



 PanAmSat

GALAXY IV R



# V 129



# ARIANESPACE FLIGHT 129

## ARIANE'S 16<sup>TH</sup> LAUNCH FOR PANAMSAT

Arianespace Flight 129 will place the GALAXY IVR communications satellite into geostationary transfer orbit for the world's leading private satcom operator, PanAmSat. GALAXY IVR is the 16th PanAmSat satellite boosted into orbit by the European launcher, following PAS 1, 2, 3, 4, 6, 6B, 3R and 7, GALAXY IV, VI, VII, XI, and XR and SBS 5 and 6.

This year marks a new high point in the long relationship between Arianespace and PanAmSat – which goes back more than 12 years. Arianespace started out the year 2000 with the successful launch of PanAmSat's GALAXY XR satellite on January 24. Another launch is slated for the American operator this year, when PAS -1R is carried on an Ariane 5 launcher next July.

Built by Hughes Space and Communications using an HS 601 HP platform, GALAXY IVR is a high-power satellite with 28 Ku-band and 28 C-band transponders. It will be positioned at 99 degrees West, and will provide television, Internet and data transmission services to the Continental United States, Alaska, Hawaii and Puerto-Rico. GALAXY IVR will be the 37th Hughes Space and Communications built satellite carried by Ariane, and the 19<sup>th</sup> HS601 platform installed on the launcher.

Flight 129 is Arianespace's fourth launch of the year, and the mission will use an Ariane 42L launcher, the version equipped with two liquid-propellant strap-on boosters.

1. ARIANESPACE FLIGHT 129 MISSION
2. RANGE OPERATIONS : ARIANE 42L - GALAXY IVR
3. COUNTDOWN AND FLIGHT EVENTS
4. FLIGHT 129 TRAJECTORY
5. THE ARIANE 42L LAUNCH VEHICLE
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# ARIANESPACE FLIGHT 129

## 1. ARIANESPACE FLIGHT 129 MISSION

The 129th Ariane launch (Flight 129) is scheduled to place the GALAXY IVR satellite into a geostationary transfer orbit using an Ariane 42L launch vehicle equipped with two liquid strap-on boosters (PAL). This will be the 96<sup>th</sup> launch of an Ariane 4 and the 11<sup>th</sup> using the 42L configuration.

It will be launched from the Ariane launch complex N° 2 (ELA2), in Kourou, French Guiana.

The launch vehicle performance requirement is 3,739 kg (8,225 lb) of which 3,668 kg (8,069 lb) represent the mass of the spacecraft to be separated on the injection orbit.

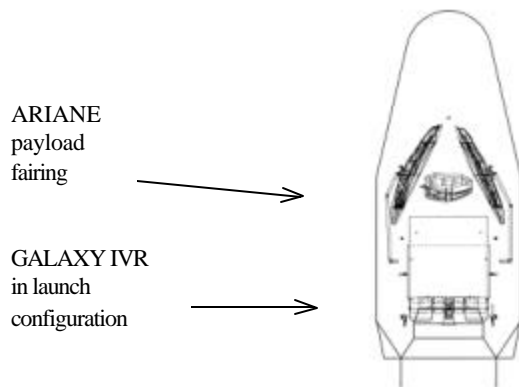
INJECTION ORBIT		
Perigee Altitude:	200	km
Apogee Altitude:	33 455	km at injection
Inclination:	7°	degrees

The ARIANE 42L launcher lift-off for Flight 129 is scheduled on **the night of April 18 to 19, 2000** as early as possible within the following launch window :

KOUROU TIME
<b>Between 09: 29 p.m. and 10: 39 p.m.</b>
<b>on April 18, 2000</b>

Launch opportunity (GMT)	Paris Time	Washington Time
<b>from 00: 29 a.m.</b>	<b>02: 29 a.m.</b>	<b>08: 29 p.m.</b>
<b>to 01: 39 a.m.</b>	<b>03: 39 a.m.</b>	<b>09: 39 p.m.</b>
<b>on April 19, 2000</b>	<b>on April 19, 2000</b>	<b>on April 18, 2000</b>

## ARIANE PAYLOAD CONFIGURATION



The GALAXY IVR satellite was built by Hughes Space & Communications at El Segundo, Calif. for PanAmSat.

