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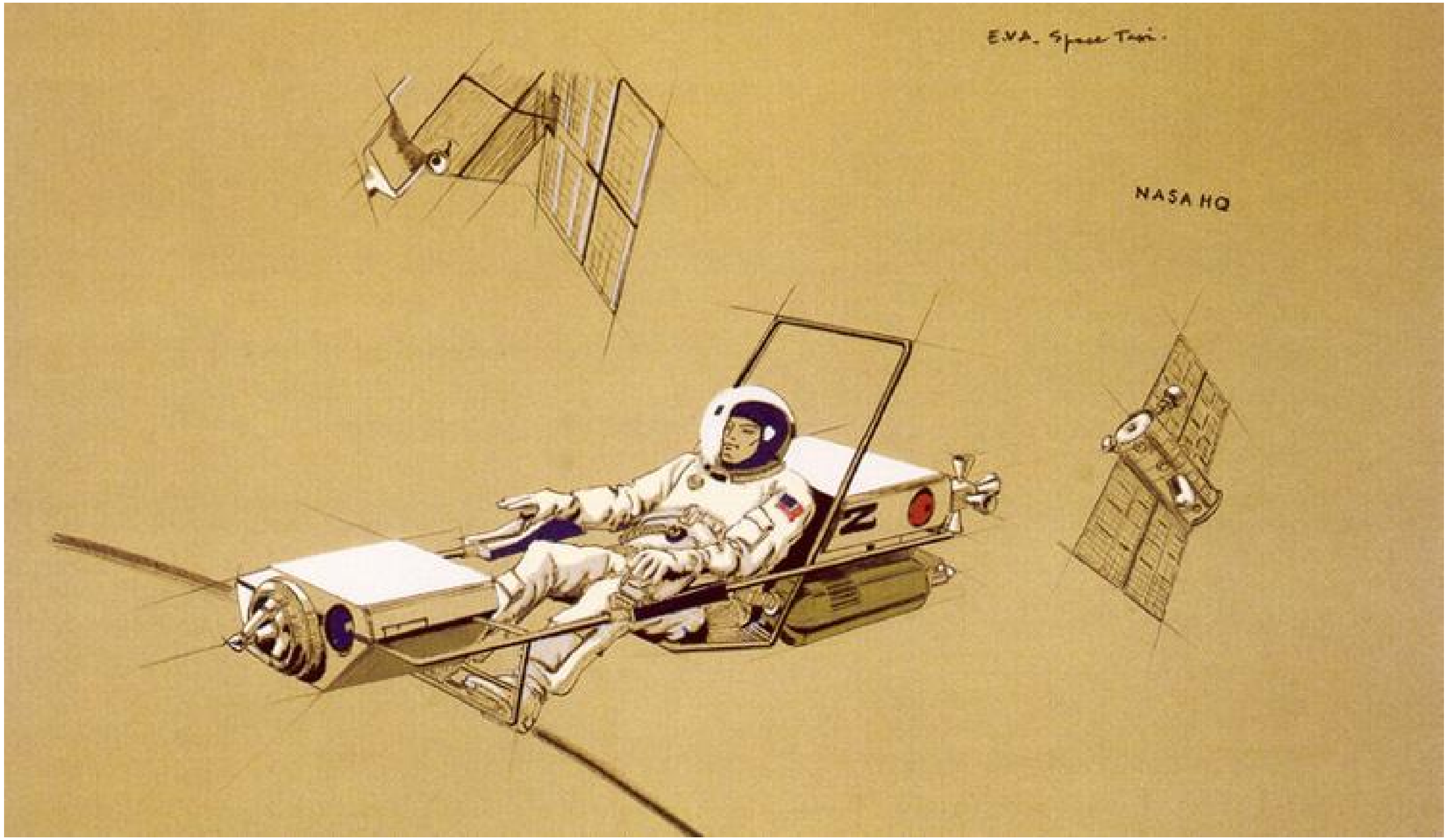
In this issue:



Space taxi

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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...

In this space history business every now and then you come across something that stumps you. Like this 'space taxi' on the front page.

I came across this about two years ago and nobody could tell me with what it was associated. Even an enquiry with a NASA contact gave a nil-result.

Anyway, it was a good opportunity for researching that piece of history. In doing so, you discover other weird things that you never knew (and perhaps should have known) and gradually your initial topic – in this case a 'space taxi' -, evolves in something big – in this case a general discussion on crew mobility, the first part of which is in this News Bulletin.

But in spite of all this additional searching through reference material both in hardcopy and on the internet, I still do not have a firm answer on what programme this 'space taxi' was intended for.

