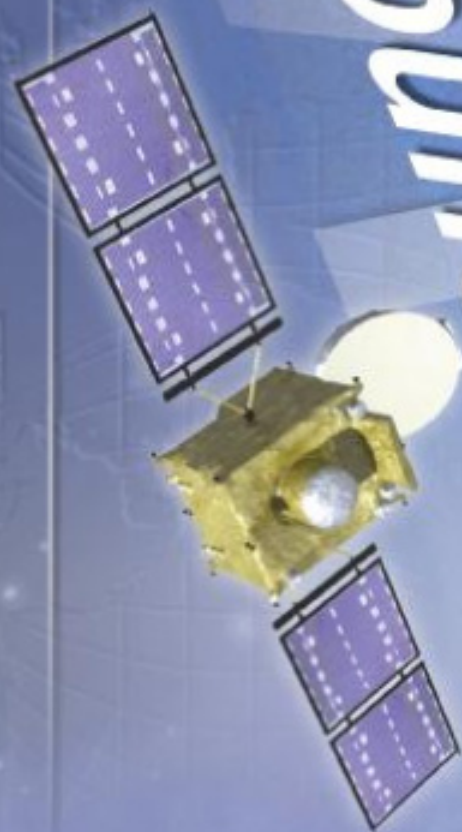


# AMOS 2 Launch

December 2003



**IAI** SYSTEMS MISSILES & SPACE GROUP  
ISRAEL AIRCRAFT INDUSTRIES LTD

# ***MBT Space Division***

## ***a member of the IAI Family***

### ***SYSTEMS MISSILES and SPACE GROUP***

**MBT Space Division** is a producer of observation and communication satellites and their associated ground stations. The division is one of five that make up the Systems Missiles and Space Group of Israel Aircraft Industries, Ltd. (IAI).

The other four divisions are:

**MBT Missiles Division** – producer of sophisticated, combat proven weapon systems for ground, naval and air applications.

**MLM** – the prime contractor and system integrator of the ARROW ATBM system and SHAVIT satellite launch vehicle and producer of C<sup>3</sup>I and advanced training and simulation systems.

**TAMAM** – producer of world-renown EO/IR payloads and Navigation Systems for naval, ground and air applications.

**MBT Technologies** – provider of engineering and production support services to the group's divisions and to all the other groups and divisions of IAI.

### ***ISRAEL AIRCRAFT INDUSTRIES, Ltd.***

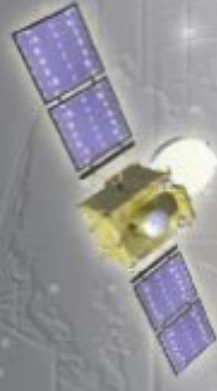
Israel Aircraft Industries, Ltd. (IAI) is a world leader in defense and civil aerospace technology. This year as it celebrates its jubilee, having been established in 1953, IAI can proudly reflect on its achievements in making Israel a regional superpower, developing the country's independent space capability, and supplying the Israel Defense Forces (IDF) and defense forces worldwide with unique and cost-effective solutions for a wide range of military needs. To meet the challenges of the 21<sup>st</sup> century, IAI is channeling its innovativeness into integrated systems to combat global terror, space technology, and adapting systems for the commercial market. Its corporate culture, based on technological innovation and customer-oriented development and services, is driven by the highest standards of excellence.

The company is involved in a very wide spectrum of activities, which fall under ten main business areas: Space; Homeland Defense; Theater Defense; Development and Manufacture of Commercial Aircraft; MRO & Conversion of Civil Aircraft; Military Aircraft & Helicopter Upgrades; Unmanned Aerial Vehicles; Intelligence Systems; Naval Systems; and Ground Systems.

With export sales to more than 60 different countries comprising over 80% of annual sales, IAI maintains offices in many capitals to provide support to all its customers.

### ***THE IAI FAMILY***

The corporation comprises five operating groups: Commercial Aircraft Group, Military Aircraft Group, BEDEK Aviation Group, ELTA Electronic Systems Group, and the Systems Missiles and Space Group. The company has 28 domestic and out-of-country plants, subsidiaries and joint-ventures associated with these groups. IAI main corporate offices are located at Ben-Gurion International Airport near Tel-Aviv.



# Space Systems

MBT Space Division is Israel's Space house and prime contractor for all of Israel's and other nations' turnkey space systems and programs. Its GEO and LEO satellites for communication and imaging, are currently operational. In-orbit testing (IOT) and control are performed throughout all phases of operation, via three ground stations at MBT.