Operational in-orbit position: 99° West

## 2. RANGE OPERATIONS CAMPAIGN: ARIANE 42L - GALAXY IVR

The satellite preparations lasts 12 working days for GALAXY IVR from its arrival in Kourou ( before encapsulation ).

The ARIANE 42L preparation campaign lasts 25 working days.

### SATELLITE AND LAUNCH VEHICLE CAMPAIGN CALENDAR

ARIANE ACTIVITIES			DATES	SATELLITE ACTIVITIES
CAMPAIGN START REVIEW and first stage erection			March 14	
Second stage erection			March 15	
Integration of liquid boosters (PAL)			March 20&21	
			<b><i>March 21</i></b>	<b><i>FLIGHT 128 LAUNCH OF ASIASTAR &amp; INSAT 3B</i></b>
Third stage erection			March 22	
			March 27	GALAXY IVR arrival in Kourou and beginning of its preparation in S3B building
ROLL-OUT TO LAUNCH PAD			April 3	
			April 5	Beginning of GALAXY 128 IVR filling operations in S3B building
LAUNCH COUNTDOWN REHEARSAL (RCL)			April 7	
<b>D-7</b>	<b>Mon</b>	<b>April 10</b>	<b>START OF COMBINED OPERATIONS</b>	
D-6	Tues.	April 11	Satellite encapsulation operations	
D-5	Wed.	April 12	Satellite composite transfer to the launch pad	
D-4	Thurss.	April 13	Satellite composite mating with launcher and overall checks	
D-3	Fri..	April 14	LAUNCH REHEARSAL	
D-2	Sat.	April 15	LAUNCH READINESS REVIEW (RAL) and launcher arming	
D-1	Mon.	April 17	Filling of 1st stage, PALs, and 2nd stage with UH 25 and N <sub>2</sub> O <sub>4</sub> .	
D-0	Tues.	April 18	LAUNCH COUNTDOWN including 3rd stage filling with liquid oxygen and liquid hydrogen.	

### 3. LAUNCH COUNTDOWN AND FLIGHT EVENTS

The final launch countdown runs through all the final launcher and satellites related operations. It configures the vehicle and its payload for ignition of the first stage and PAL engines at the selected launch time, as soon as possible within the launch window authorized by the spacecraft.

A synchronized sequence (see Appendix 3), controlled by the Ariane ground check-out computers, starts at H0 - 6 min and concludes the countdown.

Should a hold in the countdown delay the H0 time beyond the launch window, the launch is postponed to (in days): D + 1 or D + 2 (or later) depending on the source of the problem and the time to resolve it.

TIME	EVENTS
- 14 h 30 min	Start of Final Countdown
- 5 h 55 min	Start of gantry withdrawal
- 3 h 35 min	Start of the 3rd stage filling operations with liquid hydrogen and liquid oxygen
- 1 h 05 min	Activation of launcher telemetry, radar transponders, telecommand
- 6 min 00 s	"Green status for all systems" to authorize : <b>START OF SYNCHRONIZED LAUNCH SEQUENCE</b>
- 3 min 40 s	Spacecraft switched to on-board power (latest time)
- 1 min 00 s	Launcher equipment switched to on-board batteries
- 9 s	Inertial platform released
- 5 s	Release command to cryogenic arms retraction system
H0	IGNITION of first stage and liquid strap-on boosters engines
+ 4.4 s	<b>Lift-off</b>
+ 16 s	End of vertical ascent phase and start of pitch motion (10 s duration)
+ 2 min 20 s	Liquid Strap-on booster jettison
+ 3 min 14 s	First stage separation
+ 3 min 17 s	Second stage ignition
+ 4 min 05 s	Payload fairing jettison
+ 5 min 26 s	Second stage separation
+ 5 min 31 s	Third stage ignition
+ 6 min 20 s	Launcher acquired by Natal station
+ 12 min 55 s	Launcher acquired by Ascension Island station
+ 18 min 00 s	Launcher acquired by Libreville station
+ 18 min 40 s	Third stage shutdown sequence
+ 18 min 42 s	Injection into the required orbit
+ 20 min 48 s	<b>GALAXY IVR separation</b>
+ 20 min 52 s	Start of the third stage avoidance maneuver
+ 22 min 37 s	End of ARIANESPACE FLIGHT 129 Mission

