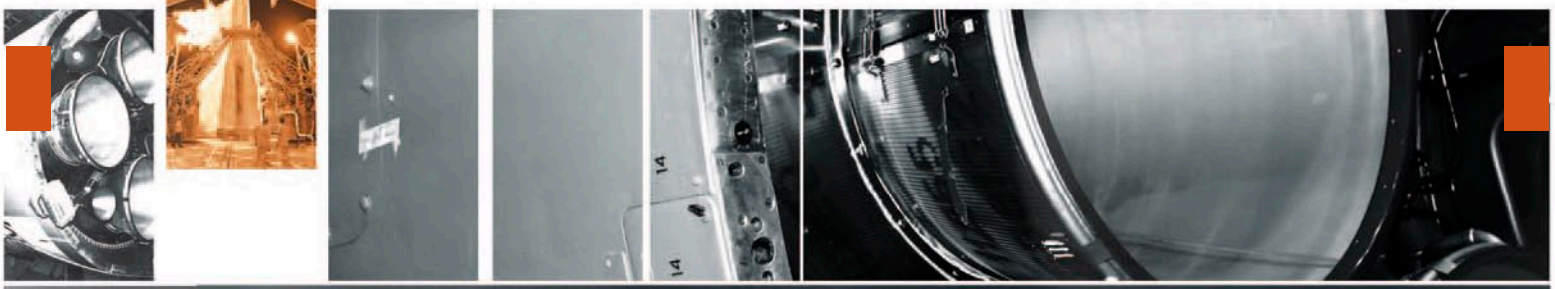
arianespace
service & solutions

July
2014



From Vision to Reality

VS 08
O3b

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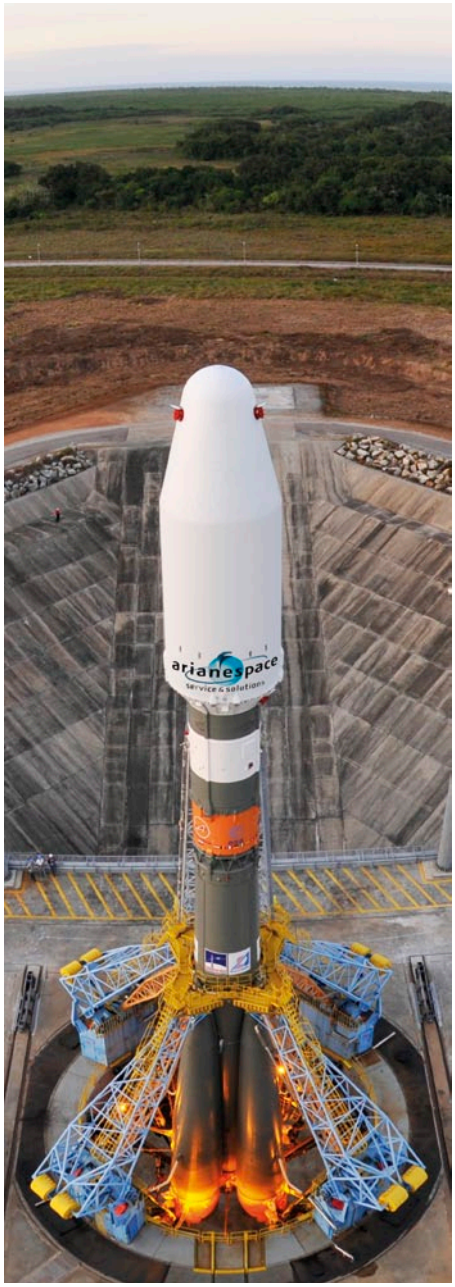
O3b Networks
Fiber Speed. Satellite Reach.

cnes

A SECOND LAUNCH FOR THE O3b CONSTELLATION

Arianespace's eighth Soyuz launch from the Guiana Space Center will be the second launch for O3b Networks, following the successful launch of the first four satellites in the O3b constellation on June 25, 2013. Arianespace continues developing long-term partnership with new operators, by providing services tailored to their specific needs. These four O3b satellites were built by Thales Alenia Space as prime contractor.



O3b, a mission to provide low-cost broadband for Internet access.

Arianespace is deploying the O3b constellation (the "Other 3 billion") into an equatorial orbit to provide high-speed, low-cost Internet access for emerging markets in Asia, Africa, Latin America, Australia and the Middle East. That covers nearly 150 countries which do not yet enjoy broadband Internet.

