

arianespace
service & solutions

LAUNCH KIT
June 2017

VA238

Hellas Sat 3-Inmarsat S EAN

GSAT-17





ARIANESPACE TO LAUNCH ON JUNE 28 “HELLAS SAT 3-INMARSAT S EAN” FOR INMARSAT AND HELLAS SAT; AND GSAT-17 FOR THE INDIAN SPACE AGENCY ISRO

For its seventh launch of the year, and the fourth Ariane 5 mission in 2017 from the Guiana Space Center in French Guiana, Arianespace will orbit two payloads: Hellas Sat 3-Inmarsat S EAN, a “condosat” for Inmarsat and Hellas Sat; and GSAT-17 for the Indian space agency ISRO (Indian Space Research Organization).

With this 290th mission performed by its family of launchers, Arianespace is at the service of three major satellites operators: Hellas Sat, Inmarsat and ISRO.

Hellas Sat 3-Inmarsat S EAN

Arianespace will orbit **Hellas Sat 3-Inmarsat S EAN**, a “condosat” for Hellas Sat and Inmarsat.

Its **Hellas Sat 3** payload, the second Hellas Sat satellite, will deliver DTH (direct-to-home) and telecom services maintaining and expanding Hellas Sat business reach.

Hellas Sat (member of the Arabsat Group) is a premium satellite operator, offering services in Europe, the Middle East and South Africa from the orbital position of 39 East. It was established in August 2001 and owns and operates the Hellas Sat 2 high-power satellite.

Hellas Sat 3 will deliver in-orbit back-up DTH and telecom services in its designated coverage areas, maintaining and expanding Hellas Sat business reach with additional capacity and bringing video content in High Definition and Ultra High Definition format to the covered regions. The FSS/BSS coverage zones are Europe, the Middle East and Sub Saharan African countries, including a cross-trap service between Europe and South Africa.

A second Hellas Sat satellite is in Arianespace’s order book to enhance Hellas Sat service availability and support the company’s business plan to create the next DTH hotspot at 39 East.

The **Inmarsat S EAN (European Aviation Network) payload** is the ninth Inmarsat satellite to be launched by Arianespace.

Inmarsat is the leading provider of global mobile satellite communications services. Since 1979, Inmarsat has been providing reliable voice and high-speed data communications to governments, enterprises and other organizations, with a range of services that can be used on land, at sea or in the air.

The European Aviation Network (EAN) builds upon a visionary and unique commercial and technological opportunity created by the European Commission’s DG CONNECT and subsequently supported by Member State telecoms regulators.

EAN is being brought to Europe in conjunction with strategic partner Deutsche Telekom. Scheduled to commence commercial services in the second half of 2017, EAN will deliver the most advanced aviation passenger Wi-Fi experience anywhere in the world and provide Europe’s aviation industry with an opportunity to build global leadership in aviation passenger Wi-Fi.

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Hellas Sat 3-Inmarsat S EAN
GSAT-17



Inmarsat S EAN, the satellite component of the new network, will be placed into geostationary orbit over Europe, providing continent-wide S-band connectivity.

International Airlines Group is to be the launch customer for the new service. IAG plans to equip in excess of 300 aircraft with the EAN service and aims to have 90% of its short haul fleet ready for commercial service by early 2019.

Built by Thales Alenia Space in Cannes, France using a Spacebus 4000C4 platform, **Hellas Sat 3-Inmarsat S EAN** will be the 149th Thales Alenia Space satellite to be orbited by Arianespace – which has eight more satellites from this manufacturer in its order book.

GSAT-17

GSAT-17 will be the 21st satellite from ISRO to be launched by Arianespace. Since the launch of the Apple experimental satellite on Ariane Flight L03 in 1981, Arianespace has won 87% of the geostationary orbit launch contracts that the country has opened to non-Indian launch systems.

