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Soyuz TMA-18M landing

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The *Tiros Space Information (TSI) - News Bulletin* is published to promote the scientific exploration and commercial application of space through the dissemination of current news and historical facts.
In doing so, Tiros Space Information continues the traditions of the Western Australian Branch of the Astronautical Society of Australia (1973-1975) and the Astronautical Society of Western Australia (ASWA) (1975-2006).
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Calling card...

SpaceX once again failed to recover the first stage of the Falcon launch vehicle on 4 March 2016.
As a qualified accountant specialising in budgeting and costing, I have always wondered about the financial aspects of such an effort and, as an (unqualified) space expert, I wonder about the technical viability.

From a technical perspective, a first stage is little more than a big tube with some equipment in it. It is a piece of hardware that lacks any aerodynamic stability forcing that much attention has to be paid to keeping it stable all the way to touchdown, with a requirement for extra fuel and equipment.
Then consider the cost penalty imposed by this extra fuel and equipment that is to be carried for a successful recovery. This cost has to be seen vis-à-vis the potential extra income that could be generated by making the space/mass of that extra fuel and equipment available for an income deriving payload.

Furthermore, the question is also how much money is being saved by re-using a first stage instead of a newly constructed first stage, bearing in mind that there will be a need to refurbish the recovered stage.
But the most damning aspects is, in my opinion, the failures so far. So far landing attempts have been made on a barge in the ocean, so if it goes wrong, there is little damage to the immediate environment. But consider the eventual proposal to land the first stage back on the launch facility – what sort of damage will that cause to that facility, in case there is a failure.

Having said all that, I trust that the SpaceX people (and any other group considering this) have studied all these matters and have concluded their idea is a viable and safe one.

As a very limited expert, I would love to see their detailed investigation reports, especially considering that one group, Orbital ATK, has found sufficient arguments against recovery.

Jos Heyman

ExoMars

On 14 March 2016 a Proton M/Briz M launch vehicle placed the ExoMars/TGO into a trans-martian trajectory.

The Exobiology on Mars (ExoMars) programme is a two spacecraft mission to search for biosignatures of Martian life, either in the past or in the present. In addition the mission is to investigate the water and geochemical distribution, to study the surface environment and identify hazards to future manned missions to Mars, to investigate the planet's subsurface and deep interior to better understand the evolution and habitability of Mars and achieve incremental steps ultimately culminating in a sample return flight.

Developed by the European Space Agency (ESA) in collaboration with the Russian space agency Roscosmos, the programme consists of:
- The Trace Gas Orbiter (TGO) and an EDM stationary lander called 'Schiaparelli';
- A Russian built lander is to deliver an ESA-built rover to the martian surface in 2018.

The 4332 kg Trace Gas Orbiter (TGO), built by Europe, carried a 112 kg science payload:
- Nadir and Occultation for MArs Discovery (NOMAD), two infrared and one ultraviolet spectrometers to perform high-sensitivity orbital identification of atmospheric components, including methane and many other species, via both solar occultation and direct reflected-light nadir observations;
- Atmospheric Chemistry Suite (ACS), a suite of three infrared instruments to investigate the chemistry and structure of the Martian atmosphere. ACS will complement NOMAD by extending the coverage at infrared wavelengths, and by taking images of the Sun to better analyse the solar occultation data;
- Colour and Stereo Surface Imaging System (CaSSIS), a high resolution camera (5 m per pixel) capable of obtaining colour and stereo images over a wide swath. CaSSIS provides the geological and dynamical context for sources or sinks of trace gases detected by NOMAD and ACS; and
- Fine Resolution Epithermal Neutron Detector (FREND), a neutron detector to map hydrogen on the surface down to a metre deep, revealing deposits of water-ice near the surface.