## **AMOS - GEO Communication Satellites**

AMOS-1, launched in May 1996, provides communication services including Direct-to-Home (DTH) broadcasting for the Middle East and Central Europe. It will be joined by the co-located AMOS-2 to provide similar services and a direct internet link with the east coast of the United States. AMOS-HP (High Power) is currently in development.

MBT Space Division offers military communication satellites, tailored to specific user requirements.

## **OFEQ - LEO Observation Satellites**

The OFEQ Low Earth-Orbit (LEO) lightweight, high-resolution imaging satellite series has a bus that enables the satellite to meet the severe performance requirements of its optical payload. OFEQ-5, launched in May 2002, is currently in orbit.

## **EROS**

EROS-A, currently in orbit and the first of a joint-venture satellite constellation, provides commercial high-resolution space imagery services for mapping, urban planning, environmental control and various earth resources missions. Its high ground sampling resolution conforms to accepted commercial specifications. EROS-B, currently in development, is being designed for even higher resolution.



# Space Systems

## **IMPS**

The IMPS (Improved Multi-Purpose Satellite) is designed to carry a wide variety of payloads. The satellite is designed to perform critical tasks requiring high pointing accuracy. Its relatively small size and light weight make it compatible with smaller-class launchers.

## **TecSAR**

TecSAR is an active LEO, three-axis stabilized, Synthetic Aperture Radar (SAR) high-resolution, day-night, all-weather imaging demonstration satellite. It is designed for remote sensing with capability to execute radar imaging observation missions.

## **Launch Vehicles and Services**

MLM Division offers satellite insertion to orbit services, using its SHAVIT launchers for LEO orbits. Services include Launch-Site Infrastructure and instrumentation set up in customer's country. SHAVIT's unique design enables independent launch from almost any site.

MLM's LEOLINK program offers the SHAVIT family of launchers that includes LK-A for launching 350 kg satellites into 240 / 600 km elliptical polar orbits. MLM is developing the LK-1, to launch 350 kg satellites into 700 km circular polar orbits.

## **MicroSatellites**

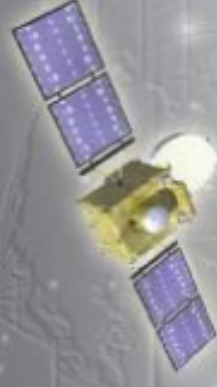
MBT Space's first micro-satellite is currently operating in space and it is continuing development of micro-satellite technologies. Weighing between 50 and 120 kg, they are designed to carry payloads for scientific, research and commercial applications, such as earth observation and communication.

## **Subsystems and Components**

TAMAM space subsystems and components such as Strap-Down Attitude Reference systems, Rate-Gyros, Reaction/Momentum Wheels, Magnetometers/Magnetotorsquers and Flux-gate Magnetometers are installed on satellites currently in orbit. MLM produces a range of Solar Array panels that provide electrical power to satellites.



# AMOS 2 Satellite



The AMOS 2 communication satellite will provide communication and broadcasting services to the Middle East, Europe and the East coast of the United States.

AMOS 2 will be positioned in a geo-stationary orbit, co-located with AMOS 1, at 4° West. The AMOS 2 satellite is a follow-on to the AMOS 1 (successfully operating in orbit since May 1996).

The spacecraft and its associated ground control center were designed and manufactured by IAI/MBT Space Division.

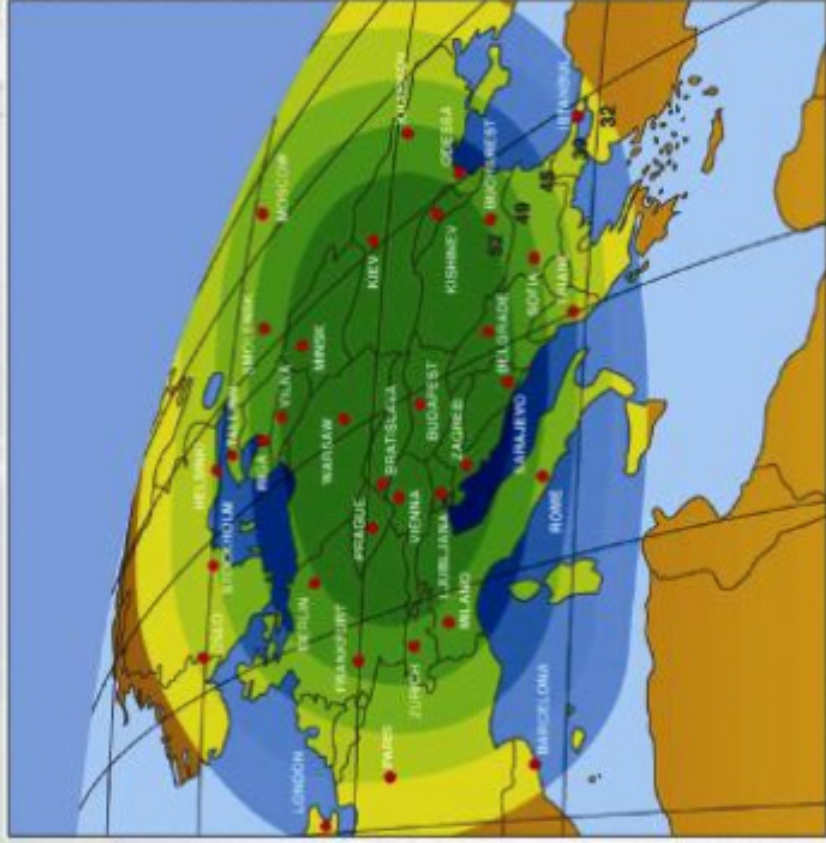
The satellite basic dimensions, in stowed configuration, are: 2,698 x 2,056 x 2,384 mm