Built by ISRO, GSAT-17 will strengthen ISRO's current fleet of 17 operational telecom satellites. It will provide continuity of Fixed Satellite Services (FSS) in Normal C and Upper Extended C bands. It also will provide Mobile Satellite Services (MSS) in S-band and Data Relay and Search & Rescue services in UHF band.

ISRO fosters the use of space to help develop the Indian subcontinent. It focuses on all types of space applications, including Earth observation, telecommunications, broadcasts of educational programs, science and navigation.

The long-standing strategic partnership between ISRO and Arianespace reflects the strong relationship between India and France in the space sector.

After choosing Arianespace to launch its GSAT-17 and GSAT-18 satellites in 2015, ISRO selected Arianespace to launch its GSAT-11 satellite.



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Hellas Sat 3-Inmarsat S EAN GSAT-17

MISSION DESCRIPTION

Arianespace's fourth 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 10,177 kg.

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

DATE AND TIME



Liftoff is planned on **Wednesday, June 28, 2017**

as early as possible within the following launch window:

- > Between 4:59 p.m. and 6:16 p.m., Washington, D.C. time
- > Between 5:59 p.m. and 7:16 p.m., in Kourou, French Guiana
- > Between 20:59 p.m. and 22:16, Universal Time (UTC)
- > Between 10:59 p.m. and 00:16 a.m., Paris time during the night of June 28 to June 29
- > Between 11:59 p.m. and 01:16 a.m., Athens, Greece and Nicosia, Cyprus time during the night of June 28 to June 29
- > Between 2:29 a.m. and 3:46 a.m., Bangalore, India time on June 29.

MISSION DURATION



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

39 minutes, 1 second.

TARGETED ORBIT



Perigee altitude
250 km.



Apogee altitude
35,786 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, in order to minimize aerodynamic loads throughout the entire atmospheric phase until the solid boosters are jettisoned.

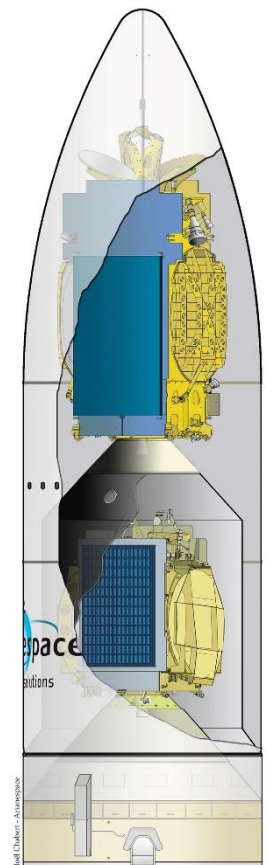
The fairing protecting the payload is jettisoned at T+202 seconds.

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 9,365 meters/second, and will be at an altitude of 640 kilometers.

PAYLOAD CONFIGURATION

- > **Upper payload (CUH): Hellas-Sat 3-Inmarsat S EAN**
Mass at liftoff: 5,780 kg.
- > **Lower payload (CUB): GSAT-17**
Mass at liftoff: approximately 3,477 kg.
- > Long version of the payload fairing
- > **SYLDA (SYstème de Lancement Double Ariane)**





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**Hellas Sat 3-Inmarsat S EAN
GSAT-17**

Hellas Sat 3-Inmarsat S EAN SATELLITE



CUSTOMER	Hellas Sat - Inmarsat
PRIME CONTRACTOR	Thales Alenia Space
MISSION	The Hellas Sat 3 payload will deliver DTH and Telecom services The Inmarsat S EAN payload will deliver communication services in the S-band to support Inmarsat's European Aviation Network, an integrated satellite and ground network that will deliver robust, high capacity inflight broadband for airline passengers across Europe.
MASS AT LAUNCH	5,780 kg.
STABILIZATION	3 axis
DIMENSIONS	5.5 m x 2 m x 2.2 m (stowed configuration for launch)
PLATFORM	Spacebus 4000C4
PAYLOAD	47 (BOL) / 44 (MOL) transponders in Ku and one Ka-band for Hellas Sat 3 Transponders in Ka and S-band for Inmarsat S EAN
ONBOARD POWER	14.5 kW (end of life)
DESIGN LIFE	More than 15 years
ORBITAL POSITION	39°East
COVERAGE AREA	Europe, the Middle East and Sub Saharan African Countries