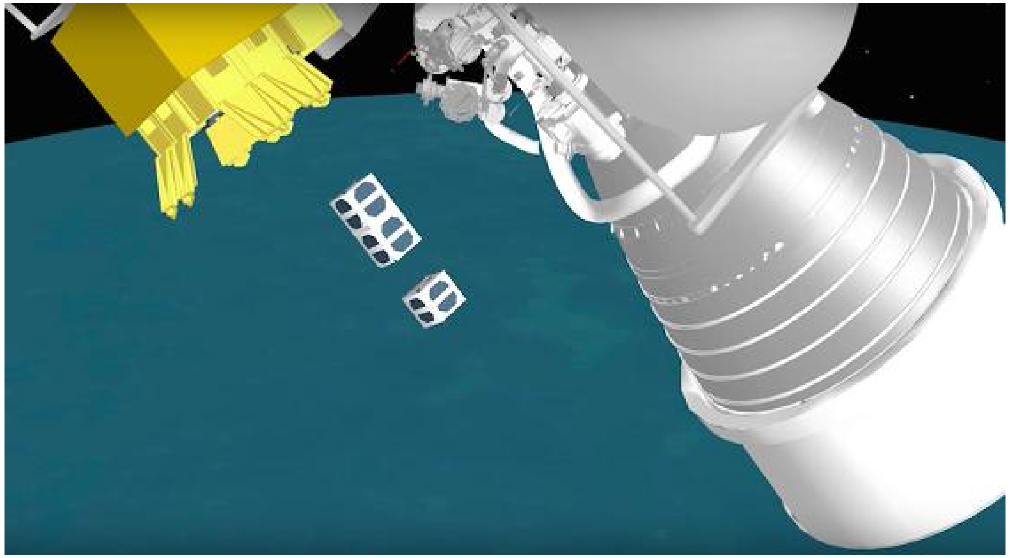
As to a guess, the presence of satellites on the picture probably means it was not associated with the Apollo programme, so my guess is that this 'space taxi' was meant for the Space Shuttle programme.

But if any of the readers has better and further information, please let me know so that I can stop wondering about this vehicle during sleepless nights.

Jos Heyman

PS
Of course the launch of the Iridium Next has been delayed to April 2016, not April 2014 (last News Bulletin, page 7). Thanks to the reader that picked this typo up.
Yes, I am a lousy typist and an even worse proof reader, but it proves that at least one person reads my ramblings. ☺

ULA and cubesats



Cubesat deployer at aft end of Centaur stage

Recognising that a few extra kilograms on a launch vehicle really does not make any impact on the cost of a launch, United Launch Alliance has now decided to offer six free cubesat rides on two Atlas V launches in 2017.
The company does so in a bid to tap into the growing market of small satellites as the company plans to place a standard cubesat carrier with as many as 24 berths for cubesats, on the aft bulkhead carrier bolted to the rear end of the Centaur upper stage. This location will prevent interference with the main payload of the launch and the cubesats will be spring ejected. It is also intended to place a similar device on the future Vulcan launch vehicle.

Crew Dragon

NASA has awarded a commercial crewed flight contract to SpaceX. This is the second such a contract, the first having been in May 2015 for the Boeing Skyliner.
Space X's crewed spacecraft is based on the Dragon cargo spacecraft and the first flight is expected in 2017.
Determination of which company will fly its mission to the station first will be made at a later time.

Satellite Update

Launches in November 2015

Int.Des.	Name	Launch date	Launch vehicle	Country	Notes
2015 063A	Zhongxing-2C	3-Nov-2015	CZ 3B	China	Communications
failed	HiakaSat-1	4-Nov-2015	Super Strypi	USA	Technology
failed	ORS[2]	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-1	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-2	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-3	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-4	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-5	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-6	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-7	4-Nov-2015	Super Strypi	USA	Technology
failed	EDSN-8	4-Nov-2015	Super Strypi	USA	Technology
failed	Argus	4-Nov-2015	Super Strypi	USA	Technology
failed	PrintSat	4-Nov-2015	Super Strypi	USA	Technology
failed	STACEM	4-Nov-2015	Super Strypi	USA	Technology
2015 064A	YW-28	8-Nov-2015	CZ 4B	China	Earth observation
2015 065A	Arabsat-6B	10-Nov-2015	Ariane 5ECA	S. Arabia	Communications
2015 065B	Gsat-15	10-Nov-2015	Ariane 5ECA	India	Communications
2015 066A	Kosmos-2510	16-Nov-2015	Soyuz 2-1b/Fregat MT	Russia	Early warning
2015 067A	LaoSat-1	20-Nov-2015	CZ 3B/G	Laos	Communications
sub-orbital	New Shepard Test-2	23-Nov-2015	New Shepard	USA	Recovery test
2015 068A	Telstar-12V	24-Nov-2015	H 2A-204	Canada	Communications
2015 069A	YW-29	27-Nov-2015	CZ 4C	China	Earth observation

Other updates

Int. Des.	Name	Notes
1997 047B	ETS-7	Re-entered 13 November 2015
1998 067FZ	GEARRSAT	Re-entered 8 November 2015
2007 014A	NFIRE	Re-entered 4 November 2015
2008 017A	C/NOFS	Re-entered 28 November 2015
2013 064P	Prometheus 1-5	Re-entered 29 November 2015
2013 064AD	Prometheus 1-3	Re-entered 21 November 2015

AMOS-5 and NOAA-16 failures

Contact with the Israeli Amos-5 communications satellite was lost on 21 November 2015, indicating a major failure.
Around the same time the US NOAA-16 meteorological satellite broke up, spreading a large amount of debris. The latter satellite had encountered an earlier failure on 6 June 214 and had been decommissioned shortly after that.