In addition the TGO carries the Entry, Descent and Landing Demonstrator Module (EDM), also named Schiaparelli, a 600 kg vehicle fitted with three clusters of 3 hydrazine pulse engines and two 12m diameter parachute. The lander was named after the 19th century astronomer Giovanni Schiaparelli.
The Schiaparelli carries the Dust Characterisation, Risk Assessment, and Environment Analyser on the Martian Surface (DREAMS) package, consisting of a suite of sensors to measure the wind speed and direction (MetWind), humidity (DREAMS-H), pressure (DREAMS-P), atmospheric temperature close to the surface (MarsTem), the transparency of the atmosphere (Solar Irradiance Sensor, SIS), and atmospheric electrification (Atmospheric Radiation and Electricity Sensor; MicroARES).
The Entry and Descent Module Descent Camera (DECA) on the EDM will deliver additional scientific data and exact location data in the form of images during the descent.

After entering into an orbit around Mars in December 2016, the TGO will deploy the EDM Schiaparelli that will land at Meridiani Planum. TGO will continue in a martian orbit to undertake its own observations as well as serving as a relay station for the EDM Schiaparelli and the 2018 lander.

The second ExoMars mission, scheduled for launch in May 2018 will comprise a Russian lander fitted with a rover vehicle that will travel across the martian surface and will drill two metres below the surface, and a stationary surface science platform.
After landing on Mars in 2019, the rover will descend from the lander via a ramp. Then both, the lander and the rover, will begin their scientific operations.

Ever since its inception by ESA in 2005, the ExoMars programme has gone through several phases of planning with various proposals for landers, orbiters, launch vehicles, and international cooperation planning.

Intitially ExoMars was to be a rover with a stationary ground station. The rover was to carry the Pasteur and Humboldt payloads with comprehensive suites of instruments that would characterise the Martian biological and geophysical environment. The launch was proposed for 2009 on a Soyuz-Fregat launch vehicle.
Funding problems caused delays although Canada's MacDonald, Dettwiler and Associates Ltd. (MDA), in association EADS Astrium of Britain, was contracted in 2007 to design and build a prototype Mars rover chassis

By July 2009 NASA and ESA agreed on a Mars Joint Exploration Initiative that significantly altered the programme into two separate launches:

- Trace Gas Orbiter (TGO), which was to carry a series of instruments into Martian orbit as well as deploy a 600 kg static meteorological lander. The launch was scheduled for January 2016 and was to be with an Atlas V411 launch vehicle whilst orbital insertion was to take place in 2017; and
- A 2018 mission that would carry the 65 kg Mars Astrobiology Explorer-Cacher (MAX-C) rover, developed by NASA, and the 270 kg ExoMars rover developed by ESA. Launch was to be with an Atlas V551 launch vehicle and orbital insertion would have been in 2019.

In August 2009 the Russian Federal Space Agency Roscosmos and ESA agreed to cooperate on two Mars exploration projects: Russia's Fobos-Grunt project and the ExoMars. At that time ESA secured a Russian Proton M launch vehicle as a backup launcher, in exchange of which the ExoMars rover, would include Russian-made parts.

In April 2011 the MAX-C rover was cancelled by NASA due to budget constraints. NASA would continue to provide the rocket to deliver it to Mars and provide the sky crane landing system. On 13 February 2012 NASA withdrew totally form the project as a result of further budget restraints, resulting in a complete restructure of the ExoMars programme that resulted in an agreement with Russia on 14 March 2013.
The Russian collaboration now consisted of two Russian instruments developed for Fobos-Grunt to be placed on TGO and the supply of two Proton M launch vehicles for the programme.