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Hellas Sat 3-Inmarsat S EAN
GSAT-17

GSAT-17 SATELLITE



CUSTOMER	ISRO
PRIME CONTRACTOR	ISRO / ISAC (ISRO Satellite Centre)
MISSION	Communications services, data relay and search & rescue services
MASS	3,477 kg. at liftoff
STABILIZATION	3 axis
DIMENSIONS	3.1 m x 1.7 m x 2 m
PLATFORM	Standard I-3K
PAYLOAD	Carrying C, Extended C, S - Band payloads along with DRT & SAS&R payloads
ONBOARD POWER	5.200 kW (end of life)
DESIGN LIFE	15 years
ORBITAL POSITION	93.5° East
COVERAGE AREA	India, the Middle East and South Asia regions

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Hellas Sat 3-Inmarsat S EAN
GSAT-17

ARIANE 5 ECA LAUNCH VEHICLE

The launcher is delivered to Arianespace by Airbus Safran Launchers as production prime contractor.

54.8 m

Fairing

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

780 tons
(total mass at liftoff)

Hellas Sat 3-Inmarsat S EAN

(Hellas Sat - Inmarsat)
Mass: 5,780 kg.

ACU - Payload adaptor (2)

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

GSAT-17

(ISRO)
Mass: 3,5477 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

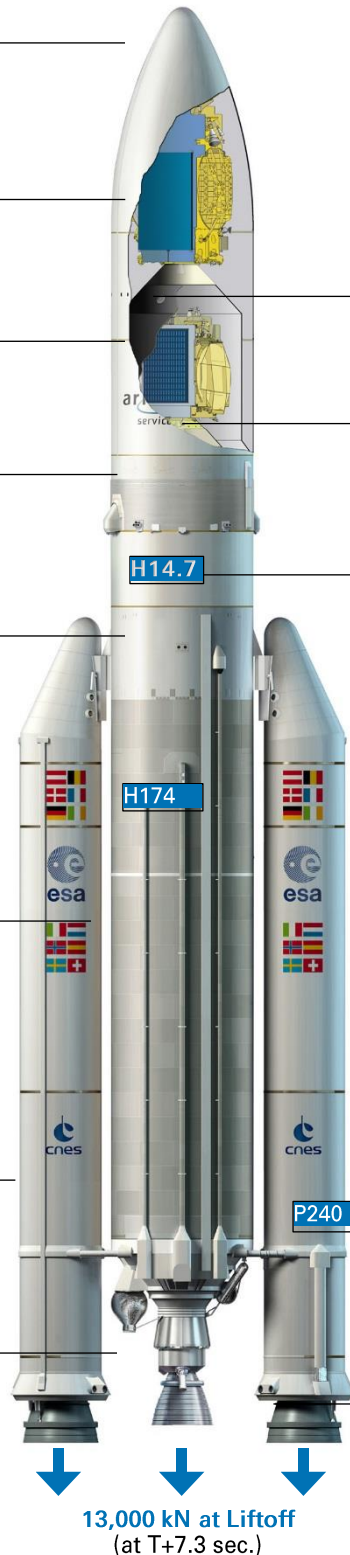
Height: 31.6 m.
Mass: 277 t approx.

