



# TIROS SPACE INFORMATION NEWS BULLETIN

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*Lotus S*

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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...

Last month I made mention of various proposed mega-constellations for communication purposes.

Clearly the market is not big enough for all these proposals to materialise in hardware but the proposals themselves pose the interesting question on how to implement it, and in particular how to get it into orbit.

With the SpaceX proposal having the most information (although that is still a minute little bit) let's use that proposal to analyse its potential deployment.

Assuming that Elon Musk only wants to use his own Falcon 9 launch vehicle, this vehicle has a payload bay of 5.2 m diameter and 13 m in length. This gives a space of about 210m<sup>3</sup>.

Musk envisages the satellites to have a mass of "several hundred kg". This somehow compares with the Orbcomm second generation satellite of 172 kg.

Last year six OG2 satellites were launched on a Falcon 9. If we take into account better instrumentation that will minimise the proposed satellites, we can assume that there can be 10 proposed satellites launched on a Falcon 9.

That means the project requires 400 launches to place the 4000 satellites into orbit over what has to be a relatively short time of one or two years. This time frame is, in my honest opinion, required to attract customers.

Compare this with about 450 launches of all version of the Atlas launch vehicles since the commencement of space exploration and one wonders how this is going to work

Only time will tell, but it promises to be interesting.

Jos Heyman

**Conference announcement: Launching Cubesats For and From Australia, refer page 10**

## Iran's space agency and Fajr

It has been reported that Iran has dissolved its national space agency on 9 January 2015. Staff at the agency have been deployed to other government organisations. However, this does not necessarily mean an end of Iran's space ambitions and the dissolution probably represents the transfer of responsibilities to other agencies.

As to prove the point, Iran successfully launched the Fajr satellite from the Semnan launch site with a Safir 1B rocket on 1 February 2015. The satellite was placed in a 224 x 460 km orbit with an inclination of 55.5°.

It has a mass of about 50 kg and carried an optical imaging payload with a resolution of about 500 m. The satellite also carried a cold-gas thruster system so that it can raise its orbit and thereby increase its operational life.

## SES-12

SES has selected an Ariane 5 for the launch of its SES-12 satellite in late 2017. SES-12 is being built by Airbus using the Eurostar E3000 platform and will carry 68 Ku band transponders and 8 Ka band transponders. It will be located at 93°East.

## URSC

Russia's President Putin has approved the merger the Russian space agency Roscosmos and most of Russia's government-owned space manufacturing enterprises, including RSC Energia, Khrunichev State Research and Production Space Center, and Lavochkin, into a single entity. The new entity is known as the United Rocket and Space Corp. (URSC).

It was created in August 2013 to overcome the problems in the Russian space industry. In the first two years the organisation went through a consolidation stage that involved the formal establishment, the development and implementation of the urgent actions plan and the development and implementation of the corporate strategy.

It has now started on the improvement stage that will last until 2017 and which involves the lean manufacturing and production scaling of industrial projects, the development of a united project management system and the start of a comprehensive quality program. The last stage, known as the expansion stage, will complete the corporate restructuring, will see expansion into new markets and will seek fundraising and alliances. This stage will extend into the 2020s.

## Jabiru-1

Construction of NewSat's Jabiru-1 communications satellite has been suspended as the company is experiencing financing difficulties. If the project can go ahead the launch may now not take place until mid-2016.

## Satellite Update

### Launches in January 2015

Int.Des.	Name	Launch date	Launch vehicle	Country	Notes
2015 001A	Dragon CRS-5	10-Jan-2015	Falcon 9 v.1.1	USA	ISS support
2015 002A	MUOS-3	21-Jan-2015	Atlas V-551	USA	Communications
2015 003A	SMAP	29-Jan-2015	Delta 7320-10C	USA	Earth observation
2015 003B	FIREBIRD-3	29-Jan-2015	Delta 7320-10C	USA	Technology
2015 003C	FIREBIRD-4	29-Jan-2015	Delta 7320-10C	USA	Technology
2015 003D	GRIFEX	29-Jan-2015	Delta 7320-10C	USA	Technology
2015 003E	ExoCube	29-Jan-2015	Delta 7320-10C	USA	Technology

### Other updates

Int. Des.	Name	Notes
1998 067ET	Chasqui-1	Re-entered 15 January 2015
1998 067EY	Flock 1b-15	Re-entered 7 January 2015
1998 067FA	Flock 1b-1	Re-entered 1 January 2015
1998 067FD	Flock 1b-7	Re-entered 20 January 2015
1998 067FE	Flock 1b-18	Re-entered 16 January 2015
2001 047A	Quickbird-2	Re-entered 27 January 2015
2002 049A	Zi Yuan-2B	Re-entered 22 January 2015
2012 006C	E-St@r	Re-entered 16 January 2015
2012 006E	MaSat-1	Re-entered 9 January 2015
2012 006H	ROBUSTA	Re-entered 28 January 2015

## Intelsat-603

On 23 January 2015 Intelsat placed the Intelsat-603 in a 'graveyard' orbit about 225 km above the geostationary orbit.