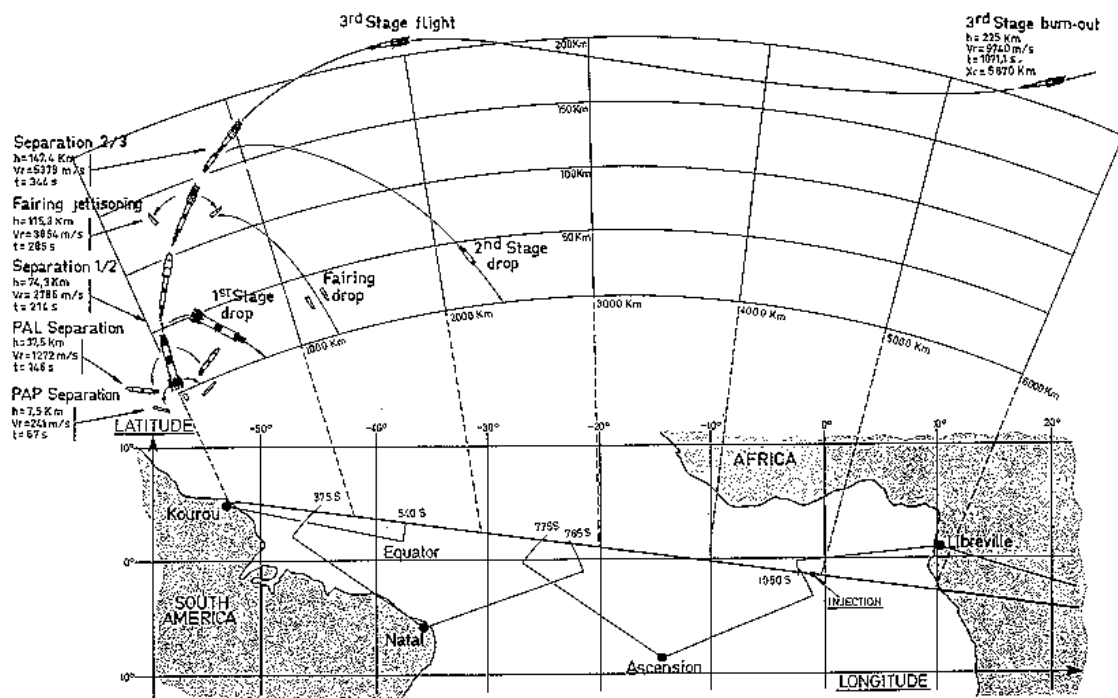
#### 4. FLIGHT 129 TRAJECTORY

The launcher ascends vertically from lift-off to  $H_0 + 13$  sec. During a period of 10 sec. after this vertical ascent, the launch vehicle tilts in the pitch plane defined by the trajectory and pre-calculated by the on-board computer.

The vehicle's attitude is commanded by a predetermined law. The guidance phase is initiated 10 sec. after ignition of the 2nd stage. The attitude law in the pitch-and-yaw plane is optimized in order to minimize the 3rd stage propulsion time necessary to reach the target orbit with a performance margin of about 66 kg. This ensures reaching this orbit with a probability of 50 % before the exhaustion of third-stage propellant.

The roll law is applied so as to improve the launcher/ground station radio link budget.

