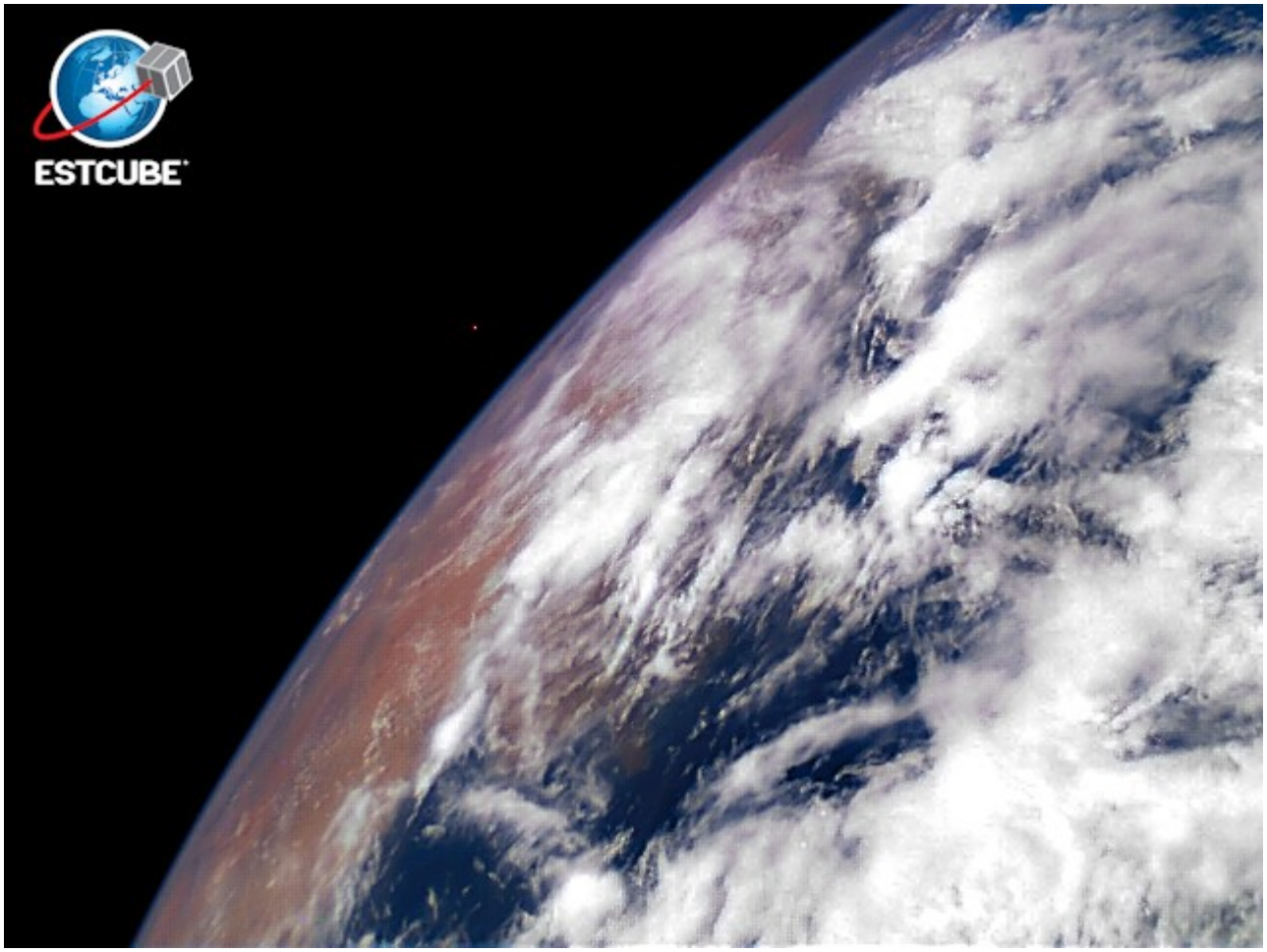
AMSAT UK

OSCAR NEWS

The official journal of AMSAT-UK for all users of OSCAR satellites



NUMBER 202 June 2013

COMMUNICATIONS FOR AMSAT-UK and MEMBERSHIP RENEWALS /Queries should be addressed to: The Secretary “Badgers”, Letton Close, Blandford, Dorset DT11 7SS
g3wgm.at.amsat.org