This satellite was launched on 14 March 1990 but due to a launch vehicle malfunction the satellite failed to achieve the geostationary orbit. The propellant of the satellite's perigee kick motor (PKM) was used to place it into an orbit of 376 x 401 km with an inclination: 28.3°.

On 14 May 1992 the satellite was recovered by the crew of the STS 49 mission and during a 4 hours, 54 minutes operation, a new PKM was installed and the satellite was released to be placed in a geostationary orbit at 35°W. The satellite was designed to operate for 15 years but continued to serve Europe, Africa and the Americas for more than 20 years.

## Navstar 3

The US Air Force has ordered an additional two Navstar (GPS) 3 navigation satellites from Lockheed Martin. This is in addition to the eight ordered earlier. The first of these is expected to be launched in 2016.

## Vandenberg

SpaceX has been granted a lease for a second launch pad at Vandenberg. Previously SpaceX used the SLC-4E launch pad but will now also be able to use the adjacent SLC-4W launch pad. Both pads were built in the 1960s for the early Atlas rockets and were modified in the 1970s for the Titan launch vehicles.

## LightSail

The Planetary Society has announced that its LightSail-1 solar sail experiment will be launched as a secondary payload on an Atlas V launch scheduled for 6 May 2015.

LightSail-1 is a 3U cubesat that, following four weeks of tests, will deploy a set of triangular sails, made of Mylar, attached to booms four meters long. Because it will be placed in a low orbit, the sail will not be able to generate thrust to overcome the atmospheric drag but engineers will be able to test the sail deployment and other systems.

The main payload of the launch will be the classified AFSPC-5, whilst other cubesats will be carried as part of NASA's Educational Launch of Nanosatellites programme.

LightSat-2 will be launched in 2016 as a secondary payload on a SpaceX Falcon Heavy rocket. It will be contained in a larger satellite called Prox-1 and will be deployed from that satellite at an altitude of 720 km. At that altitude the atmosphere will be thin enough for the sunlight to provide sufficient thrust.

## Spire

San Francisco based company Spire, formerly known as NanoSats Inc., intends to establish a constellation consisting of up to 100 cubesats to provide data on weather and climate changes on a global basis.

The satellites will be fitted with High Resolution Sensors that measure the GPS signals through Earth's atmosphere to calculate temperature, pressure, and humidity with a high accuracy and resolution.

It is expected that the satellite constellation will be upgraded every two years to keep pace with changing technology.

Once operational the system is expected to provide 5 times more data than current systems provide by the end of 2015, 10 times by the end of 2016, and over 100 times the data by the end of 2017.

## CSO

Germany will join France's Composante Spatiale Optique (CSO) optical military reconnaissance satellite system allowing the building of a third satellite in the series.

The first two satellites of the series are already under construction and will be launched in 2017 and 2018. They are being built by Airbus using the AstroSat 1000 platform whilst Thales-Alenia will provide the very high resolution optical instrument.

## MMS

NASA's Magnetospheric Multiscale (MMS) consists of four identical spacecraft which will fly in formation to study how the magnetic fields of Earth and the sun interact.

The four 1360 kg spacecraft will be launched on 12 March 2015 with an Atlas V-421 launch vehicle from Cape Canaveral.

The four spacecraft carry identical instrument arranged in three suites:

1. the Hot Plasma Suite, to observe the nature of the charged gas, or plasma, present during reconnection, comprising:
  - Fast Plasma Investigation (FPI) to observe fast-moving plasma, consisting of four dual electron spectrometers, the four dual ion spectrometers, and one data processing unit which produce a three-dimensional picture of the ion plasma;
  - Hot Plasma Composition Analyzer (HPCA), to detect the kind of ions that are present;
2. the Energetic Particles Detector Suite, to observe the fast-moving, energetic particles, comprising:
  - Fly's Eye Energetic Particle Sensor (FEEPS), two solid state detector to obtain nearly instantaneous all-sky measurements of how many electrons of different energies and different arrival directions are present;
  - Energetic Ion Spectrometer (EIS), a solid state detector to gathers all-sky measurements of the energetic ions, gathering information about their energy, their arrival direction and their mass;
3. the Fields Suite: to observe electric and magnetic fields and waves, comprising
  - Analog Fluxgate (AFG) and Digital Fluxgate (DFG) Magnetometers which carry a permeable material that changes properties in response to the presence of magnetic fields.
  - Electron Drift Instrument (EDI) to measure both the electric and magnetic fields by tracking the path of electron beams through space.
  - The Spin-plane Double Probe (SDP) and the Axial Double Probe (ADP), two sets of double-probe instruments that each measures the voltage between two electrodes to determine the electric field.
  - Search Coil Magnetometer (SCM), an instrument to provide direct measurements of changes in the magnetic fields, using something called an induction magnetometer.
  - FIELDS Central Electronics (CEB) a set of electronics to coordinated, collected, and transmitted all measurements.