O3b Networks will provide telecom operators with trunking capacity and connectivity for mobile networks at rates and response times equal to fiber-optic networks.

Placed in an equatorial orbit at an altitude of about 8,000 km, these Ka-band satellites will offer high throughput, low latency telecommunications and Internet trunking services to the "other 3 billion" people on our planet who do not yet enjoy broadband access.

Following this launch, the O3b constellation will be deployed in its initial configuration and will be fully operational.

Services tailored to customer requirements

Arianespace adapted its launch services to the specific requirements of O3b: mission analysis and proposed solutions for deployment in equatorial orbit, adaptation to a multiple launch configuration (dispenser) and optimized launch campaign to manage operations involving several satellites.

Arianespace: setting the standard in space transportation

With the Soyuz, Ariane 5 and Vega launchers now fully operational at the Guiana Space Center in French Guiana, Arianespace is the only launch services company in the world capable of launching all payloads into all orbits, from the smallest spacecraft to the largest geostationary satellites, as well as satellite clusters for constellations and cargo missions to the International Space Station.

Arianespace continues to set the standard in launch services for all operators, and guarantee independent access to space.

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MISSION DESCRIPTION

The height Soyuz launch from the Guiana Space Center (CSG) will place into circular orbit, at an altitude of about 7830 km, the four satellites of the O3b constellation.

The launcher will be carrying a total payload of 3,204 kg, including about 2800 kg for the four O3b satellites, to be released into its targeted orbit at an inclination of 0.04 degrees

The launch will be from the Soyuz Launch Complex (ELS) in Sinnamary, French Guiana.

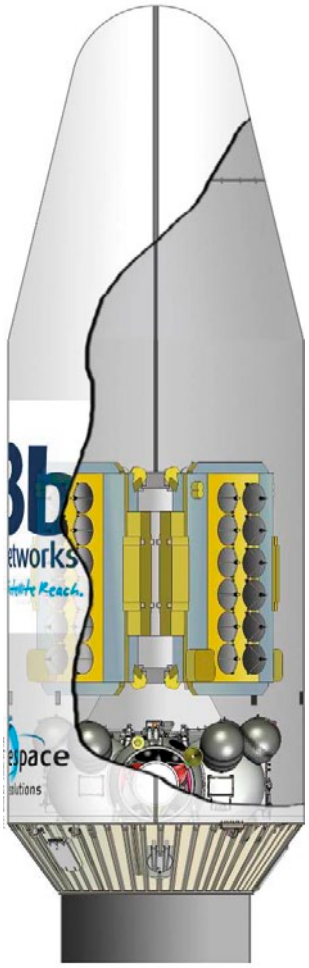
Orbit : **circular**
Altitude : **7830 km**
Inclination : **0.04°**

Liftoff is scheduled for **Thursday, July 10, 2014** at:

3:55:56 pm	(Local Time in French Guiana)
2:55:56 pm	(in Washington, DC)
6:55:56 pm	(UTC)
8:55:56 pm	(in Paris)
10:55:56 pm	(in Moscow)

The launch at a glance

Following liftoff from the Guiana Space Center, the powered phase of the lower three Soyuz stages will last about nine minutes. The third stage of the launcher will then be separated from the upper composite, comprising the Fregat upper stage and the four O3b satellites. The three lower stages will fall back into the sea.



Fregat will carry out three main powered phases:

- First burn, lasting about 4 minutes, followed by a ballistic phase lasting about 8 minutes and 30 seconds.
- Second burn, lasting about 8 minutes and 30 seconds, followed by a second ballistic phase, lasting one hour and 21 minutes.
- Third burn, lasting about 5 minutes.

One additional burn will be carried out with Attitude Control System (ACS) to inject the satellites on the dedicated orbit.

The satellites will be released two by two, with the first pair being released about two hours after liftoff. The second pair of satellites will then be released about 22 minutes later.

Two successive firings of the Fregat engine will place Fregat into an orbit underneath that of the O3b constellation.

Following satellite separation, Fregat will be inserted on a circular graveyard orbit.

Mission length

The nominal length of the mission, from liftoff to separation of the satellites, is 2 hours and 22 minutes.