New Shepard

The propulsion module of Blue Origin's New Shepard sub-orbital vehicle was successfully landed at the launch site again during a test on 23 November 2015.
Launched from the Van Horn test site, the flight reached an altitude of 100.5 km at which point the unmanned crew capsule separated and landed, separately, with a parachute.
Further tests are expected soon and Blue Origin hopes to start commercial operations later in 2016.

ALASA

The US military research agency DARPA has abandoned plans to launch small satellites with a modified F-15 jet fighter for the time being.
The launch would have been part of the Airborne Launch Assist Space Access (ALASA) programme that envisaged the launching of satellites of up to 45 kg, rapidly, cheaply and from any airfield.
To increase the payload capacity as much as possible, the launches were to use a rocket engine developed by Boeing and fuelled by a nitrous oxide-acetylene propellant, also known as NA-7. The propellant would be pre-mixed to reduce the plumbing on the rocket but in two tests conducted earlier this year the propellant exploded.
A dozen ALASA test flights had been planned for 2016.

Virgin Galactic

Virgin Galactic has purchased a Boeing 747 to be used as the carrier aircraft for the LauncherOne small satellite launch vehicle.
The use of a 747 as the carrier, instead of the Virgin's WhiteKnghtTwo, as originally planned, will allow an increased payload capacity.
The aircraft selected was previously used by Virgin Atlantic and had, already, the nickname Cosmic Girl.
It is currently being converted for use as a carrier aircraft by strengthening the wing, making use of existing strengthening between the fuselage and the left inboard engine where a fifth and spare jet engine could be carried to remote locations. This existing strengthening will be used for the pylon to which LauncherOne will be attached. The modifications are expected to be completed by the end of 2016 with tests flight taking place in 2017.
Current contracts for the LauncherOne include 39 launches for OneWeb communications satellites as well as launches in NASA's Venture Class Launch Services programme.

PlanetiQ

PlanetiQ has selected the Indian Polar Satellite Launch Vehicle (PSLV) launch vehicle for the launch of the first two PlanetiQ satellites. The satellites will be launched as secondary payloads in November 2016. They will be placed in 800 km altitude orbits from where they will undertake meteorological observations.

Crew mobility in space (part 1)

By Jos Heyman

It is one thing for astronauts and cosmonauts to get into space in a nice spaceship and spend time on a space station, but sometimes they have to operate outside the confines of these vehicles.

These operations, as we all know, are called Extra Vehicular Activities (EVA), but these EVAs (with some exceptions) have a restricted mobility as the floating spaceman remains attached to the space vehicle by means of a tether. If not, he could float away in space with disastrous results, as we have seen in so many movies.

In this article we intend to discuss the achievements in crew mobility, ie movement in space without the restriction of a tether line. We will also discuss the mobility provided to crews that landed on the Moon – mobility that allowed them to explore beyond the immediate environment of the lunar lander.

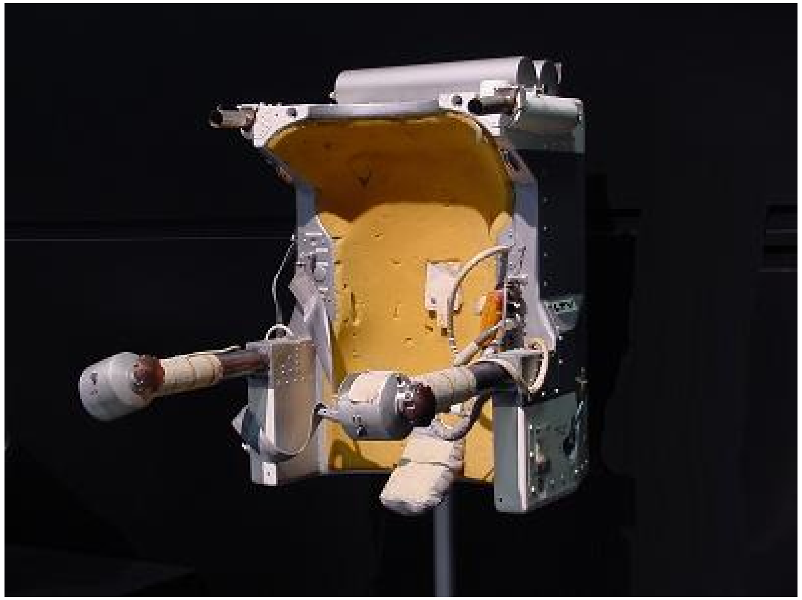
Gemini

The earliest attempts to provide mobility were during the Gemini programme were some mobility equipment was tested whilst astronauts were still tethered for safety.
During the planning of the Gemini programme two separate devices were considered. The Hand Held Manoeuvring Unit (HHMU) was planned for Gemini-4, -8, -10 and -11, whereas the US Air Force separately developed the Astronaut Manoeuvring Unit (AMU) which was to be flown on Gemiini-9 and 10.