Satellite Update

Launches in February 2016

Int.Des.	Name	Launch date	Launch vehicle	Country	Notes
2016 006A	Beidou 3M-3S	1-Feb-2016	CZ 3C	China	Navigational
2016 007A	Navstar 2F-12	5-Feb-2016	Atlas V-401	USA	Navigational
2016 008A	Kosmos-2514	7-Feb-2016	Soyuz 2-1b/Fregat M	Russia	Navigational
2016 009A	Kwangmyongsong-4	6-Feb-2016	Unha 3	N. Korea	Technology
2016 010A	Topaz-4	10-Feb-2016	Delta 4 M+(5,2)	USA	Reconnaissance
2016 011A	Sentinel 3-A	16-Feb-2016	Rokot KM	ESA	Earth observation
2016 012A	Astro-H	17-Feb-2016	H 2A-202	Japan	Astronomy
2016 012B	ChubuSat-2	17-Feb-2016	H 2A-202	Japan	Technology
2016 012C	ChubuSat-3	17-Feb-2016	H 2A-202	Japan	Technology
2016 012D	Horyu-4	17-Feb-2016	H 2A-202	Japan	Technology

Other updates

Int. Des.	Name	Notes
1998 067GN	Flock 1e-9	Re-entered 8 February 2016
2011 066A	Tianxun-1	Re-entered 7 February 2016
2013 064R	COPPER	Re-entered 4 February 2016
2015 072A	Cygnus Orb-4	Undocked on 19 February 2016 and re-entered on 20 February 2016

Iridium NG

Because of delays in Russia, Iridium has switched the launch vehicles for its 72 next generation satellites from a Dnepr launch vehicle to a Falcon 9. The first 10 satellites will be launched in July 2016 with a second batch of 10 due for October 2016. The remaining satellite would follow in batches of 10 at 60 day intervals. The launches will take place from Vandenberg.

Tiangong-2

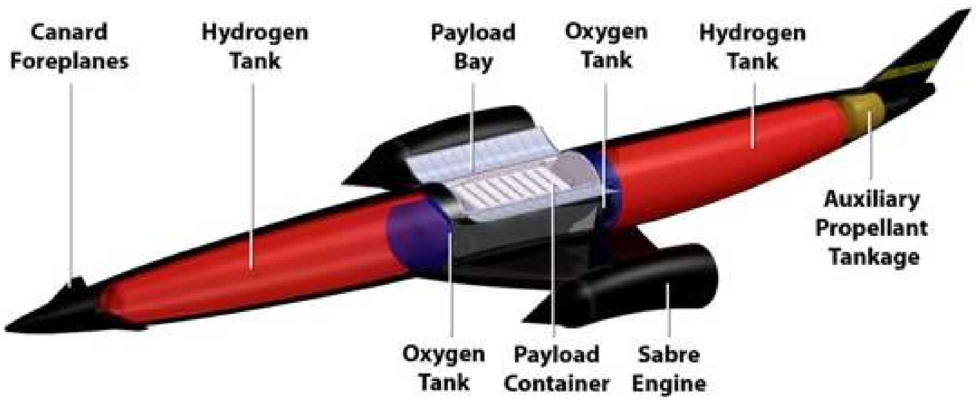
China has announced that it's second space laboratory, Tiangong-2 will be launched with a CZ 2F launch vehicle from Jiuquan in the third quarter of 2016.
This will be followed by the launch of a crew of two on board of the Shenzhou-11 in the fourth quarter using another CZ 2F launch vehicle.
The final mission in this phase, will be the launch of the Tianzhou-1 cargo space craft with a CZ 7 launch vehicle from Wenchang. The latter launch will take place early 2017 and follow a test launch of the CZ 7 in June 2016.

Cancelled Projects: Skylon

By Jos Heyman

Over the years there have been various proposals for single-stage-to-orbit (SSTO) horizontal-takeoff-horizontal-landing launch vehicles that would make spaceflight similar to aircraft flights..

One of these was the mid-1990's British Skylon proposal advanced by Reaction Engines Limited (REL), a firm established by the designer Alan Bond, Rolls Royce and British Aerospace. The design was roughly based on Bond's HOTOL proposal of 1982.



Skylon configuration

The Skylon was to have a delta wing with a span of 25 m, a fuselage length of 82 m and a fuselage width of 6.15 m. With an empty mass of 55,000 kg, it was expected to deliver 12,000 kg to a 300 km equatorial orbit or 10,500 kg to a 460 km equatorial orbit or 9,500 kg to a space station at a 460 km orbit with and inclination of 28.5^{o}.