## AMOS family characteristics

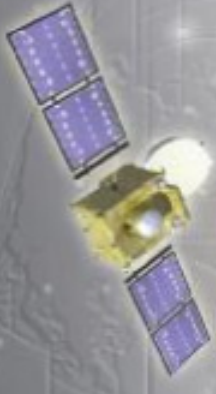
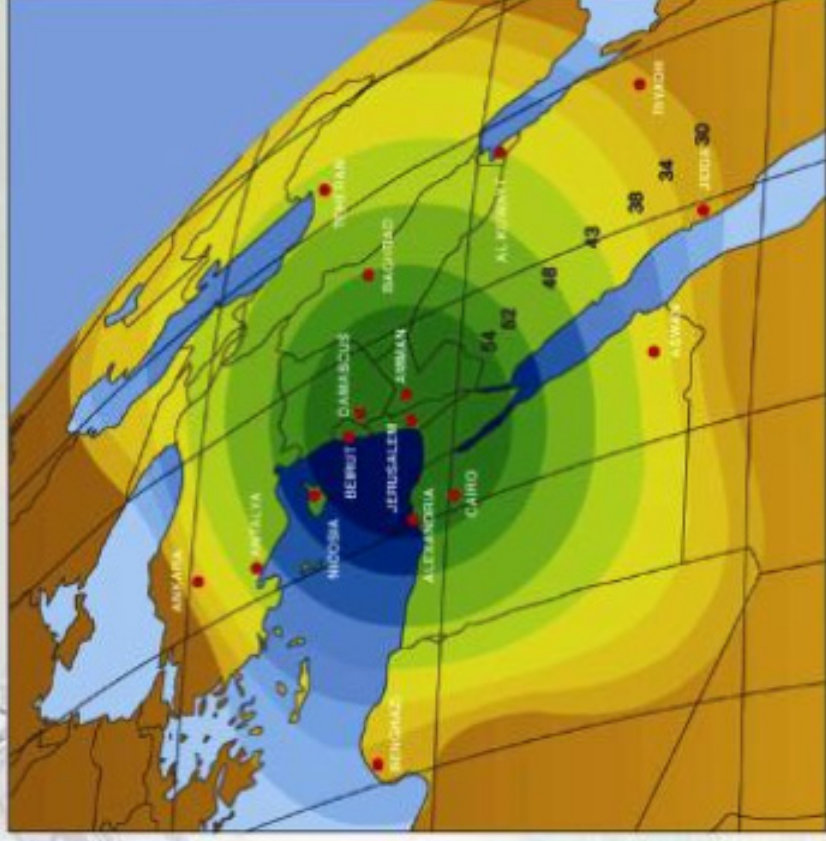
	AMOS 1	AMOS 2
S/C Mass (at Lift-off)	996 kg	1370 kg
Payload Mass	100 kg	160 kg
Payload Power	600 W	1350 W
Solar Array Power	1200 W	1800 W
Frequency Band	Ku	Ku
No. of Transponders	7/9, 72 Mhz (37W)	11/14, 72 Mhz (75W)
Service Areas	Middle East & Central Europe	Middle East, Europe & East Coast of the USA
EIRP (at beam center)	57 dBW	57 dBW (50 dBW for US service area)
Orbital Slot	4° W	4° W
Ground Control Center	AMOS GCC	Upgraded AMOS GCC
Launch Vehicle	Ariane 4	Soyuz-FG/Fregat