Soyuz payload configuration

The O3b constellation satellites were built by Thales Alenia Space for the O3b Networks Limited satellite operator

THE O3b SATELLITES

Customer	**O3b Networks Limited**
Manufacturer	**Thales Alenia Space**
Mission	**Telecommunications and internet**
Orbit	**Medium Earth orbit (MEO), 8062 km altitude**
Payload	**12 steerable antennas, 12 Ka-band transponders**
Satellites' orbital spacing	**45 °**
Period	**288 minutes**
Visibility time	**45 minutes (approximately)**
Life time	**approximately 10 years**
On-board power	**1500 W**
Mass of one satellite	**Total mass at lift-off 700 kg (per satellite)**
Coverage aera	**Asia, Africa, South America, Australia, Middle -East**

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SOYUZ LAUNCH VEHICLE

The Soyuz launch vehicle family has provided reliable and efficient launch services since the start of space exploration. Soyuz rockets, which launched both the first artificial satellite and the first man into space, have been credited with more than 1,815 launches to date. Today, Soyuz is used for manned and unmanned flights to the International Space Station, as well as commercial and Russian government launches.

The Soyuz configuration introduced in 1966 has been the workhorse of the Soviet/Russian space program. As the only manned launch vehicle in Russia and the former Soviet Union, Soyuz meets very high standards of reliability and robustness.

In 1999, Arianespace's affiliate Starsem used Soyuz to launch the 24 satellites in the Globalstar constellation, in six launches.
Following this success, Starsem introduced The more powerful restartable Fregat upper stage, which offered the operational flexibility that paved the way for a full range of missions (LEO, SSO, MEO, GTO, GEO and escape).

The first launch of the Soyuz 2-1a version on November 8, 2004 from the Plessetsk Cosmodrome represented a major step in the launch vehicle development program. This modernized version of Soyuz, also used to successfully launch MetOp-A on October 19, 2006, features a digital controlsystem providing additional mission flexibility; it also enablescontrol of the launch vehicle fitted with the 4.1-meter ST fairing. This was anecessary step towards the next-generation Soyuz 2-1b launcher, the culmination of a joint European/ Russian upgrade program. It adds a more powerful third-stage engine, significantly increasing the launcher's overall performance.

The inaugural flight of the upgraded Soyuz 2-1b launch vehicle was successfully performed on December 27, 2006, orbiting the Corot scientific spacecraft for French space agency CNES.

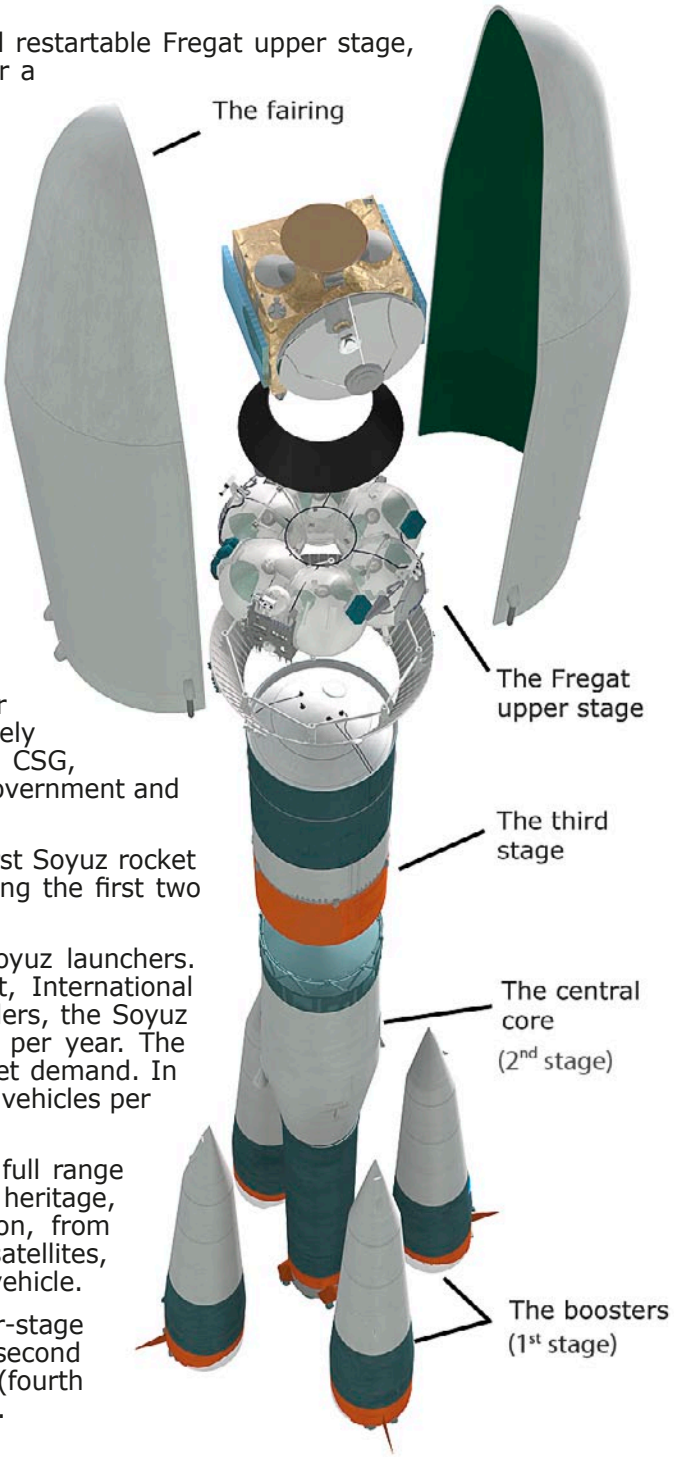
The decision of the European Space Agency to introduce Soyuz launch capability at the Guiana Space Center (CSG) marked a major step forward in expanding the range of missions. With the introduction of Soyuz at CSG, this famed Russian launch vehicle is now an integral part of the European launcher fleet, together with the heavy-lift Ariane 5 and the light Vega. Offered exclusively by Arianespace to the commercial market, for launches from CSG, Soyuz becomes Europe's standard medium launcher for both government and commercial missions.