HHMU on Gemini-4

An initial version of the HHMU was tested on Gemini-4. It used propellants from two tanks with pressurised oxygen and was tested during the 3 June 1965 EVA of Ed White. The unit was ran out of propellant after 3 minutes. Whilst White found the gun useful, fellow astronaut James McDivitt labelled the devise as 'hopeless' and 'utterly useless' as it required precise aim by the user to prevent unwanted rotation

An improved HHMU was flown on Gemini-10 whilst the use on the other mission was cancelled because various other problems encountered during the mission that prevented the tests to be conducted. The Gemini-10 HHMU received its nitrogen gas propellant from inside the spacecraft, through a hose bundled with the astronaut's umbilical connector.
It was effectively used by Michael Collins during an EVA on 20 July 1966, when he used it to move back and forth between Gemini-10 and Gemini-8 Target using a 15.24 m tether.
During this EVA he recovered a micrometeorite collection experiment from the Gemini 8 Target.
Because of problems unrelated to the device.



AMU

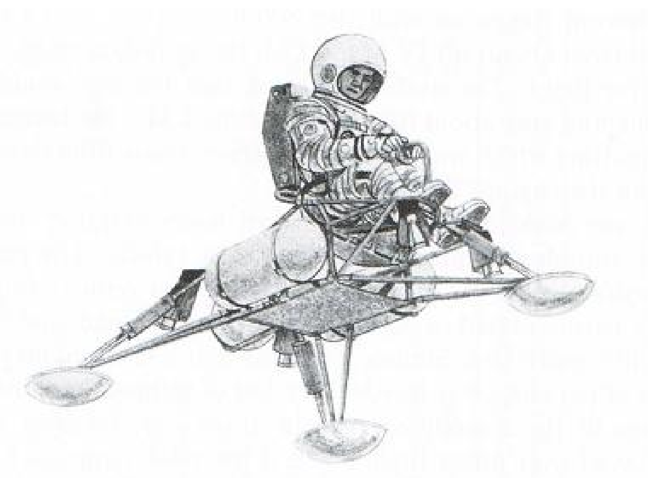
The AMU was a 75.5 kg self-contained unit in the shape of a form fitting seat that had its own propulsion, stabilization system, oxygen and telemetry for the biomedical data and systems. It used hydrogen peroxide for propellant.
The AMU featured only on Gemini-9 and was to be tested by Eugene Cernan on 5 June 1966. However, during the EVA Cernan's physical effort to connect to the unit was four times greater than anticipated and the AMU test was terminated when Cernan's helmet visor fogged up during the don phase.
The AMU was not flown at all on Gemini-12.

Apollo

To make effective use of the time spent on the Moon various options of crew mobility were studied during the early days of the Apollo programme.

One man vehicle

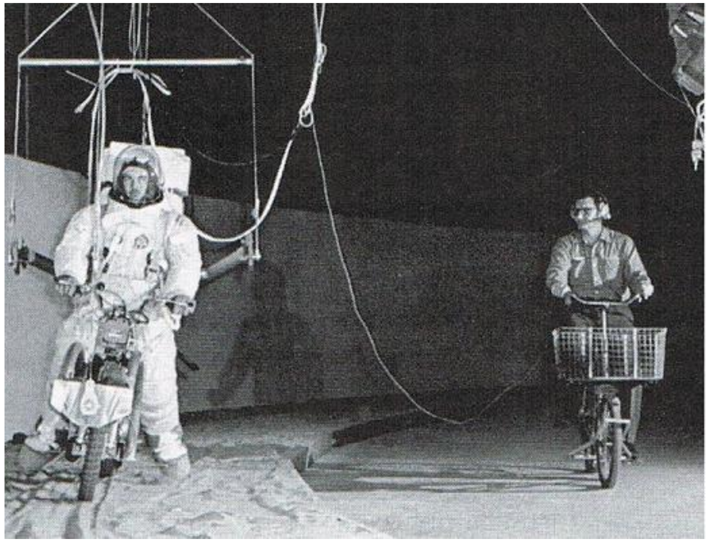
Consideration was given to various types mobility devices including a rocket powered one-man platform similar to those being developed by the US Army for terrestrial use. But these units were found to be too difficult to control.



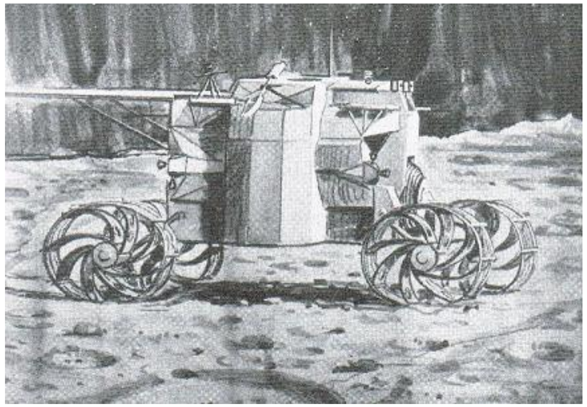
Grumman Lunar Flying Vehicle

The next step was the consideration of seated flying vehicles and a number of configurations were considered.