**TYPICAL TRAJECTORY FOR STANDARD GEOSTATIONARY TRANSFER ORBIT  
AND GROUND STATION VISIBILITY**



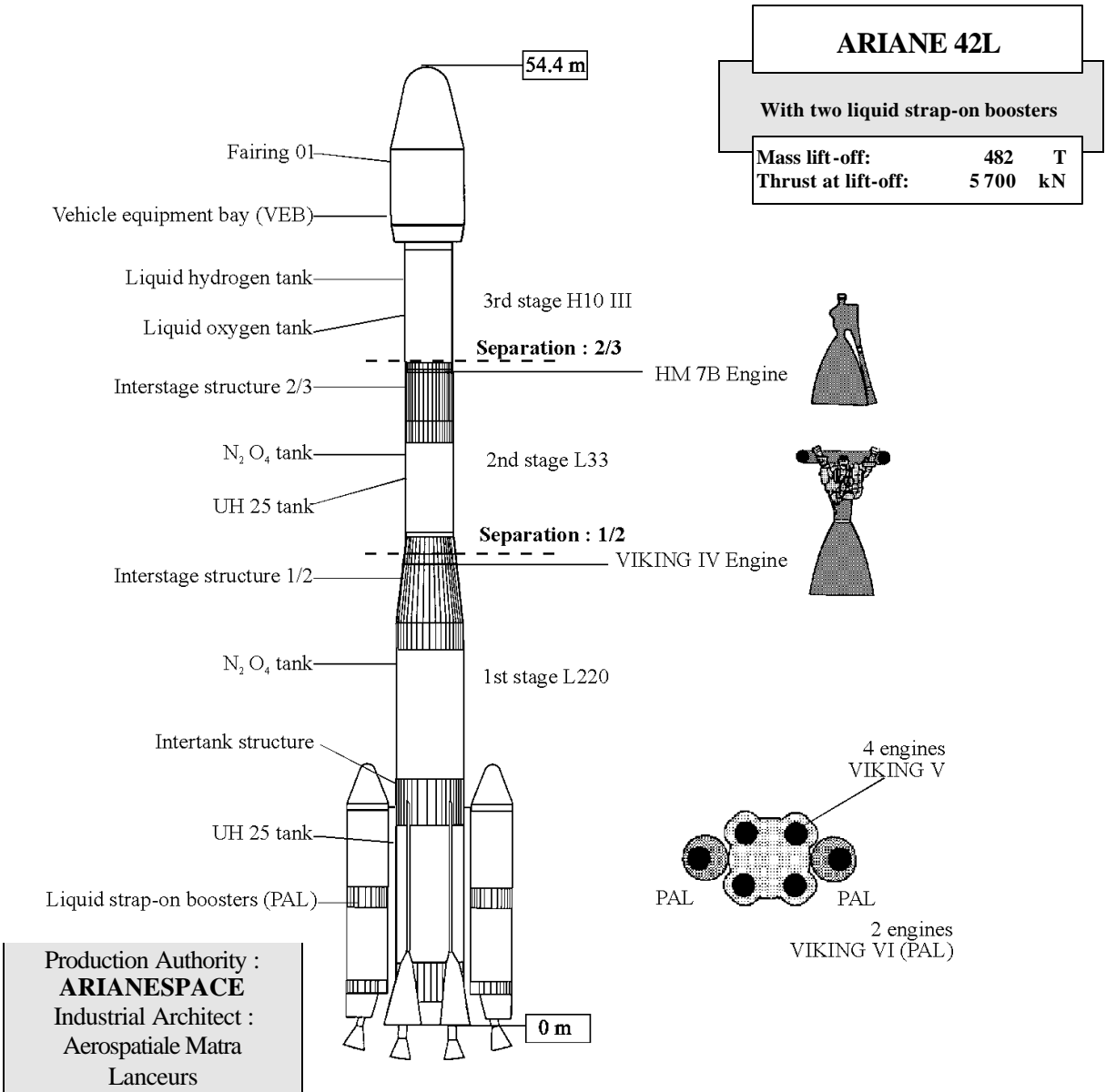
##### Down-range stations

In French Guiana	:	KOUROU (Montagne des Pères) and CAYENNE (Montabo)
In Brazil	:	NATAL
Atlantic Ocean	:	ASCENSION ISLAND
In Gabon	:	LIBREVILLE

##### Launch main events

- 1 : First stage separation
- 2 : Fairing jettison
- 3 : Second stage separation
- 4 : Third stage shutdown

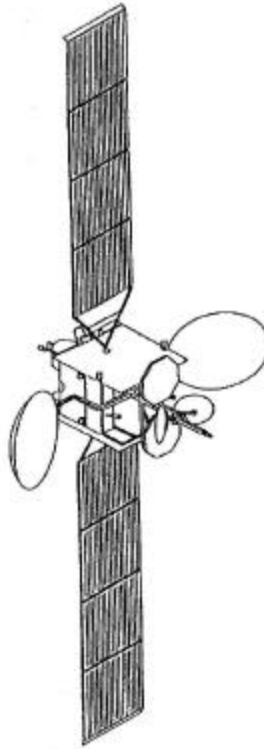
# 5. THE LAUNCH VEHICLE



	Length	AE	Dry mass	Prime
Fairing	9.6 m	4 m	740 kg	Oerlikon Contraves
VEB	1 m	4 m	530 kg	Matra Marconi Space France
3rd stage	11.7 m	2.6 m	1.25 t	Aerospatiale Matra
2nd stage	11.6 m	2.6 m	3.2 t	DaimlerChrysler Aerospace
1st stage	23.2 m	3.8 m	17.5 t	Aerospatiale Matra
PAL	19 m	2.2 m	4.5 t	DaimlerChrysler Aerospace
VIKING IV, V, VI				Snecma
HM 7B				Snecma