The Sabre engine

It was to be powered by two Rolls Royce Sabre hybrid airbreathing/rocket engines which, using liquid hydrogen fuel, would drive the launch vehicle to Mach 5.5 whilst still within the atmosphere whilst beyond that on-board liquid oxygen would be added to drive the Skylon to orbital velocity. The two engnes were to be fitted at the wing tip and the vehicle would have carried 66,000 kg of liquid hydrogen and 150,000 kg of liquid oxygen for the ascent to orbit.

The vehicle itself was to consist of a carbon fibre re-inforced plastic framework with a fibre re-inforced ceramic outer shell with a thickness of 0.5 mm. This outer shell was corrugated for stiffness.
With the framework were aluminium propellant tanks.

The payload bay measured 12.3 m in length and 4.6 m in diameter and was capable to carry contemporary payloads as well as cargo modules and even a 30 passenger module was considered. .

The vehicle would take off and land using a heavily reinforced runway and ground handling would have been fairly conventional except for the crygenic propellant that was to be loaded. A turn-around time of 2 days was envisaged.

Re-entry was to occur at an altitude of 90 to 60 km and the heat was to be radiated away from the hot aeroshell, partially using remaining liquid hydrigen that was allowed to evaporate through thermal screens to intercept the small residual heat leak and then vented overboard.

With a capacity of at least 200 flights for each Skylon vehicle, it was seen as an effective way to make space transportation an everyday tool for commercial operators. In particular it was envisaged that operators in the aviation cargo transport business would be main users.

Whilst initial operations were expected to take place from existing facilities, be it with modifications, it was envisioned that in the longer term operations would move to three sites along the equator to make use of the fullest capacity of the vehicle.
A fleet of 30 spaceplanes was envisaged which would collective launch 100 satellites in a year from the three spaceport. This would have meant a launch cost of $40 million per flight which was seen as a significant reduction in cost. In a real market, however, a pricing strategy was envisaged that would create different rates for cargo categories and human transport. The developers expected mission costs to fall to about $10 million per launch for high product value cargo, such as communications satellites, to $2.5 million for low product value cargo, such a scientific payloads and to about $100,000 per passenger for space tourists.
It was intended that the Skylon would be developed on a commercial basis by manufaturers in Europe, Asia and the Americas. Operators would then buy or lease the vehicles from the manufacturers, in much the same way as is done with aircraft.
All this was to be operational by 2020/2025.

Despite the extreme promise of the design, neither British government nor private financing was forthcoming and development was suspended in 1995.

The failure can be attrbuted to an incorrect assessment of the market potential. The assumption that the market would be big enough to keep 30 spaceplanes active with a total of 100 launches each year, was flawed from the beginnng. Bearing in mind the availability of existing and proven launch vehicles, such as the Delta, Atlas, Soyuz, Proton and Ariane, there simply would not

have been sufficient launch opportunities to make the Skylon project sustainable, even if the mega-satellite constellations that were talked about in those days, would have materialised.
Compounding this was the flawed perception that airline cargo operators would have been the main customers. These operators are interested at moving cargo from a sender's location to a receiver's location using facilities (ie airport) as close as possible to those two locations. Shipping cargo via the equatorial locations proposed for Skylon, would have been uneconomical.

Nevertheless, Bond managed to interest the European Space Agency (ESA) in the Skylon project and in 2012 ESA funded research and development work on the Sabre engine. Also the British Government gave its support in 2013 for the building of a prototype of the Sabre engine.
The ESA interest is presumably based on the capability of the Skylon to carry 11,000 kg of payload to the International Space Station.
Based on this it has been suggested that a pre-production prototype of the Skylon could be flying on a sub-ornital trajectory from Kourou to Kiruna in Sweden, in 2016, with a first full test flight in 2019 and operational flights to ISS by 2022.