In addition, an Instrument Control group contains the spacecraft instrument electronics.

## Turkmen Alem

A Falcon 9 launch vehicle will place Turkmenistan's Turkmen Alam satellite in orbit in March 2015. The satellite was built by Thales Alenia using the Spacebus 4000C2 platform which has been fitted with 78 Ku band transponders. Some of these transponders have been leased to SES. The satellite will be placed at 52.0°E, a geostationary spot owned by Monaco and hence the satellite is also known as Monacosat-1.

## CCtCAP

Boeing and SpaceX, the two companies that are developing NASA's next crewed spacecraft have announced their expected launch schedules.

In each case, NASA's contract requires two tests flights before it will certify the use of the spacecraft for operational crewed missions. Two crewed flights are provided for in the current contract. The contract includes options for further operational missions with both spacecraft. Boeing has indicated that it expects to conduct a launch pad abort test in February 2017 and the first test flight of the CST-100 spacecraft to take place in April 2017. The first crewed flight is scheduled for July 2017. If all goes well, the first operational flight will take place in December 2017. The flights will use an Atlas V-422 launch vehicle.

Space X expects the flight-abort and non-crewed flights of its Dragon V2 to take place in late 2016 with the first crewed mission taking place in 2017. The launches will make use of the Falcon 9.

SpaceX has confirmed that the first flights of the Dragon V, the crewed version of the Dragon cargo spacecraft, will descent through the atmosphere on parachutes and land in the Pacific Ocean.

They will not performing the helicopter like propulsive touchdown on land although the spacecraft has been be designed to allow it in the long term. The company has to develop the rocket assisted touchdown further and intends to undertake Dragon test landings at the company's test site in Texas.

The CST-100 and the Dragon V2 may not end the use of Soyuz spacecraft as NASA hopes to enter into an arrangement with the Russian space agency whereby in each year two Russian Soyuz TMA flights will carry one US astronauts in exchange for a Russian cosmonaut flying on two mission with the CST-100 or Dragon V2. This arrangement ensures that if ever an emergency return of a crew by one of the types of spacecraft is required, there will always be one crew member to operate either the Russian or the US modules of the space station, this being the crew member that has flown to the space station on the other nation's spacecraft.

## Akatsuki

The Japanese Akatsuki spacecraft that failed to enter into an orbit around Venus in December 2010 because of a faulty valve that caused the orbit insertion engine to fail, is now expected to make another attempt on 7 December 2015 after having travelled through the inner solar system on a course maintained by ground control.

This time it will use the less powerful attitude control thrusters for the orbit insertion. The new planned Venusian orbit will be different. Whereas the December 2010 plan was for an orbit of 30 hours, this time the spacecraft will complete one orbit in eight to nine days.

Because the spacecraft has been exposed to heat about three times hotter than that of the Earth, it is expected that some instruments will no longer work.

Akatsuki was launched on 20 May 2010.

## Kosmos-2101 to 2500 (part 2)

By Jos Heyman

### Gonets D



Two experimental precursors of the Gonets D message relay communications satellite were flown in the Kosmos series.

The Gonets D message relay communications satellites used a store and forward mode and were based on the earlier Strela 3 'sextet' military communications satellite. Their primary application was during natural and man-made disasters and emergencies.

The operational Gonets system consists of twelve satellites in four orbital planes each operating in the 200/400 MHz band. The satellites were built by Prikladnoi Mekhaniki and were launched from Plesetsk, initially with a Tsyklon 3 launch vehicle but more recently by the Rokot/Briz KM.

Name	Int. Des.	Launch date
Kosmos-2199	1992 042C	13-Jul-1992
Kosmos-2201	1992 042E	13-Jul-1992

### Rodnik

Kosmos-2416 was the first satellite in the Rodnik communications satellite system, another development of the Strela 3 military communications satellite. The series was also known as Strela 3M.

The satellites were launched with a Roket/Briz KM from Plesetsk.

Name	Int. Des.	Launch date	Name	Int. Des.	Launch date
Kosmos-2416	2005 048B	21-Dec-2005	Kosmos-2488	2013 076A	25-Dec-2013
Kosmos-2452	2009 036B	6-Jul-2009	Kosmos-2489	2013 076B	25-Dec-2013
Kosmos-2468	2010 043C	8-Sep-2010	Kosmos-2490	2013 076C	25-Dec-2013
Kosmos-2481	2012 041A	28-Jul-2012	Kosmos-2496	2014 028A	23-May-2014
Kosmos-2482	2013 001A	15-Jan-2013	Kosmos-2497	2014 028B	23-May-2014
Kosmos-2483	2013 001B	15-Jan-2013	Kosmos-2498	2014 028C	23-May-2014
Kosmos-2484	2013 001C	15-Jan-2013			

### Garpun

The Garpun military data relay satellite was built by ISS Reshetnev. A replacement for the Potok/Geizer series the only satellite launched so far was placed at 80°E. It had been launched from Baikonour with a Proton M/Briz M launch vehicle.