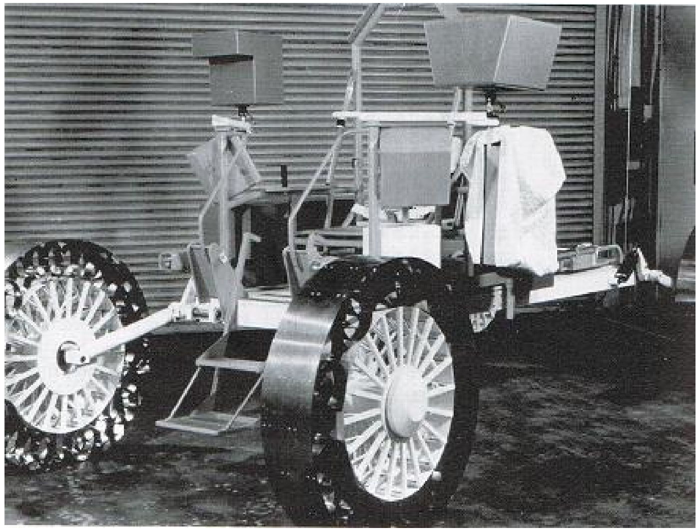
Sticking to mobility on the lunar surface proposals included a lunar motorbike and a variety of versions of a Mobile Laboratory (MOLAB), which were essentially pressurised rooms on wheels. Gradually these designs made way for a Local Scientific Survey Modules (LSSM) which had a capability to travel up to 200 km.



Testing of a lunar motor cycle



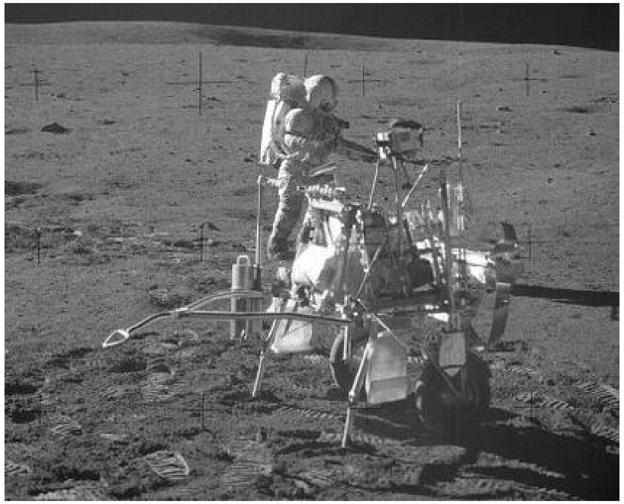
MOBLAS design by Grumman



Bendix LSSM design

Eventually two mobility aids were selected for the Apollo programme, but the first two lunar missions, Appllo-11 and Apollo-12, were not equipped with any of these devices. As such the range of exploration remained limited and the Apollo-11 crew did not travel beyond 61 m of the landing site whilst on Apollo-12 the range was extended to 400 m.

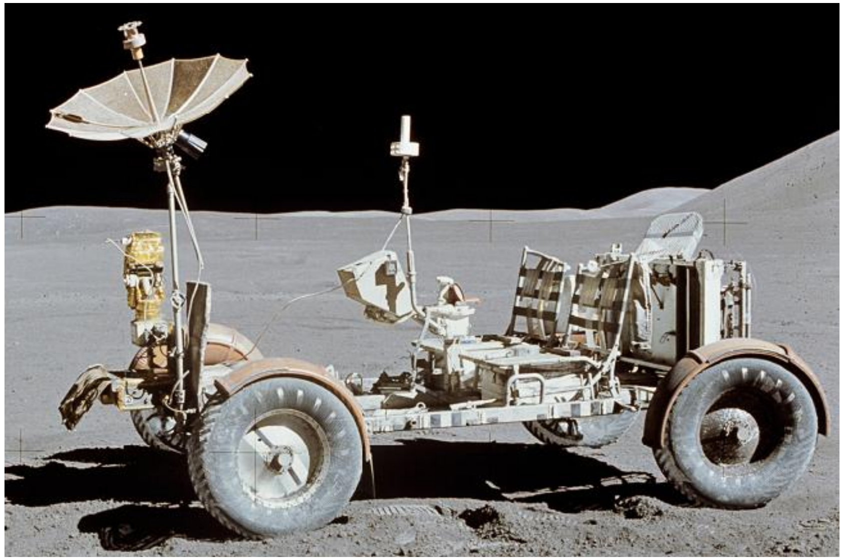
The crew of the Apollo-14 mission still explored by foot but were assisted by a two wheeled Modular Equipment Transporter (MET). They travelled as far away as 1.45 km from the lander.



MET

The MET had a tubular structure 2.18 m long, 1 m wide and 0.80 m high and was fitted with a single handle for towing and two legs to provide four-point stability at rest.
It had a mass of 12 kg and could carry about 65 kg.
It was originally intended that the MET would also be carried on Apollo-15 and -16, but a review the Apollo programme changed this.

Instead Apollo-15, -16 and -17 carried the Lunar Roving Vehicle (LRV).