# AMOS 1 - Service Areas

Europe EIRP (dBW)

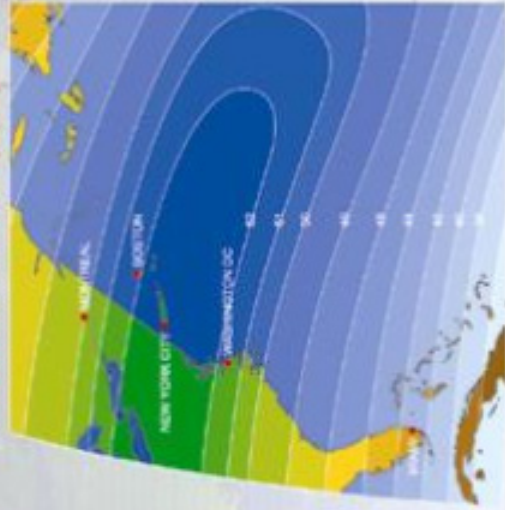


Middle East EIRP (dBW)

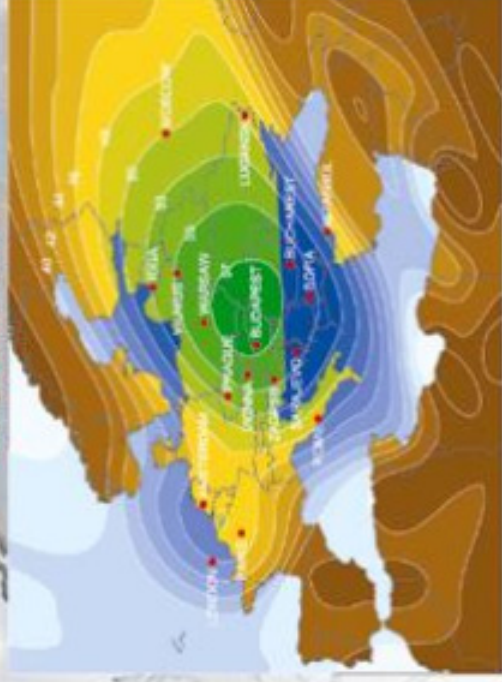


# AMOS 2 - Service Areas

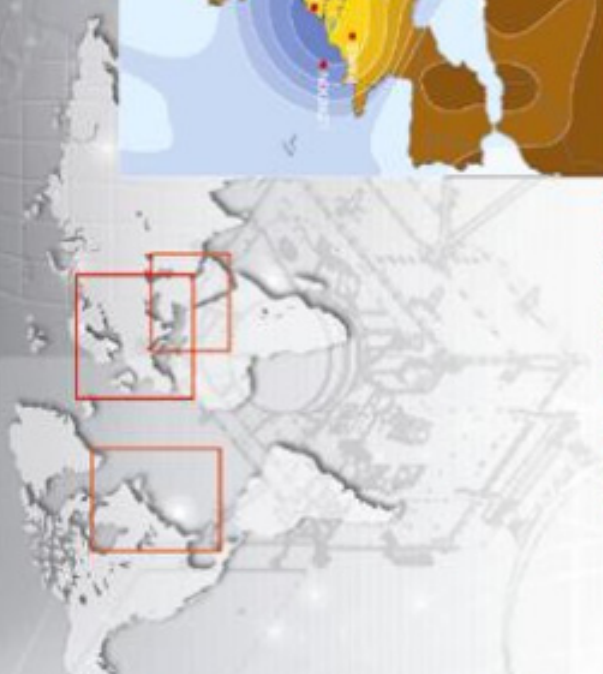
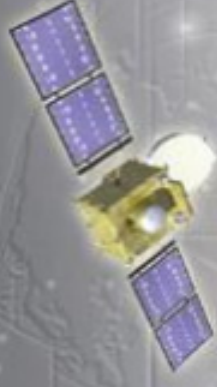
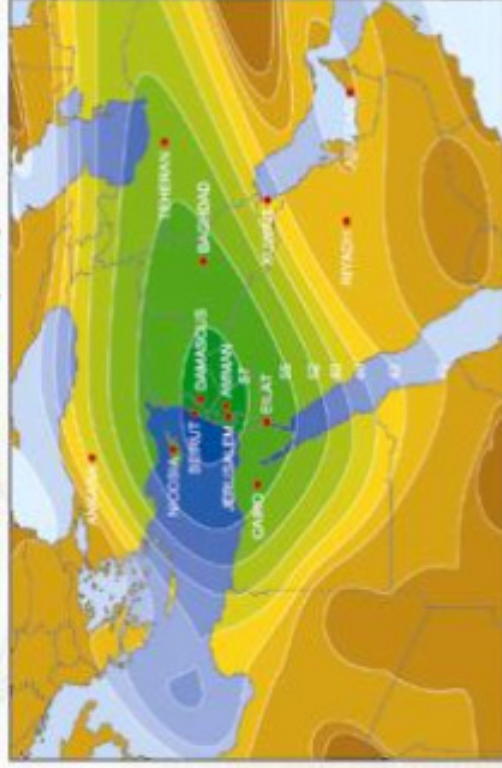
North America EIRP (dBW)