But, even though the basic vehicle is the same as that advanced in the 1990s, this potential ESA involvement is for a totally different purpose and does not support the vision of the 1990s. And whether the ESA involvement will result in flyable hardware remains doubtful, considering the potential future of ISS and the ESA commitment to the Ariane 6 development.

Skylon in space

WSG

The US Air Force is considering to acquire three more Wideband Global Satcom satellites for replacements in the current three satellites system.
Currently there are seven WSG satellites in orbit with another three to be launched in the next three years, making a total of ten. The three additional ones now being considered would make it a total of thirteen.

ISS One Year Mission

On 2 March 2016 Scott Kelly and Mikhail Kornienko returned to Earth after having spend 340 days, 8 hours and 43 minutes in space.
They came to the International Space Station on 27 March 2015 on board of Soyuz TMA-16M. The return flight was made on Soyuz TMA-18M, along with Sergey Volkov.

Kelly and Kornienko's year in space mission was to study how the human body responds to lengthy exposure to microgravity and space radiation. During this period they made 5440 orbits around Earth.

Whilst Kelly and Kornienko's mission has been the longest on ISS, longer missions were completed three times on the Mir space station with Valeri Polyakov having the longest mission of 438 days. But those missions did not gather as much data as is possible with current technology and experiment facilities established on ISS.
In addition, Scott Kelly has an identical twin brother, Mark, who was also an astronaut and this will enable the comparison of the genetic changes Scott may have encountered during his stay in space.
Scientists are expected to be busy for years analysing the data gathered on this mission.

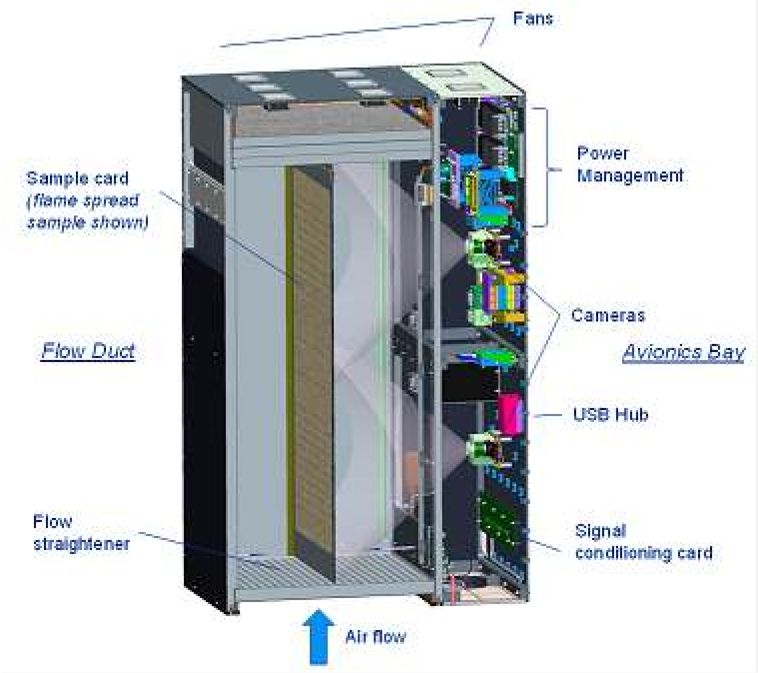
Re-usable launch vehicles

Orbital ATK has stated that it will not pursue re-usability of its Antares launch vehicle components at this point of time, as it is not clear yet whether, considering the launch rates and refurbishment cost and payload penalties imposed by re-usability, it makes economic sense to re-use some or a large part of the launch vehicle.
Meanwhile, Gwynne Shotwell, President of Space X, has suggested that the re-usable first stage of the Falcon 9, could cut launch cost by 30%.
She said it was too early to set precise prices for a re-used Falcon 9, but that if the fuel on the first stage costs $1 million or less, and a re-used first stage could be prepared for reflight for $3 million or so, a price reduction of 30% - to around $40 million - should be possible.