## 6. THE GALAXY IVR SATELLITE



**CUSTOMER:** PanAmSat Corp, Greenwich, Connecticut, USA.

**MISSION:** Digital TV networks, Internet and data transmission.

**PRIME CONTRACTOR:** Hughes Space & Communications, El Segundo, California, USA

<b>MASS:</b> <div><div>-</div><div>Total mass (at lift -off) :</div><div>3,668 kg (8,069 lb)</div></div> <div><div>-</div><div>Dry mass :</div><div>1,895 kg (4,169 lb)</div></div>		<b>DIMENSIONS:</b> <div><div>-</div><div>Dimension at launch :</div><div>4.00 x 3.60 x 2.70 m</div></div> <div><div>-</div><div>Operational configuration (deployed) :</div><div>26 m</div></div>	
<b>STABILIZATION:</b> 3-axis			
<b>ON-BOARD POWER:</b> 8,700 W at end of life		<b>LIFE TIME:</b> 15 years	
<b>PAYLOAD:</b> <div><div>-</div><div>28 Ku-band transponders ( 24 X 36 MHz )</div></div> <div><div>-</div><div>28 C-band transponders ( 24 X 36 MHz )</div></div>			
<b>ORBITAL LOCATION:</b> 99° West longitude			

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## ANNEXES

### ANNEX 1 - ARIANESPACE FLIGHT 129 KEY PERSONNEL

<i>In charge of the launch campaign</i> Mission Director	(CM)	<b>Didier CASSE</b>	ARIANESPACE
<i>In charge of the launch service contracts</i> GALAXY IVR Mission Manager and ARIANE Payload Manager	(RCUA)	<b>Christophe BARDOU</b>	ARIANESPACE
ARIANE Payload Deputy Manager	(RCUA/A)	<b>Steve HALL</b>	ARIANESPACE
<i>In charge of the GALAXY IVR satellite</i> Satellite Mission Director	(DMS)	<b>Robert BEDNAREK</b>	PANAMSAT
Satellite Project Manager	(CPS)	<b>Jeff HOFFMAN</b>	HSC
Satellite Preparation Manager	(RPS)	<b>Kirk NYGREN</b>	HSC.
<i>In charge of the launch vehicle</i> Launch Site Operations Manager	(COEL)	<b>Jean-Louis LEBLANC</b>	ARIANESPACE
ARIANE Production Project Manager	(CPAP)	<b>Bernard DONAT</b>	ARIANESPACE
<i>In charge of the Guiana Space Center (CSG)</i> Range Operations Manager	(DDO)	<b>Pierre RIBARDIERE</b>	CNES/CSG
Flight Safety Officer	(RSV)	<b>Stanislas BLANC</b>	CNES/CSG

### ANNEX 2 - LAUNCH ENVIRONMENT CONDITIONS

The allowable weather conditions for gantry withdrawal depend on the Ariane stage pressurization values. Wind speed has to be below 17 m/s.

Acceptable wind speed limits at liftoff range from between 9 m/s to 14 m/s according to the wind direction. The most critical is a northerly wind. For safety reasons, the wind speed on the ground (at Kourou) and at a high altitude (between 10,000 and 20,000 m) also is taken into account.

### ANNEX 3 - SYNCHRONIZED SEQUENCE

The synchronized sequence starts at H0 -6 min. This sequence is used for final preparation of the launcher, and for checkout operations related to switchover to flight configuration. The sequence is fully automatic, and is controlled in parallel, up to H0-5 sec., by two computers in the Ariane Launch Center (CDL). All resources used for launch are synchronized on a common countdown sequence.

One computer configures fluids and propellants for flight and performs associated checks. The other computer executes final preparation of the electrical systems (initiation of flight program, start-up of servomotors, switchover from ground power to flight batteries, etc.) and corresponding checkout operations.