On October 21, 2011 Arianespace successfully launched the first Soyuz rocket from the Guiana Space Center (CSG) in French Guiana, orbiting the first two satellites in the Galileo constellation.

The Samara Space Center in Russia continues to produce Soyuz launchers. Because of sustained demand from the Russian government, International Space Station requirements and Arianespace's commercial orders, the Soyuz is being produced at an average rate of 15 to 20 launchers per year. The manufacturer can also rapidly scale up to accommodate market demand. In fact, annual Soyuz production peaked in the early 1980's at 60 vehicles per year.

Soyuz is a reliable, efficient, and cost-effective solution for a full range of missions, from LEO to Mars or Venus. Offering an unrivaled heritage, Soyuz has already performed almost every type of mission, from telecommunications, Earth observation, weather and scientific satellites, to manned spacecraft. It is a very scalable and flexible launch vehicle.

The Soyuz version currently offered by Arianespace is a four-stage launch vehicle: four boosters (first stage), a central core (second stage), a third stage, and the restartable Fregat upper stage (fourth stage). It also includes a payload adapter/dispenser and fairing.



Boosters (first stage)

The four cylindrical-conical boosters are assembled around the central core. The booster's RD-107A engines are powered by liquid oxygen and kerosene, the same propellants used on each of the lower three stages. The kerosene tanks are located in the cylindrical part and the liquid oxygen tanks in the conical section. Each engine has four combustion chambers and four nozzles. Three-axis flight control is provided by aerofins (one per booster) and steerable vernier thrusters (two per booster). Following liftoff, the boosters burn for approximately 118 seconds and are then jettisoned. Thrust is transferred to the vehicle through a ball joint located at the top of the conical structure of the booster, which is attached to the central core by two rear struts.

Central core (second stage)

The central core is similar in construction to the four boosters, with a special shape to accommodate the boosters. A stiffening ring is located at the interface between the boosters and the core. This stage is fitted with an RD-108A engine, also comprising four combustion chambers and four nozzles. It also has four vernier thrusters, used for three-axis flight control once the boosters have separated. The core stage has a nominal burn time of 286 seconds. The core and boosters are ignited simultaneously on the launch pad, 20 seconds before liftoff. Thrust is first adjusted to an intermediate level to check engine readings. The engines are then gradually throttled up, until the launcher develops sufficient thrust for liftoff.

Third stage

The third stage is linked to the central core by a latticework structure. Ignition of the third stage's engine occurs approximately two seconds before shutdown of the central core engine. The third stage engine's thrust enables the stage to separate directly from the central core. Between the oxidizer and fuel tanks is a dry section where the launcher's avionics systems are located. The third stage uses either a RD-0110 engine in a ST-A version, or a RD-0124 engine in a ST-B version.