Name	Int. Des.	Launch date
Kosmos-2473	2011 048A	20-Sep-2011

### Neman

Kosmos-2153 was the first of the Neman series of military reconnaissance satellite developed by TsSKB as article 17F117. The satellites had a mass of 7000 kg and were fitted with electro-optical equipment operating in the visible and infrared bands. Also known as Yantar 4KS1M and based on the Terilen satellites, the satellites used initially retrievable capsule to return film and later data relay satellites to return CCD imagery rather than physically recovering film.

They were launched by Soyuz U from Baikonour.

Name	Int. Des.	Launch date	Name	Int. Des.	Launch date
Kosmos-2153	1991 049A	10-Jul-1991	Kosmos-2305	1994 088A	29-Dec-1994
Kosmos-2183	1992 018A	8-Apr-1992	Kosmos-2320	1995 051A	29-Sep-1995
Kosmos-2223	1992 087A	9-Dec-1992	Kosmos-2359	1998 039A	26-Jun-1998
Kosmos-2267	1993 071A	5-Nov-1993	Kosmos-2370	2000 023A	3-May-2000
Kosmos-2280	1994 025A	28-Apr-1994			

### Yenisey

Yenisev was a military reconnaissance satellite based on the Don series. The satellites, also known as Orlets-2, carried up to 22 film return capsules. It is also likely that the satellites' optics systems allowed them to take images at a higher resolution than that achieved by the satellites of previous generations.

The two satellites in the series were launched by a Zenit 2 from Plesetsk and Baikonour respectively.

Name	Int. Des.	Launch date
Kosmos-2290	1994 053A	26-Aug-1994
Kosmos-2372	2000 056A	25-Sep-2000

## Arkon



Kosmos-2344 was the first flight of the Arkon or Araks military reconnaissance satellites which were fitted with a reflecting telescope system with a focal length of 27 m, providing a resolution of 2 to 5 m, depending on the orbit altitude. The satellite's CCD sensor operated in 8 bands in the optical and near infra-red region of the spectrum from 0.4-1.1 microns. The 30 km swath width, combined with a capability of rolling at least 20o provided an observation path of 3000 km wide.

The Arkon series was built by Lavochkin as article 11F664 and had a mass of app. 6000 kg. They two satellites in the series were launched by a Proton K/DM-5 from Baikonour.

Name	Int. Des.	Launch date
Kosmos-2344	1997 028A	6-Jun-1997
Kosmos-2392	2002 037A	25-Jul-2002

## Yantar 4KS2

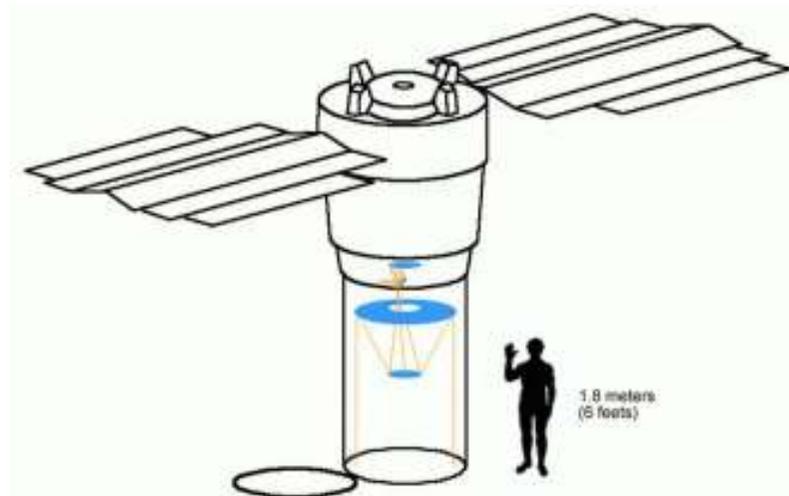
The Yantar 4KS2 military reconnaissance satellite was a development of the Yantar 4K2. Also known as Kobalt M and article 11F695M, the satellites carried a small film recovery capsules as well as a large re-entry vehicle.

The satellites were launched from Baikonour with a Soyuz U launch vehicle although a Soyuz 2-1a was used for the latest launch.

Other reference sources have suggested that Kosmos-2410 was the first of the Liana electronic intelligence gathering satellites developed by Progress and Arsenal.

Name	Int. Des.	Launch date	Name	Int. Des.	Launch date
Kosmos-2410	2004 038A	24-Sep-2004	Kosmos-2462	2010 014A	16-Apr-2010
Kosmos-2420	2006 017A	3-May-2006	Kosmos-2472	2011 028A	27-Jun-2011
Kosmos-2427	2007 022A	7-Jun-2007	Kosmos-2480	2012 024A	17-May-2012
Kosmos-2445	2008 058A	14-Nov-2008	Kosmos-2495	2014 025A	6-May-2014
Kosmos-2450	2009 022A	29-Apr-2009			

## Persona



The Persona military photo reconnaissance satellite was based on the Yantar spacecraft and was fitted with an imaging system derived from the Arkon satellite.