Cygnus Orb-6

The Cygnus Orb-6 cargo transfer spacecaft, named SS Rick Husband, was launched on 23 March 2016 and docked at the Earth facing port of the Unity module of ISS on 26 March 2016. It carried 3513 kg of cargo, including 20 Flock 2d Earth observation satellites, 5 Lemur 2 satellites as well as the Diwata-1 satellite. The launch vehicle for this flight, an Atlas V-401, had originally been intended for the GOES-R flight, which has been delayed.

When Cygnus Orb-6 will be undocked in May, it will be used in the Spacecraft Fire Experiment (SAFFIRE)-1 experiment to study how flames spread in weightlessness. The deliberate fire will be contained within an instrumented research box measuring 89 x 130 cm.
NASA intends to run SAFFIRE experiments on three consecutive Cygnus spacecraft launching through to the end of this year. The SAFFIRE-1 and -3 tests will use single combustion samples of 40 x 97 cm, whilst the SAFFIRE-2 test will use nine smaller combustion samples, each measuring 5 x 15 cm. The burns are expected to last 15 to 20 minutes and the development of the flames will be recorded by two cameras.



SAFFIRE-1

Earlier experiments of this nature have been done on ISS but on a very small scale so as not to endanger the lives of the crew. This time there is no such restriction and the results will provide a better understanding of how fires in the cabin atmosphere will behave in weightlessness. From this it will possible to develop fire safety for future spacecraft and define the right types of fire detection, suppression and protection for astronauts trying to fight a blaze.

Flock 2 series

With 20 Flock 2d Earth observation satellites flown to ISS on board of Cygnus Orb-6, it is appropriate to investigate the other batches of Flock 2 satelltes.
At the time of writing fourteen Flock 2b satellites have been deployed from ISS (although two failed), whilst another twelve, identified as Flock 2e, are already on board of ISS, awaiting deployment.
The Flock 2a batch (number unknown) will be launched in December 2016 with a Soyuz 2-1b/Fregat as an auxiliary payload on the Meteor M2-1.
The Flock 2c series (again number unknown) is scheduled for launch in mid-2016 with a Soyuz 2-1a/Fregat as a secondary payload to Kanopus-V-IK.

Hispasat

Spanish satellite operator has renamed its operational communications satellites to reflect their orbital location. The new names are:

- Hispasat 30W-4: formerly Hispasat 1-D
- Hispasat 30W-5: formerly Hispasat 1-E
- Hispasat 55W-1: formerly Amazonas-1
- Hispasat 84W-1: formerly Hispasat 1-C

Two future satellites, Hispasat AG-1 and Hispasat 1-F have been renamed as Hispasat 36W-1 and Hispasat 30W-6 respectively.
Whilst there is no mention of Hispasat 30W-1, -2 and -3, we can assume that these names reflect retired satellites and have not been formally adopted.

Europasat/Hellas Sat-3

Delays with the SpaceX Falcon Heavy has made Inmarsat switch to a Proton launch vehicle for the deployment of its Europasat/Hellas Sat-3 communications satellite, scheduled for 2017.
Co-owned with Arabsat the satellite will carry 44 Ku band transponders to be used by Arabsat, a Ka band transponder and an S band payload for use by Inmarsat. The satellite is being built by Thales Alenia using the Spacebus 4000C4 platform.

Satellogic

Satellogic is set to launch the first of its 300 operational Earth observation satellites later this year. Each satellite will have a mass of about 35 kg and will undertake one meter multispectral imaging.
Two are expected to be launched with a CZ 4B in May 2016 with another four with a Dnepr launch vehicle later during the year. Another 19 are expected to be launched in 2017. After that it is intended to launch 25 each year. Once the constellation is completed it will provide near-real time imagery of the Earth.
The company is based in California, USA but a factory in Buenos Aires, Argentina, will build the satellites at a rate of about 50 satellites each year.