LRV

A request for proposal for the LRV was issued on 11 July 1969 and Boeing, Bendix, Grumman and Chrysler submitted proposals.
On 28 October 1969 Boeing was selected with General Motors as the major subcontractor.

A total of four LRVs were built which were to be flown on Apollo-17, -18, -19 and -20. After the Apollo programme was reviewed and the final three missions were cancelled, three were used for Apollo-15, -16 and -17, whereas the fourth was used for spares. In addition several test and training versions were built.

The LRV had a 3 m long frame and a 2.3 m wheelbase and a height of 1.1 m. The three part chassis was made of aluminium alloy tubing and was hinged at the centre so that it could fit in the Lunar Module.

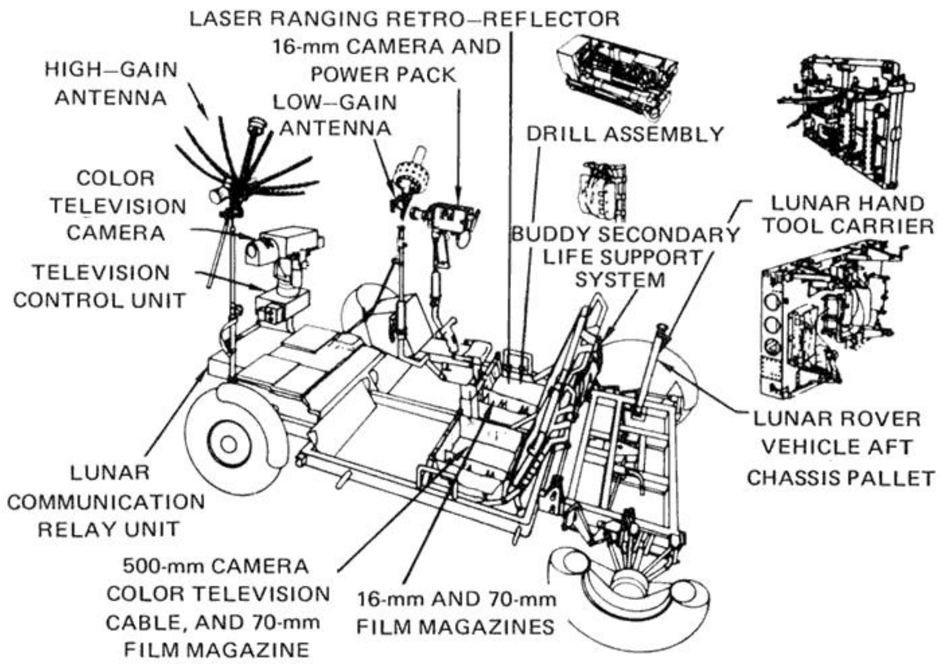
The maximum speed was 13 km/h although, on one of the missions, a speed of 18 km/h was recorded.
It had two side-by-side foldable seats with an armrest mounted between the seats. A large mesh dish antenna was mounted on a mast on the front centre of the vehicle whilst there was a colour TV camera fitted on the armrest.

The four wheels had been designed by General Motors and consisted of a spun aluminium hub and an 81 cm diameter, 23 cm wide tire made of zinc-coated woven 0.84 mm diameter steel strands attached to the rim and discs of formed aluminium. Titanium chevrons covered 50% of the contact area to provide traction. Each wheel had its own direct current (DC) electric drive motor developed by Delco and capable of generating 0.25 hp. Both the front and rear wheels had steering capabilities.
Power for the motors as well as other equipment was provided by two 36 V silver-zinc potassium hydroxide non-rechargeable batteries.

The drive motors were controlled by a T-shaped hand controller located between the two seats. This also controlled the steering mechanism and the brakes. Moving the stick forward powered the LRV forward, left and right turned the vehicle left or right, and pulling backwards activated the brakes. A switch on the handle would turn the vehicle into reverse whilst pulling the handle all the way backwards activated the parking brake.

The maximum range of the LRV was 92 km but in operations, the range was limited by the need to be able to walk back to the lander in the event that the LRV failed.

At the end of each use, the LRV was positioned in such a way that the camera was able to record the take-off of the ascent stage of the Lunar Module.



LRV

Mission	Trips	Total distance km	Total time h/m	Longest distance km	Maximum range from LM
Apollo-15	3	27.76	3.02	12.47	5.0
Apollo-16	3	26.55	3.26	11.59	4.5
Apollo-17		35.89	4.26	20.12	7.6

LRV deployment

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(to be continued)

LISA Pathfinder

On 3 December 2015 a Vega launch vehicle placed the LISA Pathfinder spacecraft in orbit.
Originally known as Small Missions for Application Research and Technology (SMART)-2, the objective is to test the technologies to be used on the Laser Interferometer Space Antenna (LISA), a future spacecraft to detect gravitational waves rippling across the cosmos as predicted by Einstein's general theory of relativity. That mission has not yet been accepted as an ESA programme.
The satellite carried the LISA Test Packages and the Disturbances Reduction System (DSR) to validate the sensors by observing the behaviour of two blocks of gold separated by 30 cm.
The satellite had a mass of 1900 kg of which 1420 kg was the propulsion module, and was placed in an orbit around the L-1 Lagrange point.