Europe EIRP (dBW)



Middle East EIRP (dBW)



# SOYUZ Launch Vehicle

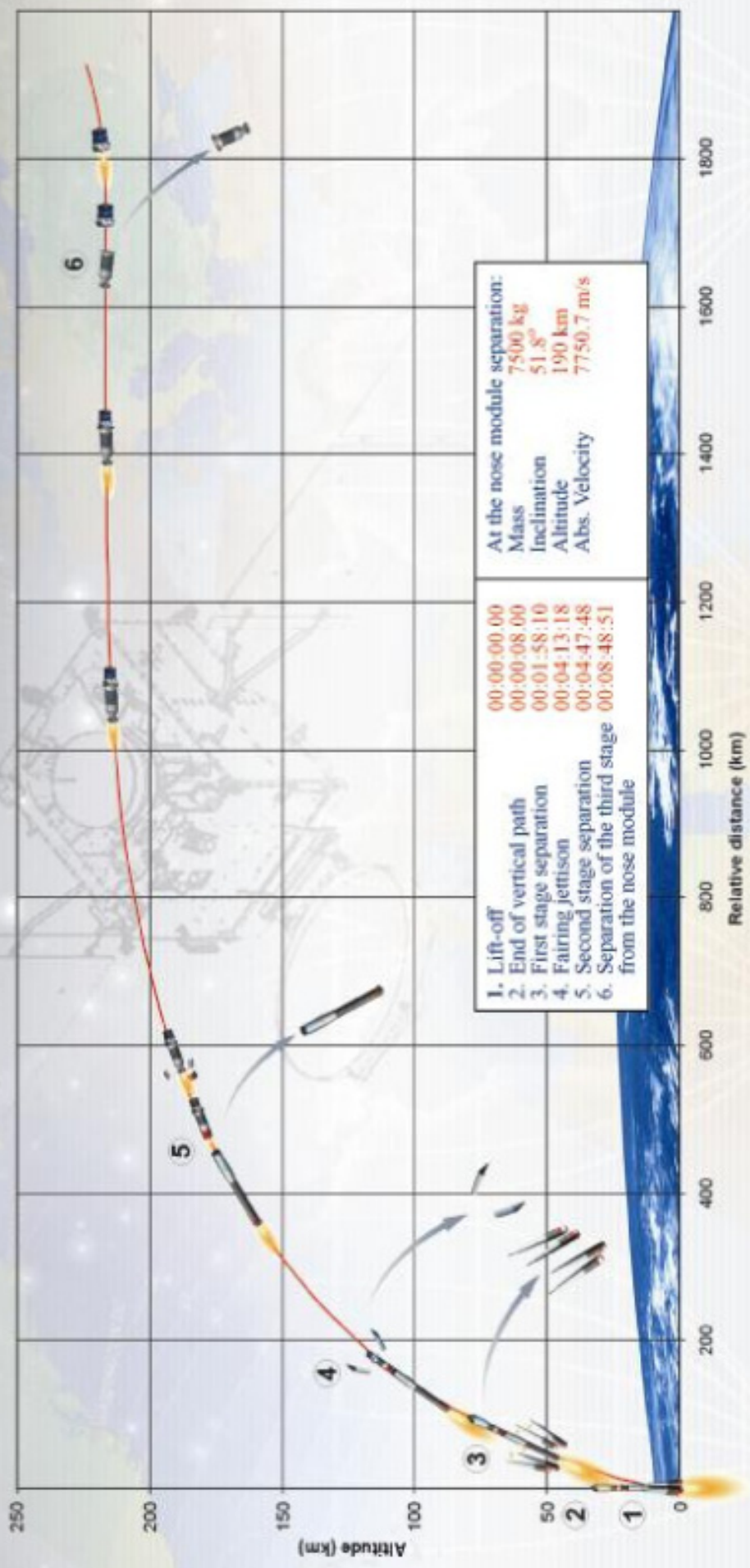
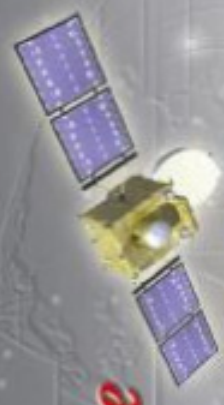
The Soyuz configuration, introduced in 1966, has been the workhorse of the Soviet/Russian space program, achieving a high launch success rate in over 1,680 flights. As the only manned launch vehicle in Russia and the former Soviet Union, the Soyuz benefits from standards of excellence in both reliability and robustness.