Fregat upper stage (fourth stage)

Flight qualified in 2000, the Fregat upper stage is an autonomous and flexible stage that is designed to operate as an orbital vehicle. It extends the capability of the Soyuz launcher, now covering a full range of orbits (LEO, SSO, MEO, GTO, GEO and escape). To ensure high reliability for the Fregat stage right from the outset, various flight-proven subsystems and components from previous spacecraft and rockets are used. The upper stage consists of six spherical tanks (four for propellants, two for avionics) arranged in a circle and welded together. A set of eight struts through the tanks provide an attachment point for the payload, and also transfer thrust loads to the launcher. The upper stage is independent from the lower three stages, since Fregat has its own guidance, navigation, attitude control, tracking, and telemetry systems. The stage's engine uses storable propellants – UDMH (unsymmetrical dimethyl hydrazine) and NTO (nitrogen tetroxide) – and can be restarted up to 20 times in flight, thus enabling it to carry out complex missions. It can provide the customer with 3-axis or spin stabilization of their spacecraft.

The Fregat upper stage is encapsulated in a fairing with the payload and a payload adapter/dispenser.

Payload accommodation

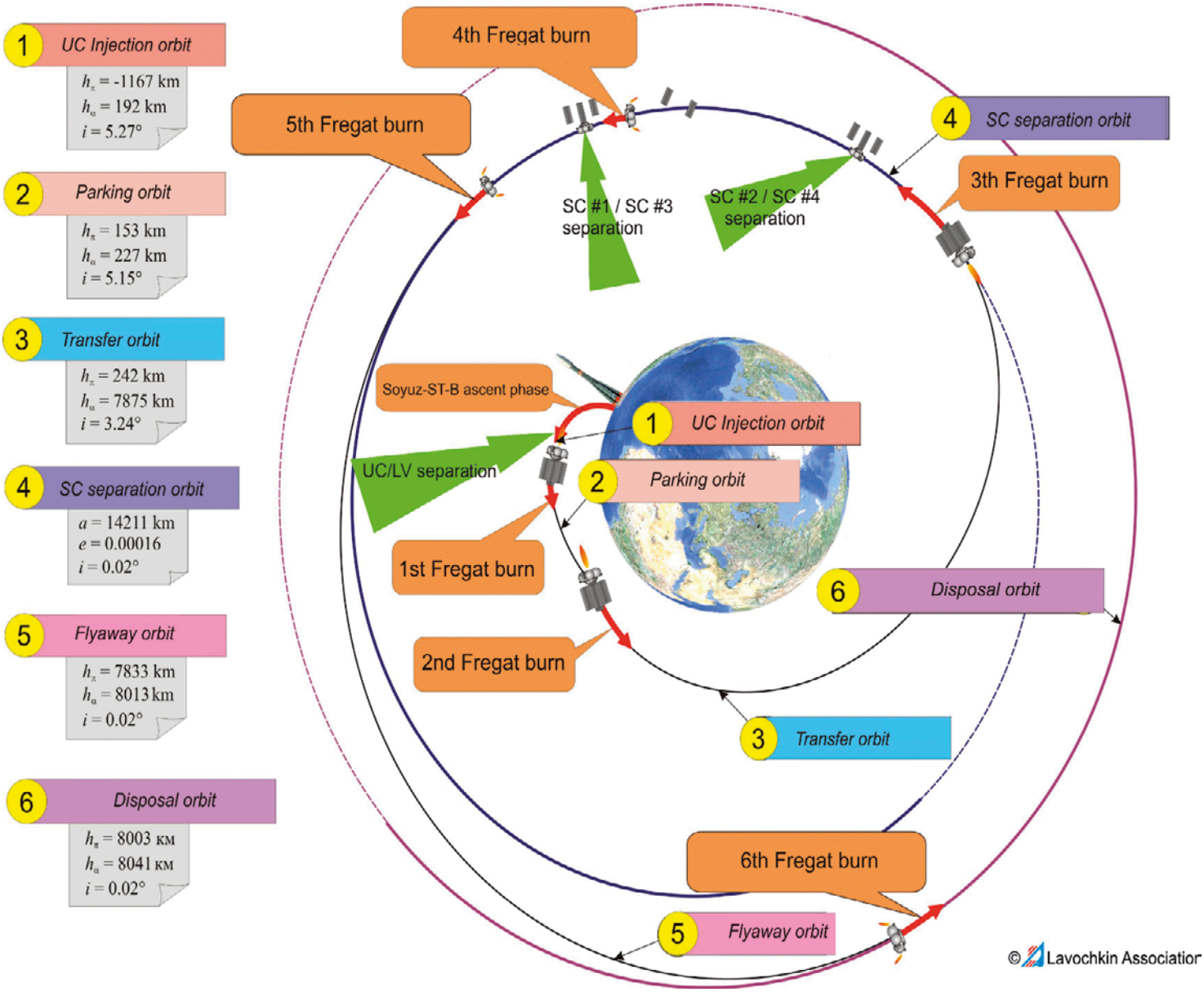
Soyuz launchers operated by Arianespace at CSGuse the ST fairing in standard configuration, with an external diameter of 4.1 meters and a length of 11.4 meters.