Satbyul

Satbyul (Morning Star), is a South Korean company providing launch services as well as satellite platforms.
The platforms include;

- GEO-Atom, a communications satellite fitted with electric propulsion and with a capacity of up to 20 transponders;
- SAR-Rigel, a 600 kg S band radar satellite that can provide images with a resolution of 6 m over a swath of 100 km;
- EO-Auriga, a multispectral imaging satellite;
- EO-Perseus, another multispectral imaging satellite with a 22 m resolution;
- PM-Tel600, a 180 kg scientific satellite with a 600 mm aperture telescope suitable for planetary and small bodies observations;
- AIS-DX1, an Automatic Identification System satellite for shipping.

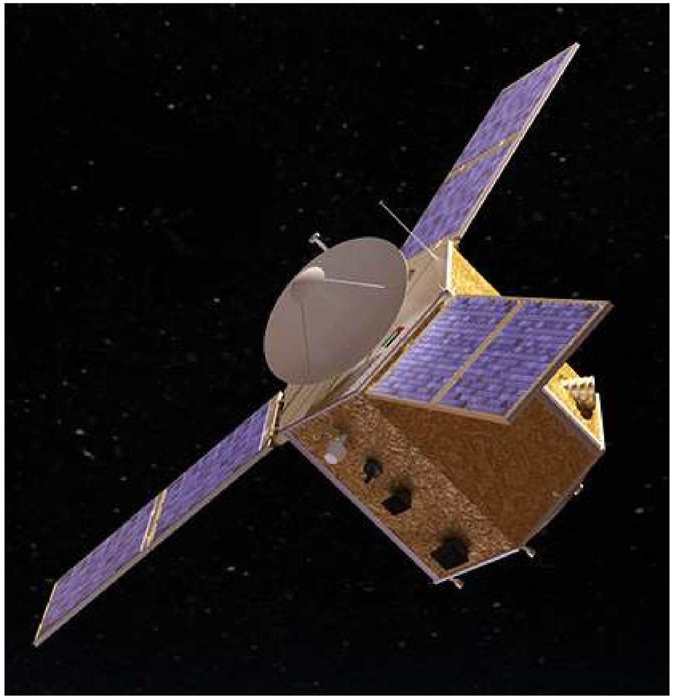
The company also advertises the Space Container that can be fitted on a Soyuz 2.1a launch vehicle's third stage to deploy small payloads.
The rather user unfriendly website does not give any indication when the satellites will be launched – if at all – although there are vague indications that the Space Container may be carried on a Soyuz 2.1a launch llater this year.

Moog OMV

The US firm Moog has developed a family of Orbital Maneuvering Vehicles (OMV) that forms a suitable basis for rideshare-based payloads.

Based on the EELV Secondary Payload Adapter (ESPA) it provides a facility to deploy multiple small satellites to a variety of orbits including low-Earth, geostationary as well as Earth-Sun Lagrange points orbits and lunar orbits.
The OMV comprises an integrated avionics unit (IAU) for both Command and Data Handling (C&DH) and Electrical Power System (EPS), Guidance and Navigation Control (GNC) sensors and actuators, a chemical propulsion system and other functions in a modular form that can be tailored to specific missions to take advantage of lower launch costs through rideshare.
Apart from the deployment of small satellites, the OMV can undertake the functions of a carrier/tug vehicle and a mothership for applications in Earth orbit and beyond. In many cases, a combination of these missions can be accomplished by a single OMV to provide cost-effective options.

EMM



The United Arab Emirates has selected the Japanese H 2A launch vehicle for the launch of its Emirates Mars Mission (EMM) spacecraft. Also referred to as Hope, the spacecraft is expected to be launched in the summer of 2020 with arrival at Mars in 2012, to coincide with the 50th anniversary of the founding of the UAE.
The spacecraft will study the Martian atmosphere and climate.

Eutelsat 7-C

Eutelsat has ordered the Eutelsat 7-C communications satellite from Space Systems/Loral (SSL). To be based on the SSL-1300 platform the satellite will be fitted with 44 Ku band transponders. It will be launched in the third quarter 2018 and will be located at 7ºE.