The launch of AMOS 2, originally planned on Ariane launcher, will be performed by the Soyuz vehicle from the Baikonur Cosmodrome in Kazakhstan.

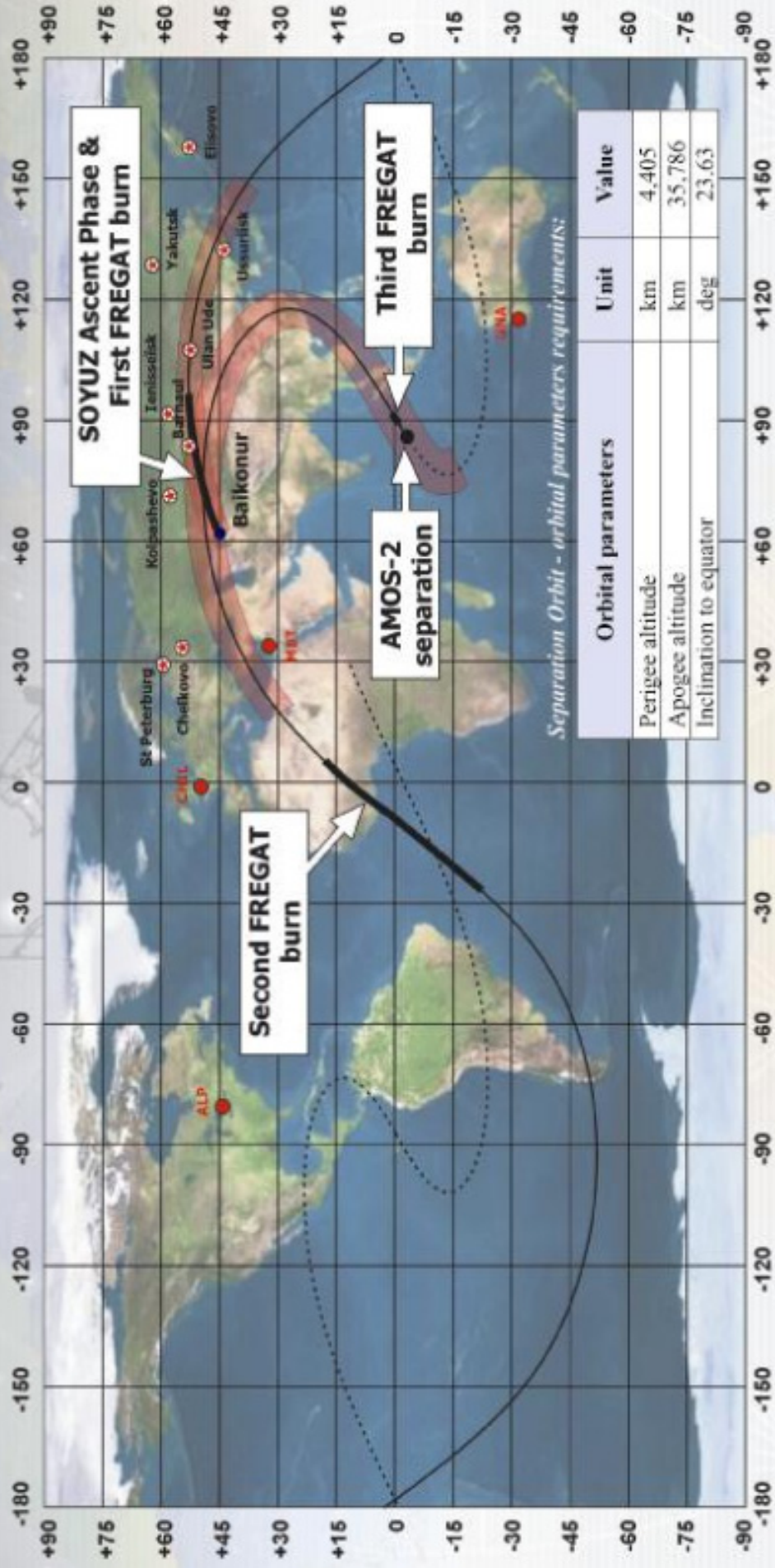
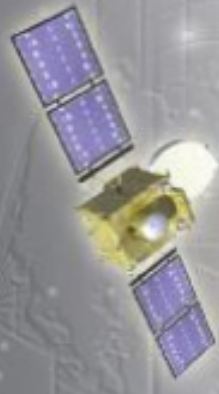
The Soyuz currently offered by Starsem is a four-stage launch vehicle. The vehicle consists of four boosters (first stage), a central core (second stage), a third stage, and the autonomous FREGAT upper stage (fourth stage). Each vehicle also includes a payload adapter/dispenser and a fairing.