The Shop:
CJ Morgan, AMSAT-UK, 5 Montgomery Avenue, Hampton on the Hill, Warwick, Warwickshire. CV35 8QP, United Kingdom
amsat-uk-shop.at.amsat.org

THE AMSAT-UK CLUB CALL is G0AUK and the HF Net operates:

3.780MHz +/- QRM Sundays @ 10.00 am local time.

For all AMSAT-UK information see www.amsat-uk.org

Oscar News is usually sent to members 4 times per year (Dec. Mar, Jun, and Sep). Articles and news items for inclusion in future issues will be very welcome. For the time being please email: g3vzv.at.amsat.org
AMSAT-UK takes no responsibility for the content of articles or advertisements

Front Cover Picture: First picture from space taken by Estcube-1. See information on page 9.

FROM THE HON SEC'S KEYBOARD!

The FUNcube-1 Launch

As previously reported, all the formalities of the FUNcube launch will be handled by ISL bv (Innovative Space Logistics). They are a sister company to ISIS bv. There has been a dearth of news until recently. It seems that the Russian government has now decided that they WILL proceed with at least two DNEPR launches this year, and have concluded agreements with the necessary other agencies and organisations, eg Kosmotras, etc. We understand that we are on the second planned launch, and that the first will be in August, and ours probably following a few months later. So this could put us in November as things stand at present. The ongoing delay is disappointing, but we must remember that we are at the mercy of the primary payload and the launch agency! Patience please!

The FUNcube-2 Launch

FUNcube-2 is a subsystem that is included in the UKube-1 3U CubeSat. Presently the Flight Model is being hard stacked and fully integrated. It is expected that the spacecraft will be carried to Russia in late June for a launch on a Soyuz launch vehicle from Baikonur sometime during September.

AMSAT-UK Electronic Membership

This seems to be going well. See page 31 for more information. I havn't received many comments on this new form of membership and delivering Oscar News. As at the time of writing approx 40% of our members have opted for delivery of Oscar News by pdf.

The 2013 AMSAT-UK Colloquium

The next Colloquium will be taking place as normal in JULY, specifically over the period 19/20/21 July 2013. Please see page 29 for more details. PLEASE be aware that the hotel will only hold our bedrooms until 21 days prior to the event, ie 28th June. If you book after this day, you run the risk of being unable to get a room to stay overnight. As normal, day visitors or welcome, as are those who are not members of AMSAT-UK. Spread the word at your local club! See you there.

GB4FUN.

RSGB members will probably know that the RSGB have decided to discontinue running GB4FUN, and offered it, for free, to any club who made a bid for it. AMSAT-UK was among about 6 clubs who did so, but sadly we were unsuccessful. It went to the Sheffield ARC.

73 Jim Heck, G3WGM,
g3wgm@amsat.org
Hon Sec AMSAT-UK 30 May 2013

CONTENTS

Please support the FUNcube project. If you are a UK tax payer, and wish to donate in a tax efficient way, please visit www.tinyurl.com/funcubegiving and making a donation, however small. Your cash will be collected by the Radio Communication Foundation, who will reclaim the Gift Aid; we get an extra 20% !

