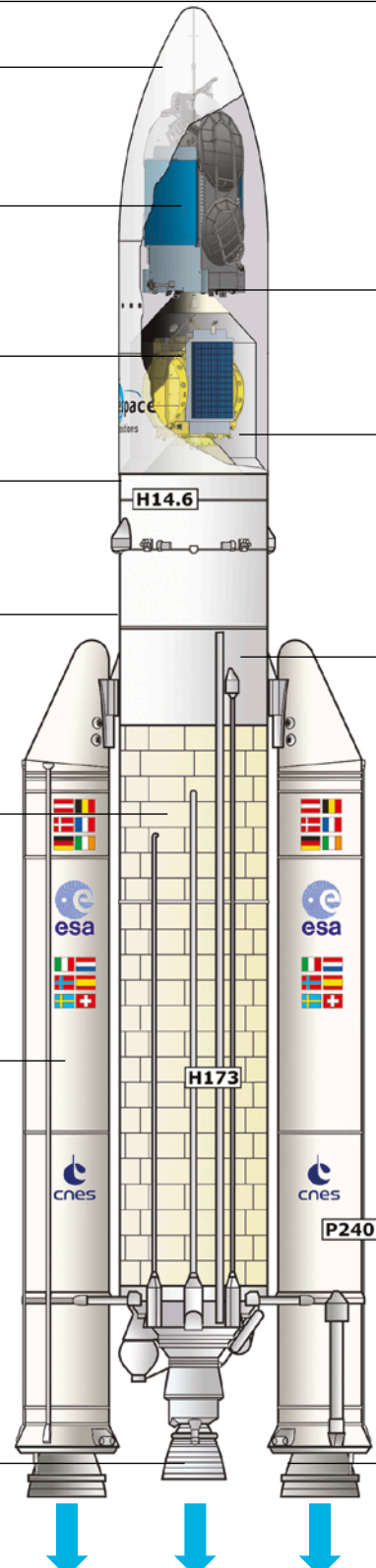
- (Airbus Defence and Space)
- ▼ 7 versions (Height: 4.9 to 6.4 m)
- ▼ Mass: 400 to 530 kg

M-7B Engine

- (Snecma)
- ▼ Thrust: 67 kN (in the vacuum)
- ▼ 945 sec of propulsion

Propellants (in tons) at T-O

- H** : Cryogenic
- P** : Solid



13,000 kN at Lift-off
(at T-O + 7 to 8 sec)

MPS - Solid Propellant Motor

- (Europropulsion)
- ▼ Average thrust: 5,060 kN
- ▼ Maximum thrust: 7,080 kN (in the vacuum)
- ▼ 130 sec of propulsion



VA 221

DIRECTV-14 - GSAT-16



▶ RANGE OPERATIONS CAMPAIGN: ARIANE 5 - DIRECTV-14 - GSAT-16

DIRECTV-14 - GSAT-16 and launch vehicle campaign calendar

Dates	Satellite activities	Launch vehicle activities
October 6, 2014		Campaign start review
October 7, 2014		EPC erection
October 8, 2014		EAP transfer and positioning
October 8, 2014	Arrival of DIRECTV-14 and beginning of preparation campaign in building S5C	
October 9, 2014		EPC/EAP integration
October 13, 2014		ESC-A Erection and equipment bay integration
October 21, 2014	DIRECTV-14 transfer to S5A	
October 22, 2014	Arrival in Kourou of GSAT-16 and beginning of preparation campaign in building S5C	
October 23 - 27, 2014	DIRECTV-14 filling operations	
October 28, 2014	DIRECTV-14 integration on adaptor (PAS) and functional test	
October 29, 2014	DIRECTV-14 transfer to Final Assembly Building (BAF)	
October 30, 2014	DIRECTV-14 integration on SYLDA	
November 13, 2014		Transfer BIL-BAF
November 13, 2014	GSAT-16 transfer to S5A	
November 13 - 19, 2014	GSAT-16 filling operations	
November 22, 2014	GSAT-16 integration on ACU	
November 24, 2014	Fairing integration on SYLDA	

DIRECTV-14 - GSAT-16 launch vehicle campaign final calendar

Dates	Satellite activities	Launch vehicle activities
Monday November 24, 2014	GSAT-16 transfer to Final Assembly Building (BAF)	
Tuesday, November 25, 2014	GSAT-16 integration on launcher	
Wednesday, November 26, 2014	Composite integration with DIRECTV-14 on launcher	
Thursday, November 27, 2014		Completion of composite integration on launcher
Friday, November 28, 2014		ESC-A final preparations and Launch rehearsal
Monday, December 1 st , 2014		Arming of launch vehicle
Tuesday, December 2, 2014		Launch readiness review (RAL) and final preparation of launcher
Wednesday, December 3, 2014		Rollout from BAF to Launch Zone, launch vehicle connections and filling of the EPC liquid helium tank
Thursday, December 4, 2014		Start of final countdown and launch countdown, including EPC filling with liquid oxygen and liquid hydrogen





VA 221

DIRECTV-14 - GSAT-16



▶ COUNTDOWN AND FLIGHT

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 the ignition of the main stage engine, then the two boosters, for a liftoff at the targeted time.