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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GSAT-17**

LAUNCH CAMPAIGN - ARIANE 5

Hellas Sat 3-Inmarsat S EAN / GSAT-17

SATELLITE AND LAUNCH VEHICLE CAMPAIGN CALENDAR

DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
May 15, 2017	Arrival in French Guiana of GSAT-17 and transportation to the S5C	
May 17, 2017	GSAT-17 fitcheck	Campaign start review EPC unpacking
May 18 and 19, 2017		EAP1 and EAP 2 transfer - EPC erection
May 20, 2017		EPC/EAP integration
May 23, 2017	Arrival in French Guiana of Hellas Sat 3-Inmarsat S EAN and transportation to the S5C	Erection of ESC-A with Vehicle Equipment Bay
June 2, 2017	Hellas Sat 3-Inmarsat S fitcheck	
June 6 to 9, 2017	Hellas Sat 3-Inmarsat S EAN fueling operations	
June 7 to 13, 2017	GSAT-17 fueling operations	
June 12, 2017		Transfer from BIL (Launcher Integration Building) to BAF (Final Assembly Building)
June 14, 2017	Hellas Sat 3-Inmarsat S integration on PAS in the S5B hall;	
June 15, 2017	Hellas Sat 3-Inmarsat S transfer to the Final Assembly Building (BAF)	
June 16, 2017	Hellas Sat 3-Inmarsat S integration on SYLDA GSAT-17 integration on PAS	

SATELLITES AND LAUNCH VEHICLE CAMPAIGN FINAL CALENDAR

DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
Saturday, June 17, 2017	Hellas Sat 3-Inmarsat S encapsulation in the payload fairing GSAT-17 transfer to the Final Assembly Building (BAF)	
Monday, June 19, 2017	GSAT-17 integration on launch vehicle	HM7B engine final inspection
Tuesday, June 20, 2017	Completion of composite integration on launcher and payload checks	
Wednesday, June 21, 2017		Finalization of the composite/launcher integration, and payload checks
Thursday, June 22, 2017		Launch rehearsal
Friday, June 23, 2017		Arming of launch vehicle
Monday, June 26, 2017		Launch readiness review (RAL), final preparation of launcher and BAF for the chronology
Tuesday, June 27, 2017		Rollout from BAF to Launch Zone, launch vehicle connections and filling of the EPC liquid helium tank
Wednesday, June 28, 2017		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/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	Chilldown of Vulcain main stage engine
- 03 h 18 min	Start of filling of ESC-A with liquid oxygen and liquid hydrogen
- 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	Ignition of the cryogenic main stage engine (EPC)
+ 07 s	Ignition of solid boosters (EAP)
+ 07 s	Liftoff
+ 13 s	End of vertical climb, beginning of pitch motion
+ 17 s	Beginning of roll maneuver
+ 2 min 19 s	EAP separation
+ 3 min 17 s	Fairing jettisoned
+ 7 min 41 s	Acquisition by Natal tracking station
+ 8 min 52 s	End of EPC thrust phase
+ 9 min 58 s	EPC separation
+ 9 min 02 s	Ignition of ESC-A stage
+ 13 min 33 s	Acquisition by Ascension tracking station
+ 18 min 17 s	Data acquisition by Libreville tracking station
+ 23 min 59 s	Acquisition by Malindi tracking station
+ 25 min 04s	Injection
+ 28 min 17 s	Hellas Sat 3-Inmarsat S EAN satellite separation
+ 29 min 58 s	SYLDA separation
+ 41 min 47 s	GSAT-17 satellite separation
+ 39 min 01 s	End of the Arianespace mission



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).