Amsat

Recently four satellite carrying radio amateur payload have been given 'Oscar' names. They are:

- 2015 025E: Naval Academy Oscar (NO)-83, also known as BRICSat-P
- 2015 025B: Naval Academy Oscar (NO)-84, also known as Psat
- 2015 058D: Amsat Oscar (AO)-84, also known as Fox-1A
- 2015 052B: Indonesia Oscar (IO)-86, also known as Lapan A-2

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Kanopus ST

On 5 December 2015 a Soyuz 2.v.1/Volga launch vehicle attempted to place the Kanopus ST remote sensing satellite in orbit but the satellite failed to detach from the upper stage and re-entered, along with the upper stage, on 8 December 2015.
Also known as Kosmos-2511, Kanopus ST was a 350 kg remote sensing satellite built by PO Polyot. The satellite was fitted with a microwave radiometer with a conical scanning geometry, capable of achieving a swath width of 2,200 km and a resolution of 12 to 160 km, as well as a multi-spectral imaging system covering the visible wavelengths across a 1,000 km swath, reaching a spatial resolution of 30 to 50 meters.
It was intended to scan the global oceans and land for weather research and operational hydrometeorological applications and, possibly, also to scan underwater areas for submarines.
Carried on Kanopus ST was a secondary payload identified as Kosmos-2512 or KYuA-1. This payload, a 15.8 kg sphere, successfully separated and began its function as a target for radar calibration.

Cygnus Orb-4

After several delays, the Cygnus Orb-4 cargo spacecraft was launched on 6 December 2015 with an Atlas V launch vehicle.
Also referred to as OA-4 and named SS Deke Slayton, it docked at Earth facing port of the Unity module of ISS on 9 December 2015.
The spacecraft carried 3349 kg of provisions to the station, comprising:

- Crew supplies: 1181 kg
- Vehicle hardware: 1007 kg
- Science utilization: 847 kg
- EVA gear: 227 kg
- Computer resources: 87 kg

With packing materials this came to 3513 kg.

The hardware included Kaber, a system developed by Nanoracks to deploy small satellites from the International Space Station. It is not restricted to cubesats and can handle payloads with a mass of up to 100 kg. It is based on the current deployment facilities on ISS
The payload also included 12 Flock 2E cubesats and the MinXSS, Cadre, Node-1, Node-2, SIMPL and STMSat-1 cubesats which will be deployed from ISS in due course,

Miniature X-Ray Solar Spectrometer Nanosatellite (MinXSS) is a 3U cubesat developed at the University of Colorado at Boulder to gather scientific data to further the current understanding of the energy distribution of Solar Flare Soft X-Ray emissions and the associated impacts on the Earth's Ionosphere, Thermosphere and Mesosphere.

The CubeSat investigating Atmospheric Density Response to Extreme driving (CADRE) is a 3U cubesat developed at the University of Michigan's Student Space Systems Fabrication Lab (S3FL). The primary mission objective is to demonstrate the technology for the future Amanda multi-satellite mission, in particular testing the Wind Ion Neutral Composition Suite (WINCS) instrument in an operational environment.

The Node-1 and Node-2 satellites were intended to be an extension to the Edison Demonstration of Smallsat Network (EDSN) that failed to be deployed on 4 November 2015. The Node satellites are almost identical to the EDSN satellites except for modifications associated to their deployment from ISS.

Satlet Initial-Mission Proofs and Lessons (SIMPL), also known as Hyper Integrated Satellite (HISat), was developed by NovaWorks in collaboration with NanoRacks Microsat to demonstrate the use of cellular structures for a nanosatellite using identical satlets as building blocks. On SIMPL six satlets and two solar arrays were used which were to be assembled by an astronaut on board of the ISS before being deployed.
The payload included an electro-optical imaging equipment as well as the QIKcom-1 amateur communications payload for the US Naval Academy Satellite Lab, containing an APRS packet radio communications transponders for relaying remote telemetry, sensor and user data from remote users and amateur radio environmental experiments or other data sources back to Amateur Radio experimenters via a global network of internet linked volunteer ground stations.
The satellite also has a propulsion system to maintain or raise its orbit, thereby extending its mission life.
It will be the first NanoRacks microsatellite deployed through the Kaber facility.

Finally, the St. Thomas More Satellite (STMSat)-1, is a 1U cubesat built by elementary school students at St. Thomas More Cathedral School, becoming the first ever satellite designed entirely by elementary school students with support by technical advisers from NASA. The satellite carries an amateur radio payload, an Earth imaging system and a number of symbolic items.