After H0 - 5 s. and retraction of the cryogenic arms retraction from the launcher, a majority logic sequencer delivers the main timing pulses for :

- first stage & liquid booster engine ignition (H0)
- engine parameter checkout (conducted in parallel by the two computers, starting at H0 + 2.8 s.)
- opening of the launch table clamps (releasing the launch vehicle between H0 + 4. 1s. and H0 + 4.6 s.) as soon as engine parameters are judged as nominal by one of the computers.

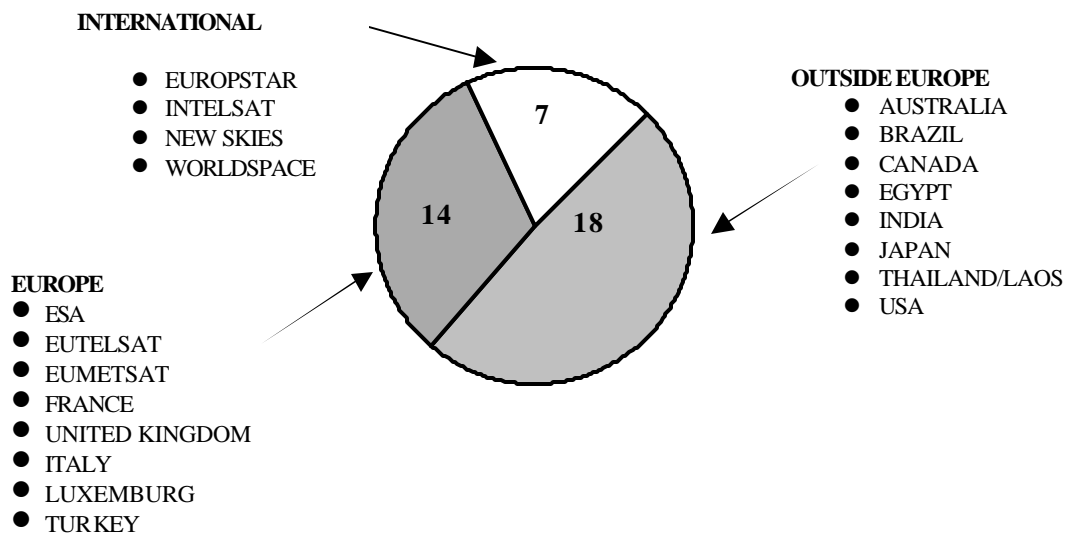
**Any hold in the synchronized sequence before H0 - 5 s. automatically resets the launcher to the H0 - 6 min. configuration**

## ANNEX 4 - ARIANESPACE ORDER BOOK

To date **170** satellites and **34** auxiliary payloads have been launched by Arianespace.

Out of the **209** satellites signed for launch since 1981 by Arianespace and **before** Flight 129, **39** satellites remain to be launched.

EUROPE 14 SATELLITES	OUTSIDE EUROPE 25 SATELLITES
<p>ASTRA 1K, 2B, X, 2D</p> <p>ENVISAT-1/PPF</p> <p>EURASIASAT 1</p> <p>MSG-1 &amp; 2</p> <p>SICRAL 1</p> <p>SKYNET 4F</p> <p>SPOT 5</p> <p>STENTOR</p> <p>W1 &amp; EUROBIRD</p>	<p><b>INTERNATIONAL ORGANIZATIONS: 7 satellites</b></p> <p>AMERISTAR (WorldSpace) EUROPESTAR FM 1 INTELSAT 902, 903, 904 NEW SKIES SATELLITES 6 &amp; 7</p> <p><b>OTHERS: 18 satellites</b></p> <p>ANIK F1 (Canada) BRASILSAT B4 (Brazil) BSAT 2A &amp; 2B (Japan) <b>GALAXY IVR</b> (USA) GE 7, 8 &amp; TBD (USA) INSAT 3A (India) ISKY 1 &amp; 2 (USA) LORALSAT 3 (USA) L-STAR A &amp; B (Thailand/Laos) NILESAT 102 (Egypt) N-SAT 110 (Japan) OPTUS C1 (Australia) PAS-1R (USA)</p>
35 %	65 %



## APPENDIX 5 - ARIANESPACE, its relations with ESA & CNES

### *FROM A PRODUCTION BASE IN EUROPE, ARIANESPACE, A PRIVATE COMPANY, SERVES CUSTOMERS ALL OVER THE WORLD*

Arianespace is the world's first commercial space transportation company, created in 1980 by 36 leading European aerospace and electronics corporations, 13 major banks and the French space agency CNES (Centre National d'Etudes Spatiales).