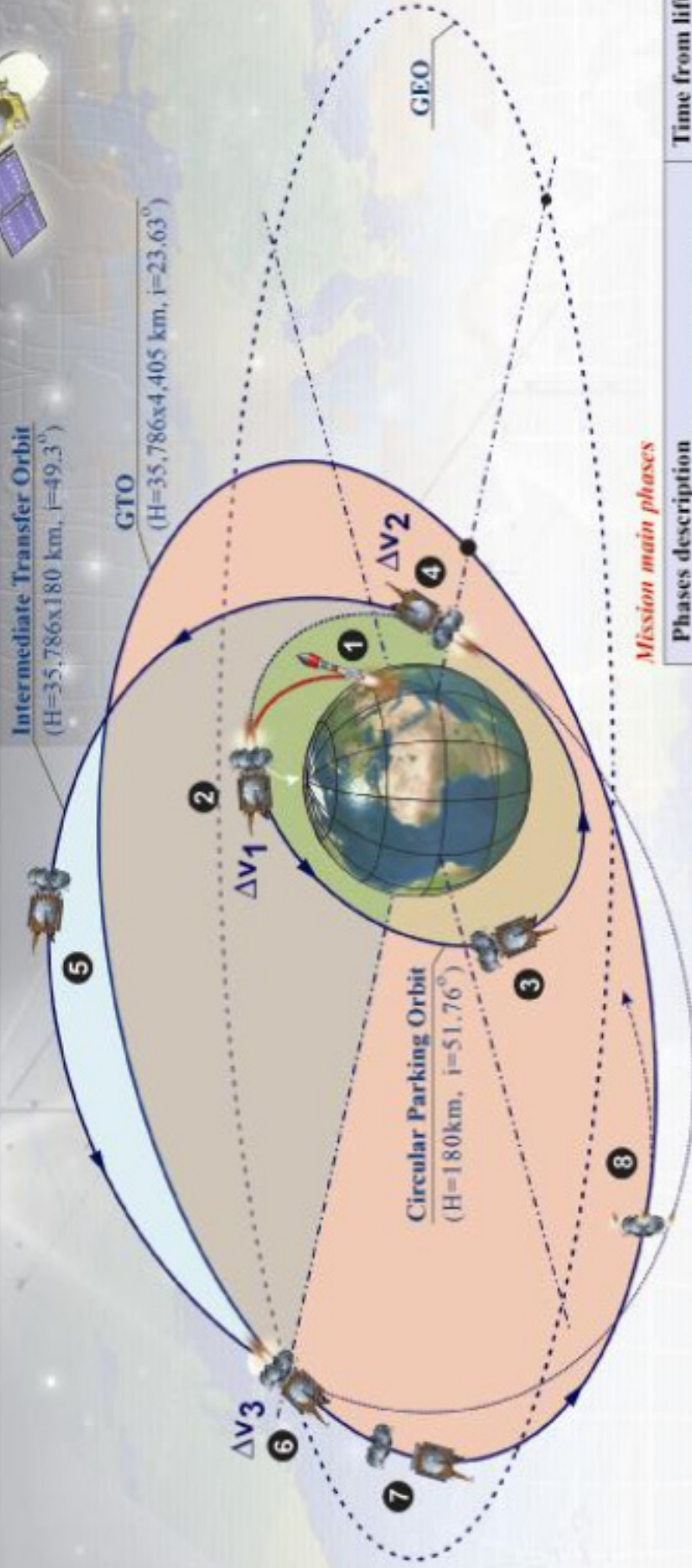
# Three-Stage SOYUZ Vehicle Ascent Phase