Zenit

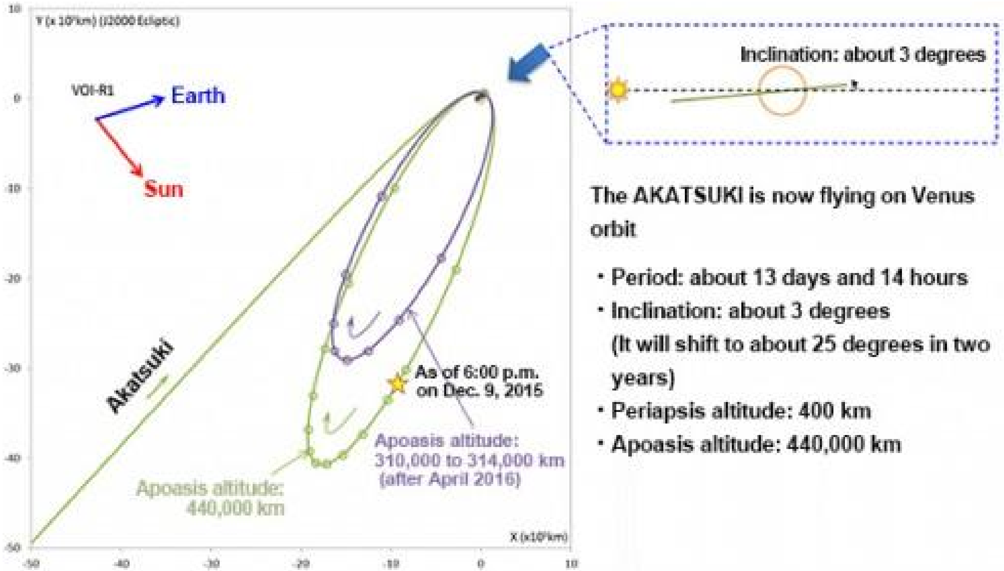
The launch of the Elektro L-2 meteorological satellite on 11 December 2015 is believed to have been the last launch of a Zenit launch vehicle.
Zenit was developed and built by Yuzhnoe, a Ukrainian company and flew for the first time in 1985.
Although Russia has one Zenit left in storage, the political tension between the two countries makes it unlikely that this one will actually be launched, let alone that more Zenit launch vehicles will be acquired by Russia.
The remaining Zenit was intended to be used for the Spektr-RG launch in 2017 but it is expected that this satellite will now be placed in orbit by a Proton M launch vehicle.
It was also to be used for Lybid, a communications satellite to be built by Russia for Ukraine, a project that is now unlikely to materialise.
The only possible use for the Zenit may be through the Sea Launch operations.

O3b

O3b has ordered an additional eight satellites from Thales Alenia, bringing the constellation of these communications satellites to 20, after their launch in 2018.
The satellites will be similar to those launched in 2013 and 2014.

Akatsuki

On 9 December 2015 the Japanese Akatsuki Venus Orbiter was successfully place in an orbit around Venus of 400 x 440,000 km with an inclination of 3º.



The spacecraft was launched on 20 May 2010 but on 6 December 2010 the spacecraft failed to be placed in an orbit around Venus due to a faulty valve in the orbit insertion engine.
The spacecraft subsequently remained in its interplanetary orbit and when close to Venus again in December 2015, used its reaction control thrusters for the orbit insertion. Earlier, in November 2011 three short burns of the reaction control thrusters had modified the spacecraft's trajectory slightly.
Regular observations of the Venusian atmosphere by Akatsuki will begin in April 2016, but the instruments are already collecting data and multi-band imagery from the highly elliptical orbit of the spacecraft.

Progress MS-1

On 21 December 2015 the first Progress MS cargo transfer spacecraft was launched. Based on the Progress M-M, this improved version is fitted with a new rendez-vous and docking system identified as Kurs NA, a new antenna system identified as EKTS, a new computer, identified as TsVM-101, a smaller digital telemetry system as well as additional protection against space debris and micrometeorites. Through the use of lighter instrumentation, the cargo mass capacity has been increased. Progress MS-1 docked at the Pirs nadir port of ISS on 23 December 2015 and is scheduled to undock in July 2016.

Falcon 9 v1.2

On 22 December 2015 SpaceX launched the first Falcon 9 v1.2, also known as Falcon 9 FT. This version has improved Merlin 1D engines that permit a larger payload capacity, especially important when the launch vehicle is required to place payloads into a geostationary transfer orbit. On this launch 11 Orbcomm Second Generation communications satellites were carried that were placed in an approximately 600 km orbit.

Also on this flight the first stage was successfully recovered after 9 minutes, 54 seconds, landing at the Landing Zone 1 at Cape Canaveral, formerly Space Launch Complex 13.
It is not intended to re-use this particular first stage.

Mars InSight

The March 2016 launch of the Mars InSight mission has been delayed until sometime in 2018, when the next Mars launch window occurs and may even be cancelled altogether, after one of the key instruments, the Seismic Experiment for Interior Structure (SEIS), suffered a series of leaks
SEIS is provided by the French Space Agency CNES and is intended to take precise measurements of Marsquakes and other seismic activity. The other main instrument is the Heat Flow and Physical Properties Package (HP^3) developed by the German Aerospace Center DLR that will hammer a sensor up to five meters into the Martian surface to measure heat coming from the Martian core.
The launch was to take place from Vandenberg, using an Atlas V 401 launch vehicle.