COUNTDOWN AND FLIGHT

The countdown comprises all final preparation steps for the launcher, the satellite and the launch site. If it proceeds as planned, the countdown leads to the ignition of the core stage engine and the four boosters.

Event	Time (h:min:s)
Beginning of the State Commission meeting for launcher fueling authorization	-04:20:00
Beginning of Launch Vehicle fuelling	-04:00:00
End of fueling operation	-01:45:00
Mobile gantry withdrawal	-01:00:00
Key on start (beginning of Soyuz synchronized sequence)	-00:06:10
Fregat transfer to onboard power supply	-00:05:00
Upper Composite umbilical drop off command.	-00:02:25
Ground-board power transfer	-00:00:40
Lower stage umbilical mast retraction	-00:00:20
Ignition	-00:00:17
Preliminary thrust level	-00:00:15
Full thrust level	-00:00:03
Liftoff	**00:00:00**
Jettisoning of boosters	+00:01:58
Jettisoning of fairing	+00:03:29
Separation of main stage	+00:04:48
Separation of 3rd stage	+00:09:23
Fregat 1st burn	+00:10:23
Fregat shut-down and beginning of ballistic phase	+00:14:20
Fregat 2nd burn	+00:22:50
Fregat shut-down and beginning of ballistic phase	+00:31:22
Fregat 3rd burn	+01:52:25
Fregat shut-down and beginning of ballistic phase	+01:57:27
Separation SC2 & SC4	**+02:00:47**
Fregat reignition (4th burn) and injection on s/c 1 & 3 separation orbit	+2:45:47 à +02:16:03
Separation SC1 & SC3	**+02:22:27**

O3b MISSION PROFILE



ARIANESPACE AND THE GUIANA SPACE CENTER

Arianespace was founded in 1980 as the world's first launch service & solutions company.

Today, Arianespace has 21 shareholders from ten European countries (including French space agency CNES with 34%, Airbus Defense and Space with 30%, and all European companies participating in the construction of Ariane launchers).

Since the outset, Arianespace has signed more than 350 launch contracts and launched over 370 satellites using Ariane, Soyuz and Vega launchers from the Guiana Space Center. Nearly two-thirds of the commercial satellites now in service worldwide were launched by Arianespace.

The company posted sales of 989 million euros in 2013.

Arianespace offers launch Service & Solutions 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.
- The Soyuz medium launcher, operated from the Baikonur Cosmodrome in Kazakhstan by Starsem, a Euro-Russian subsidiary of Arianespace, and from the Guiana Space Center.
- The Vega light launcher, launched from the Guiana Space Center since February 2012.

With this complete family of launchers, Arianespace has won nearly half of the commercial launch contracts open to competition 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 over 30 years, the Guiana Space Center (CSG), Europe's Spaceport in French Guiana, has offered a complete array of launch facilities.

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 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 Ariane, Soyuz and Vega launch complexes.

French space agency CNES plays several roles at the Guiana Space Center:
- It designs all infrastructures and is responsible, on behalf of the French government, for safety and security.
- It provides the resources needed to prepare the satellites and launcher for their missions.

Whether during tests or actual launches, CNES is also responsible for overall coordination of operations. It collects and processes all data transmitted from the launcher via a network of receiving stations, to track Ariane and Soyuz rockets throughout their trajectory.

In French Guiana, Arianespace is the contracting authority in charge of operating the family of three launchers, Ariane, Soyuz and Vega.

Roscosmos and the Russian launcher industry

Roscosmos, the Russian space agency, is responsible for license allocations and intergovernmental relations. it is the launch authority in charge of range operations.

TsSKB-Progress (Samara Space Center) is responsible for the design, development, and manufacture of launch vehicles, including the Soyuz launch vehicle's first, second and third stages and fairing. It also integrates vehicle stages and handles flight operations.

NPO Lavochkin manufactures and integrates the Fregat upper stage, and is responsible for launch operations.

TsENKI is the launch authority in charge of launch planning and the provision of associated services, including systems engineering, and the design, and technical and operational management of the launch pad and associated facilities dedicated to the Soyuz launcher.