It was the first USSR/Russian photo reconnaissance satellite launched into a sun-synchronous orbit. These launches took place from Plesetsk with a Soyuz 2-1b.

Name	Int. Des.	Launch date
Kosmos-2441	2008 037A	26-Jul-2008
Kosmos-2486	2013 028A	8-Jun-2013

## Lotos S

Kosmos-2455 was the first Lotos S electronic intelligence satellite which was built by TsSKB-Progress Samara Space Center and KB Arsenal as article 14F138. Kosmos-2455 may also have carried the Nuklon high energy cosmic rays detector as a secondary scientific experiment.

It was launched from Plesetsk with a Soyuz U launch vehicle.

A second Lotus S was launched as Kosmos-2502.

Name	Int. Des.	Launch date
Kosmos-2455	2009 063A	20-Nov-2009

## Kosmos-2491 and -2149

These two satellites were originally thought to be debris of the Rokot/Briz KM launch vehicle but Kosmos-2491 turned out to be a small military satellite probably built by Reshetnev and with a mass of around 45 kg.

The objective of these tests is not known. It could be a test in Russia's plan to clean up space junk or it could be a test leading towards of repairing and refuelling satellites. However, as Russia did not declare the launch of this satellite until 5 May 2014, and judging by the object's peculiar and

very active movements across the skies, it could be part of an anti-satellite weaponry programme, something that the then USSR abandoned in 1982 but may be revived by Russia, based on a 2010 statement by Oleg Ostapenko, then commander of Russia's space forces, and now head of its space agency, who said Russia was again developing "inspection" and "strike" satellites.

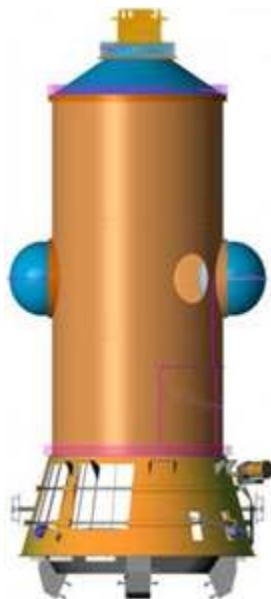
Similarly, Kosmos-2491 was observed by amateur satellite trackers making unusual maneuvers that culminated, on 9 November 2014, in a rendez-vous with the rocket stage that had launched it. By then its orbit was 1151 x 1504 km.

On 30 November 2014 the two satellites activated the RS-46 and RS-47 amateur radio payloads.

Name	Int. Des.	Launch date
Kosmos-2491	2013 076E	25-Dec-2013
Kosmos-2499	2014 028E	23-May-2014

### SKRL 756

Launched by a Soyuz 2-1v/Volga on what was essentially a test flight of this new version of the Soyuz launch vehicle and the Volga upper stage, the two SKRL 756 are believed to have been radar calibration satellites that, during the launch, were attached to the ballast upper stage of the launch vehicle. It was later that they were given a Kosmos number.



Name	Int. Des.	Launch date
Kosmos-2493	2013 078A	28 Dec-2013
Kosmos-2494	2013 078B	28-Dec-2013

*(to be continued)*

## CSLI 2015

NASA has announced 14 new cubesats proposals that have been selected as part of the 2015 round of the Cubesat Launch Initiative, These satellites are now eligible to be placed on a launch manifest depending on the availability of flight opportunities.

The NASA press release provided the following details:

### Arizona State University, Tempe, Arizona

Asteroid Origins Satellite is a science laboratory that will be the world's first cubesat centrifuge. It will enable a unique set of science and technology experiments to be performed on a cubesat to answer fundamental questions of how the solar system formed and understand the surface dynamics of asteroids and comets.

### California State University, Northridge, California

The mission of California State University Northridge Satellite is to test an innovative low temperature capable energy storage system in space developed by NASA's Jet Propulsion Laboratory in Pasadena that will enable future missions, especially those in deep space, to do more science while requiring less energy, mass and volume.

### Capitol Technology University, Laurel, Maryland

The Coordinated Applied Capitol Technology University Satellite (CACTUS-1) is a technological demonstration of a cost-saving communications and commanding innovation. The payload will lower investment in communications and ground systems technology by licensing conventional internet satellite providers for low earth orbit use. The cubesat's aerogel-based Particle Capture and Measurement instrument is the first cubesat-based orbital debris detector to be flown in low-Earth orbit.