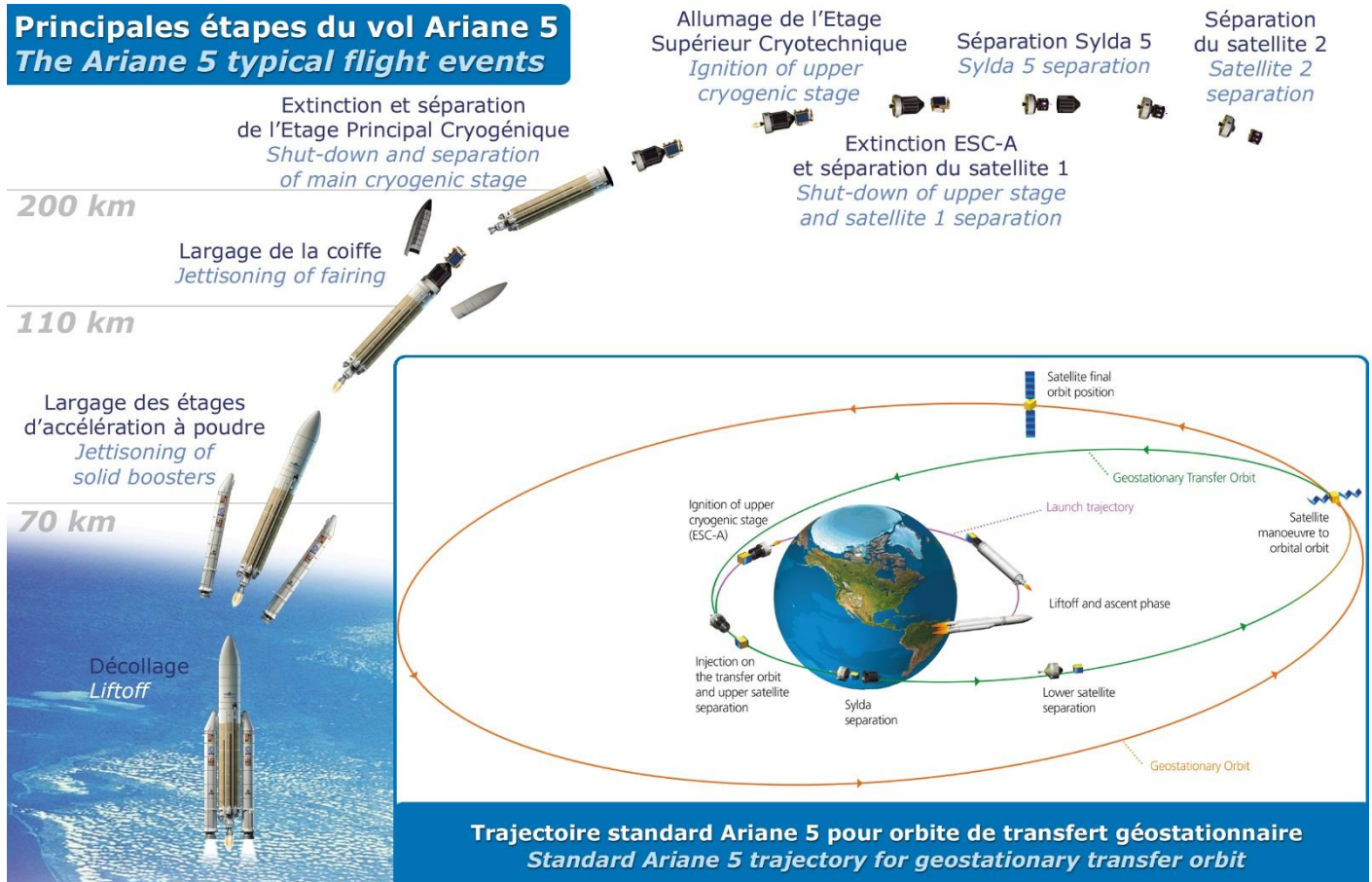
The synchronized sequence starts seven minutes before ignition (T-0). It is primarily designed to perform the final operations on the launcher prior to launch, along with the ultimate checks needed following switchover to flight configuration. As its name indicates, the sequence is fully automatic, and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





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Hellas Sat 3-Inmarsat S EAN
GSAT-17



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 Airbus Safran Launchers, 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 1.4 billion euros in 2016.

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 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 (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 Safran Launchers - all participating 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 functional checks of the Ariane launcher - built by Airbus Safran Launchers 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), which is operated by the Guiana Space Center (CNES/CSG). Next, Arianespace oversees final assembly of the launcher and integration of satellites in the Final Assembly Building (BAF), followed by transfer of the Ariane launcher to Launch Zone No. 3 (ZL3), and then the final countdown and liftoff - which are managed from the 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.