# FREGAT Flight Path



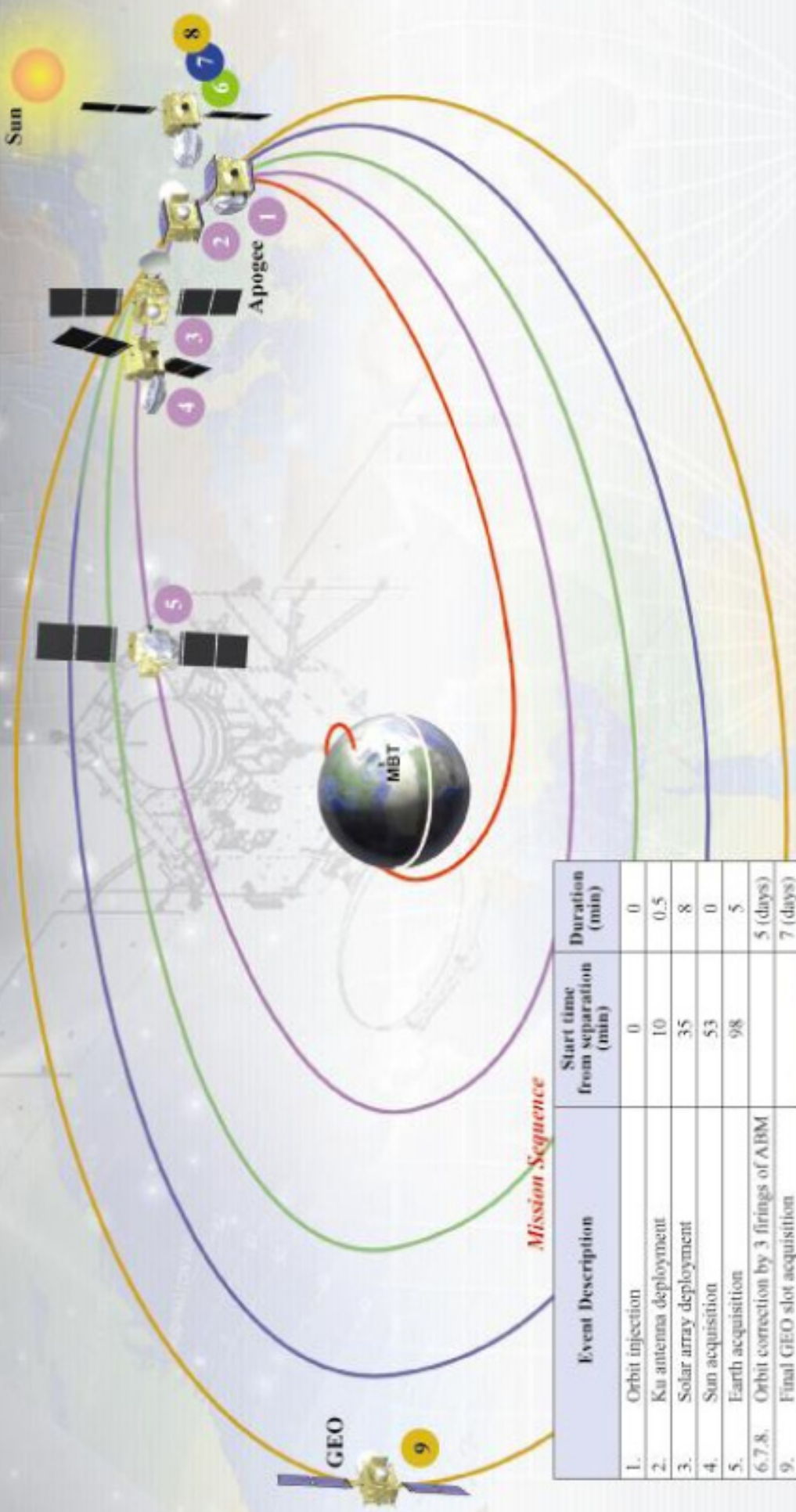
# FREGAT Orbital Phase



## Mission main phases

Phases description	Time from lift-off
1. FREGAT separation from the third stage	00:08:49
2. First FREGAT burn	00:10:16
3. Coast phase	
4. Second FREGAT burn	01:21:34
5. Coast phase	
6. Third FREGAT burn	06:36:47
7. Spacecraft separation	06:46:47
8. FREGAT maneuver into safe orbit	07:16:47

# Major Events after S/C Separation



*Mission Sequence*

Event Description	Start time from separation (min)	Duration (min)
1. Orbit injection	0	0
2. Ku antenna deployment	10	0.5
3. Solar array deployment	35	8
4. Sun acquisition	53	0
5. Earth acquisition	98	5
6,7,8. Orbit correction by 3 firings of ABM		5 (days)
9. Final GEO slot acquisition		7 (days)