### Colorado State University, Fort Collins, Colorado

The Temporal Experiment for Storms and Tropical Systems – Demonstrator (TEMPEST-D) provides risk mitigation for the TEMPEST mission that will provide the first temporal observations of cloud and precipitation processes on a global scale. These observations are important to understand the linkages in and between Earth's water and energy balance, as well as to improve our understanding of cloud model microphysical processes that are vital to climate change prediction.

### Cornell University, Ithaca, New York

KickSat-2 is a cubesat technology demonstration mission designed to demonstrate the deployment and operation of prototype Sprite "ChipSats" (femtosatellites). The Sprite is a tiny spacecraft that includes power, sensor and communication systems on a printed circuit board measuring 3.5 by 3.5 centimeters with a thickness of a few millimeters and a mass of a few grams. ChipSats could enable new kinds of science and exploration missions, as well as dramatically lower the cost of access to space.

### Montana State University, Bozeman, Montana

A Satellite Demonstration of a Radiation Tolerant System, RadSat, is a technology demonstration of a new radiation tolerant computer system in a low-Earth orbit satellite mission to demonstrate a technology readiness level 9 of the technology.

#### **NASA's Glenn Research Center, Cleveland**

The Advanced eLectrical Bus (ALBus) cubesat is a technology demonstration mission of an advanced, digitally controlled electrical power system capability and novel use of shape memory alloy technology for reliable deployable solar array mechanisms. The goals of the mission are to demonstrate efficient battery charging in the orbital environment, 100 Watt distribution to a target electrical load, flexible power system distribution interfaces, adaptation of power system control on orbit and successful deployment of solar arrays and antennas using resettable shape memory alloy mechanisms.

#### **NASA's Independent Verification & Validation Program, Fairmont, West Virginia**

In partnership with the University of West Virginia, the Simulation-to-Flight 1 (STF-1) mission will demonstrate the utility of the NASA Operational Simulator technologies across the cubesat development cycle, from concept planning to mission operations. It will demonstrate a highly portable simulation and test platform that allows seamless transition of mission development artifacts to flight products.

#### **Southwest Research Institute, San Antonio**

The cubesat mission to study Solar Particles over the Earth's Poles (CuSPP) mission is a space weather mission that will study the sources and acceleration mechanisms of solar and interplanetary particles near-Earth orbit. It will study magnetospheric ion precipitation in the high-latitude ionosphere. It will increase the technology readiness level of a supra-thermal ion spectrograph concept so that it may fly with reduced risk and cost on future heliophysics missions.

#### **University of Central Florida, Orlando, Florida**

The Cubesat Particle Aggregation and Collision Experiment (Cu-PACE) will perform a long-duration microgravity experiments in orbit to observe novel low-speed collisions in greater numbers than possible in ground-based, parabolic and suborbital flight experiments.

#### **University of Central Florida, Orlando, Florida**

SurfSat is a science investigation that will measure plasma-induced surface charging and electrostatic discharge measurements. It will take in-situ measurements of the ground current waveforms from chosen common spacecraft dielectric material samples, measure the spacecraft and material potentials and will use a Langmuir probe system to measure the ambient plasma environment.

#### **University of Michigan, Ann Arbor, Michigan**

The Miniature Tether Electrodynamics Experiment (MiTEE) will use cubesat capabilities to deploy a picosatellite body of approximately 8 cm × 8 cm × 2 cm from a 3U cubesat to demonstrate and assess an ultra-small satellite electrodynamics tether in the space environment where the fundamental dynamics and plasma electrodynamics. The miniature electrodynamics tethers, which are a few meters long, have the potential to provide propellantless propulsion, passive two-axis attitude stabilization and enhanced communication utility to the next generation of small satellites.

#### **University of Michigan, Ann Arbor, Michigan**

The Tandem Beacon Experiment (TBEx) will consist of a tandem pair of cubesats, each carrying tri-frequency radio beacons, in near identical, low inclination orbits and a cluster of diagnostic sensors on five islands in the Central Pacific sector. The science objectives and goals of TBEx are to study how the dynamics and processes in the troposphere can act to cause variability in the behavior of the upper atmosphere and ionosphere.

#### **University of North Dakota, Grand Forks, North Dakota**

The Open Prototype for Educational NanoSats (OPEN) mission aims to reduce mission risk and cost for universities, researchers and other spacecraft developers through the creation of an open-hardware/open-source software framework for Cubesat development.

This was the fifth round of the CSLI programme and brings the total of selected cubesats to 128. Of these 36 have been launched through the Educational Launch of Nanosatellite (ELaNa) Program.

#### **CZ 5**

China has completed the ground tests of the power system of the CZ 5 launch vehicle. The first test flight of the CZ 5 is expected to take place in 2016.

#### **Intelsat and Azercosmos**

Intelsat and Azercosmos of Azerbaijan have agreed to jointly have a communications satellite built that will be located at 45°E. It will be launched in 2017 to replace Intelsat-12 which is expected to be retired in 2018.

#### **Early warning technology**

The US Air Force plans to launch an experimental tactical missile warning sensor later this year. This may be followed up by a further demonstration of a strategic sensor in 2019/20.