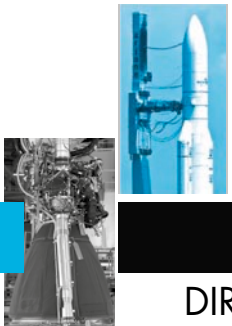
The countdown culminates in a synchronized sequence (see appendix 3), which is managed by the control station and onboard computers starting at T-7 minutes.

If an interruption in the countdown means that T-0 falls outside the nominal liftoff 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 30 mn	Start of final countdown
- 07 h 30 mn	Check of electrical systems
- 04 h 50 mn	Start of filling of main cryogenic stage with liquid oxygen and hydrogen
- 03 h 20 mn	Chilldown of Vulcain main stage engine
- 01 h 10 mn	Check of connections between launcher and telemetry, tracking and command systems
- 07 mn 00.0 s	"All systems go" report, allowing start of synchronized sequence
- 04 mn 00.0 s	Tanks pressurized for flight
- 01 mn 00.0 s	Switch to onboard power mode
- 05.5 s	Cryogenic arm opening command
- 04.0 s	Onboard systems take over
- 03.0 s	Two inertial reference systems switch to flight mode

T-O	Ignition of the cryogenic main stage engine (EPC)
+ 07.0 s	Ignition of solid boosters (EAP)
+ 07.3 s	Liftoff
+ 12.5 s	End of vertical rise, beginning of pitch motion (10 seconds duration)
+ 17.0 s	Beginning of roll maneuver
+ 02 mn 20.4 s	EAP separation
+ 03 mn 19.2 s	Fairing jettisoned
+ 08 mn 07.0 s	Acquisition by Natal tracking station
+ 08 mn 59.3 s	End of EPC thrust phase
+ 09 mn 05.3 s	EPC separation
+ 09 mn 20.0 s	Beginning of first ESC-A thrust phase
+ 13 mn 49.3 s	Acquisition by Ascension tracking station
+ 18 mn 23.5 s	Acquisition by Libreville tracking station
+ 23 mn 02.8 s	Acquisition by Malindi tracking station
+ 25 mn 09.1 s	End of first ESC-A thrust phase / Injection
+ 27 mn 53.7 s	DIRECTV-14 satellite separation
+ 29 mn 19.4 s	Sylda 5 separation
+ 32 mn 20.4 s	GSAT-16 satellite separation
+ 51 mn 19.5 s	End of Arianespace mission





VA 221

DIRECTV-14 - GSAT-16



DIRECTV-14 - GSAT-16 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 7 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:

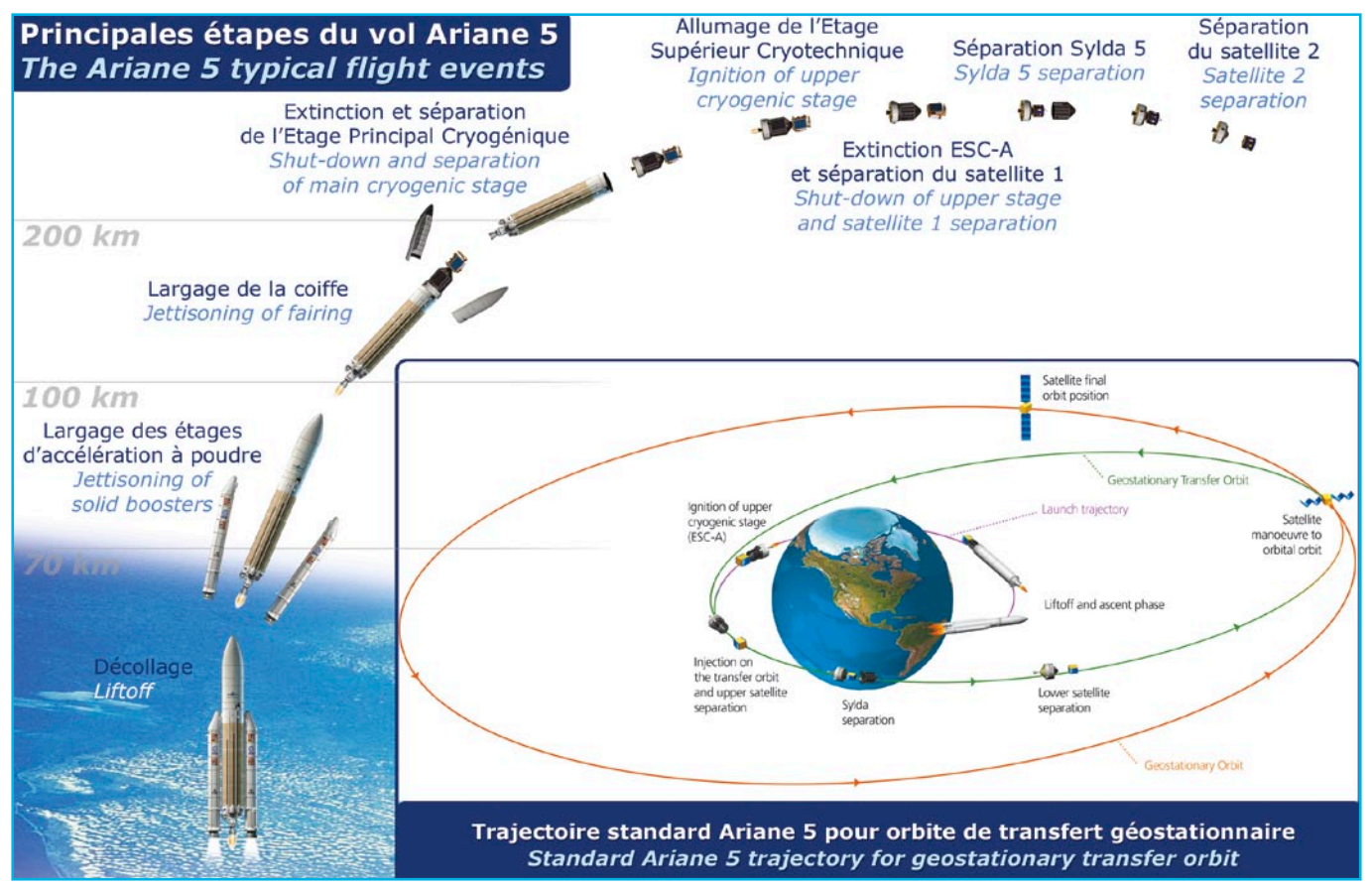
- Startup of water injection in the flame trenches and jet guide (T-30 sec).
- Hydrogen aspiration for chilldown of the Vulcain engine in the jet guide (T-18 sec).
- Burnoff of hydrogen used for chilldown (T-5.5 sec).

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

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

Ariane 5-ECA - DIRECTV-14 - GSAT-16 trajectory





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DIRECTV-14 - GSAT-16



ARIANESPACE AND THE GUIANA SPACE CENTER

Arianespace, the first launch service company in the world

Arianespace was founded in 1980 as the world's first launch Service & Solutions company. Arianespace now has 21 shareholders from ten European countries (including French space agency CNES with 34%, Airbus Defence and Space with 30%, and all European companies participating in the construction of Ariane launchers). Since the outset, Arianespace has signed more than 390 launch contracts and launched 490 satellites. More than two-thirds of the commercial satellites now in service worldwide were launched by Arianespace. The company posted sales of about 989 million euros in 2013.

At January 1, 2014, Arianespace had 330 employees, working at the company's 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 Service to satellite operators from around the world, including private companies and government agencies. These services call on three launch vehicles:

- The Ariane 5 heavy launcher, operated from the Guiana Space Center in Kourou, French Guiana.
- The Soyuz medium launcher, currently in operation at the Baikonur Cosmodrome in Kazakhstan and the Guiana Space Center.
- The Vega light 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 last two years. Arianespace now has a backlog of more than 40 satellites to be launched.

The Guiana Space Center: Europe's Spaceport

For 40 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 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 Regulux, Europropulsion, Air Liquide Spatial Guyane and Airbus Defence and Space, all involved in the production of Ariane 5 components. 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 is responsible for the Ariane, Soyuz and Vega development programs. Once these launch systems are qualified, ESA transfers responsibility to the operator 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 has several main responsibilities at the Guiana 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, 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 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 functional checks of the Ariane launcher, built by Astrium as production prime contractor, in the Launcher Integration Building (BIL). It then carries out acceptance tests of the launcher at the same time as satellite preparations in the Payload Preparation Complex (EPCU), operated by the Guiana Space Center (CSG). Arianespace next oversees final assembly of the launcher and integration of satellites in the Final Assembly Building (BAF), followed by transfer of the launcher to Launch Zone No. 3 (ZL3), and then final countdown and liftoff from Launch Complex No. 3 (CDL3).

Arianespace deploys a top-flight team and technical facilities 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.