Arianespace is a European venture--, the direct result of the participating nation's commitment to bringing the Ariane family of launch vehicles from the drawing board to the launch pad. To do so, they turned to the European Space Agency (ESA) and mobilized the scientific and technological expertise of CNES.

The shareholder partners in Arianespace represent the scientific, technical, financial and political capabilities of 12 countries : Belgium, Denmark, Germany, France, Great Britain, Ireland, Italy, Netherlands, Norway, Spain, Switzerland and Sweden.

In order to meet the market needs, Arianespace is present throughout the world : in Europe, with its head office located near Paris, France at Evry, in North America with its subsidiary in Washington D.C. and in the Pacific Region, with its representative offices in Tokyo, Japan, and in Singapore.

Arianespace employs a staff of 330. Share capital totals FF 2,088 million.

As a space transportation company, Arianespace :

- markets launch services to customers throughout the world.
- finances and supervises the construction of Ariane expendable launch vehicles.
- conducts launches from Europe's Spaceport in Kourou in French Guiana.
- insures customers for launch risks.

Personalized reliable service forms an integral part of Arianespace's launch package. It includes the assignment of a permanent team of experts to each mission for the full launch campaign. Our customers appreciate the time and cost savings made possible by our efficiency and flexibility.

Most of the world's commercial satellite operators have contracted to launch at least one payload with Arianespace. This record is the result of our company's realistic cost-effective approach to getting satellites into orbit.

### RELATIONS BETWEEN ESA, CNES AND ARIANESPACE

Development of the Ariane launcher was undertaken by the European Space Agency in 1973. ESA assumed overall direction of the ARIANE 1 development program, delegating the technical direction and financial management to CNES. The ARIANE 1 launcher was declared qualified and operational in January 1982. At the end of the development phase which included four launchers, ESA started the production of five further ARIANE 1 launchers. This program, known as the "promotion series", was carried out with a management arrangement similar to that for the ARIANE 1 development program.

In January 1980 ESA decided to entrust the commercialization, production and launch of operational launchers to a private-law industrial structure, in the form of ARIANESPACE, placing at its disposal the facilities, equipment and tooling needed to build and launch the ARIANE vehicles.

Ariane follow-on development programs have been undertaken by ESA since 1980. They include a program for developing uprated versions of the launcher : Ariane 2 and Ariane 3 (qualified in August 1984); the program for building a second ARIANE launch site (ELA 2) (validated in August 1985); the Ariane 4 launcher development program (qualified on June 15th, 1988); and the preparatory and development program of the Ariane 5 launcher and its new ELA 3 launch facility. All these programs are run under the overall direction of ESA, which has appointed CNES as prime contractor.

In general, as soon as an uprated version of the launcher has been qualified, ESA makes the results of the development program together with the corresponding production and launch facilities available to ARIANESPACE.

*ESA is responsible (as design authority) for development work on the Ariane launchers. The Agency owns all the assets produced under these development programs. It entrusts technical direction and financial management of the development work to CNES, which writes the program specifications and places the industrial contracts on its behalf. The Agency retains the role of monitoring the work and reporting to the participating States.*

*Since Flight 9 Arianespace has been responsible for building and launching the operational Ariane launchers (as production authority), and for industrial production management, for placing the launcher manufacturing contracts, initiating procurements, marketing and providing Ariane launch services, and directing launch operations.*

### *Use of the Guiana Space Center*

The "Centre Spatial Guyanais" (CSG), CNES's launch base near Kourou, has all the equipment needed for launching spacecraft : radar tracking stations, telemetry receiving stations, a meteorology station, a telecommand station, safety facilities, etc...

It became operational in 1968 for the purpose of the French National Space Program.

ESA built its own launch facilities, the ELA 1 and ELA 2 complexes (for Ariane 4) and ELA 3 (for Ariane 5) and the EPCU payload preparation complex. These facilities comprise Europe's Spaceport. The use of these facilities requires, CSG's technical and operational resources, especially during launch operations. The French Government has granted ESA the right to use the CSG for its space programs. In return, ESA shares in the costs of operating the CSG.

Arianespace directly covers the costs of use, maintenance and upgrading of the Ariane launch sites and the payload preparation complex.