#### **Geo-Kompsat 2**

South Korea has selected the Ariane 5 to launch two geostationary meteorological and environment-monitoring satellites in 2018 and 2019, The two satellites, identified as Geo-Kompsat 2-A and B, will be built by the Korea Aerospace Research Institute (KARI). The first satellite will be optimised for meteorological observations and will have a mass of about 3420 kg. The second satellite will have a mass of about 3200 kg and will carry an ocean-color imager. Both satellites will be located at 128.2°East.



## Delta V

Delta V has been established as a new vision for the Australian Space Industry that comprises four Australian space teams: Saber Astronautics Pty Ltd, Launchbox Pty Ltd, the Australian Centre for Space Engineering Research (ACSER) at UNSW and the SpaceNet Project at Sydney University

Its a startup-led vision: an industry accelerator bringing talent, opportunity and product innovation together with mentors, investors and customers to bootstrap an export-focused hi-tech space services & manufacturing industry within the burgeoning global marketplace.

Delta-V will guide, select and accelerate startup teams from universities and other talent pools to develop innovative new space-and earth-system solutions for customers and partners worldwide.

## ISS EVAs

On 21 and 25 February 2015 ISS EX-42 crew members Barry Wilmore and Terry Virts made two EVAs to prepare the International Space Station for the future US manned spacecraft.

The EVAs, which lasted 6 hours, 41 minutes and 6 hours, 43 minutes respectively, concentrated on installing cables or the International Docking Adapters (IDAs) that will be installed on the Pressurized Mating Adapters (PMA)-2 and -3 in June and December 2015. In addition the astronauts performed maintenance of the robotic arm. Finally, work was performed on the Node 3 Aft port which will be occupied by the Bigelow Expandable Module (BEAM) in September 2015 for a two-year stay.

All these activities will allow the following changes to be made to the ISS configuration at a later date during 2015:

- The Permanent Multipurpose Module (PMM) will be relocated from Node 1 Nadir to Node 3 Forward using robotic capabilities. This will allow Node 1 Nadir to be used for future docking of cargo spacecraft, adding to the Node 2 Nadir that has been used to date and allowing two cargo spacecraft being docked simultaneously.
- The existing Pressurized Mating Adapters (PMA), previously used by the Space Shuttle will be outfitted with International Docking Adapters that will be delivered to ISS later this year.
- The Pressurized Mating Adapter (PMA)-3 will be moved from Node 3 Port to Node 2 Zenith for future commercial crew vehicle dockings.

A further EVA planned for 1 March 2015 will make preparations for the installation of the Common Communications for Visiting Vehicles (C2V2) to be installed on the exterior of the

Space Station and to become the standard communications system between ISS and visiting vehicles during proximity operations.

## ALASA

Boeing has been selected as the prime contractor for the Airborne Launch Assist Space Access (ALASA) programme, sponsored by DARPA.

The ALASA programme seeks to test the technologies to launch 50 kg satellites within 24 hours of identifying the requirement and at a cost of less than \$ 1 million. The basis of the technology is the use of a conventional aircraft to take a launch vehicle to a high altitude where it would be released. The aircraft will be able to take off from any runway, thereby increasing the flexibility. The launch vehicle will be made from advanced composite structures and will be fitted with a rocket engine using a new high-energy monopropellant, combining fuel and oxidizer into a single liquid. This will enable a simpler design and reduced manufacturing and operation costs. The first flight demonstration is expected by the end of 2015 followed by the first of 12 orbital tests in 2016.

## Mars One

Mars One has selected 50 men and 50 women from 202,586 applicants to advance to the next round of the Mars One Astronaut Selection Process. They come from every part of the world: 39 from the Americas, 31 from Europe, 16 from Asia, 7 from Africa, and 7 from Oceania. Eventually six teams of four individuals will be selected for training to undertake a one way flight to Mars to establish a human colony there.

The current plan is to build a practice colony on Earth this year, although no location for this been identified as yet. A unmanned mission identified as Mars-bound Demonstration Mission and Communication Satellite is to be launched in 2018 to test some of the technologies that are important for a human mission as well as place a communication satellite in a martian orbit to provide 24/7 communications, including relay of images and video. Lockheed Martin and Surrey Satellites have completed concept studies for this mission but it seems further work has been suspended.

It is planned to send a Rover vehicle and a Trailer to Mars in 2020. The Rover will be used to select the best location for the settlement and the Trailer will be used to transport the landers. This will be followed in 2022 by a second Rover, two Living Units, two Life Support Systems, and a Supply Unit. These will land on Mars in 2023 using a beacon on the first Rover to guide them to the landing site.

The first crew will depart in 2024 to land in 2025, followed by a second crew departing in 2026 along with cargo missions and landing in 2017. After that every two years another mission will depart to build up the population.

Currently the cost is estimated at US\$ 6 billion but, as with all space projects, this is likely to become more. It was expected that most of this amount would come from television rights, but the agreement with global entertainment company Endemol established in 2014, appears to have been terminated.

## Korean Moon Rover

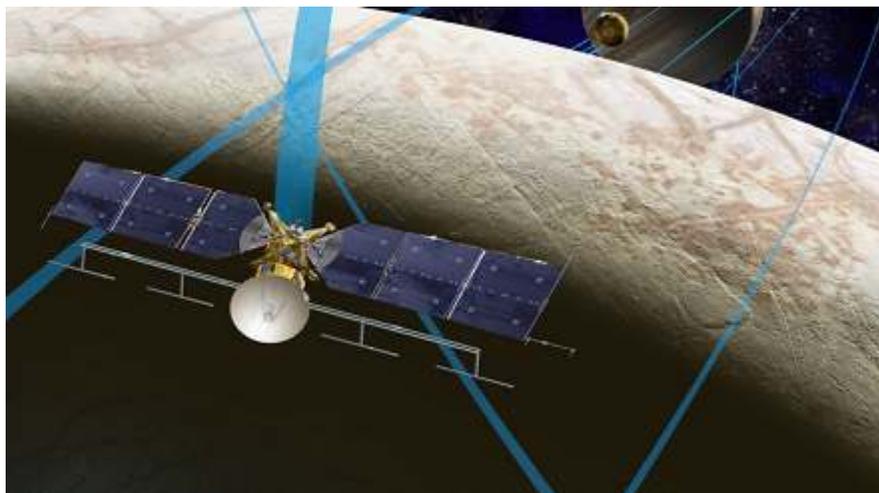
The Korea Institute of Science and Technology on Monday is developing an unmanned lunar rover that may be sent to the Moon by a Korean built rocket in 2020. The 50 cm wide, 70 cm long and 25 cm high vehicle will have a mass of 20 kg and will search for rare minerals and metals on the moon's surface.

## Europa Clipper

Europa Clipper is a NASA proposal for a detailed survey of Jupiter's moon Europa with a particular emphasis on the possibility of liquid water underneath the icy crust which would have a potential for life.

Currently in a conceptual phase the payload could include radar to penetrate the frozen crust and determine the thickness of the ice shell, an infrared spectrometer to investigate the composition of Europa's surface materials, a topographic camera for high-resolution imaging of surface features, and an ion and neutral mass spectrometer to analyze the moon's trace atmosphere during flybys.

Launch could take place in 2022 and it is envisaged that the spacecraft would perform 45 flybys of Europa at altitudes varying from 2700 km to 25 km.



NASA has also granted funds to ten universities for the conceptual development of cubesats that would be deployed by the Europa Clipper once in orbit around Europa.

These universities are:

- Arizona State University, Tempe;
- Georgia Tech Research Corporation, Atlanta;
- Stanford University, Stanford, California;
- New Mexico State University, Las Cruces, New Mexico;
- University of Colorado, Boulder;

- University of Michigan, Ann Arbor;
- University of Alaska, Fairbanks;
- University of Southern California, Los Angeles;
- University of Illinois, Urbana; and
- University of Washington, Seattle.

These cubesats would study future landing sites, gravity fields, magnetic fields, atmospheric and plume science, as well as undertake radiation measurements.

## Antares

Orbital ATK expects to have the Antares launch vehicle back in service in March 2016. Following the launch failure on 28 October, it has been decided to replace the aging AJ26 engines of the first stage with RD-181 engine built NPO Energomash of Russia. As far as the launch pad at Wallops Island is concerned, this is expected to have been repaired in December 2015.

## NanoRacks deployer

The NanoRacks deployer on ISS that malfunctioned in August 2014, has been repaired by crew members on ISS. The problem was traced to screws that were not tightened correctly as well as issues with a power feed. The repair hardware was recently delivered to ISS with the Dragon CRS-5.

The repaired deployer was tested on 11 February 2015 with the deployment of the Brazilian AESP-14 cubesat. Further deployments of cubesats held at ISS, are expected in March 2015.

## Conference announcement: Launching Cubesats For and From Australia

The Australian Centre for Space Engineering Research (ACSER) invites you to discuss Australia's growing cubesats capabilities.

This event will bring together international and domestic experts in small satellite mission design, construction and launch to examine the challenges of launching small satellites for Australia, and eventually from Australia. A varied cross section of stakeholders will discuss the current state of the art and constructive ideas for advancing Australia's position in the space industry. We welcome participation from active domestic and international researchers, as well as interested parties from government, industry and the public.

The event will take place on 1 April 2015 in the Seminar Room G3, Electrical Engineering Building, University of New South Wales - Kensington Campus, Sydney, Australia

The programme for this free event is:

Keynote Presentation: Developing a new launch capability for small satellites

Session 1: Current and future launch opportunities for Australian nano-satellites

Session 2: Australian Cubesat missions, current and future

Session 3: Round Table Discussion - The next steps for launching Australian satellites.