GAMANET: NETWORKING QB50

Pedro Rodriguez

GAMANET is an ambitious endeavour in space communications, led by TEKEVER, a Portuguese technology Group, and University of Porto, also from Portugal. Its challenge is the creation of the largest ad hoc communications network ever in space. Its goal is to bring the networking capability to satellite constellations. The target mission is QB50 and the main objective is to join CubeSats and Ground Stations in a seamless communications network. GAMANET will deliver each individual CubeSat a unique set of benefits that no traditional communications system is able to provide: increased ground coverage, by having access to ground links from all other satellites in the network; higher downlink and uplink capacity and reliability, combining communication resources from all satellites; or improved positioning precision, combining GPS and InterSatellite Links (ISL) data from all available network nodes. It also enriches the scientific value of QB50, since GAMANET allows synchronisation between satellites and the collection of data during re-entry. In short, GAMANET presents a disruptive space communications and networking concept, targeting small satellite platforms to enable distributed missions and address their needs.

THE QB50 MISSION

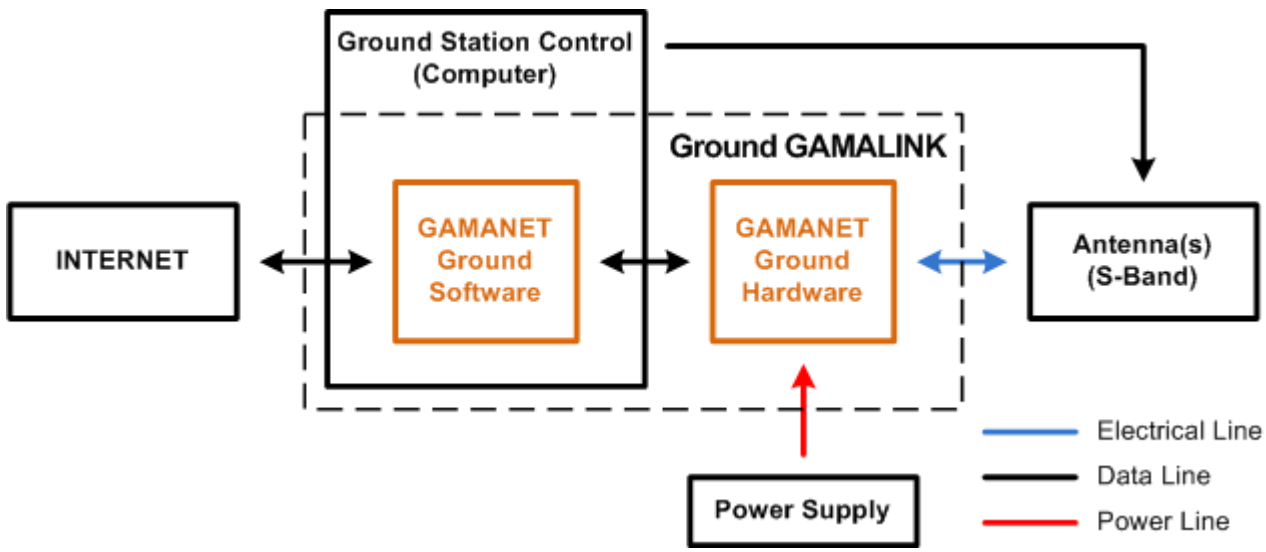
QB50 is a network 50 CubeSats in a 'string-of-pearls' configuration that will be launched together in the first half of 2015 into a circular orbit at 320 km altitude, and with an inclination of 79º. The 50 CubeSats will comprise about 40 atmospheric double CubeSats and about 10 double or triple CubeSats for science and technology demonstration. Most of the CubeSats will carry a set of standardized sensors for multi-point, in-situ, long-duration measurements of key parameters and constituents in the largely unexplored lower thermosphere and ionosphere. The mission lifetime of individual CubeSats is estimated to be about three months. QB50 will also study the re-entry process by measuring a number of key parameters during re-entry, such as the CubeSat on-board temperature and deceleration. The re-entry process will also be studied by comparing predicted (using a variety of atmospheric models, trajectory simulation software tools and CubeSat drag coefficients) and actual CubeSat trajectories and orbital lifetimes, and by comparing predicted and actual times and latitudes/longitudes of atmospheric re-entry. The distributed nature of QB50 presents the ideal context to test and validate GAMANET and its technologies in space.

GAMALINK, THE ENABLER!

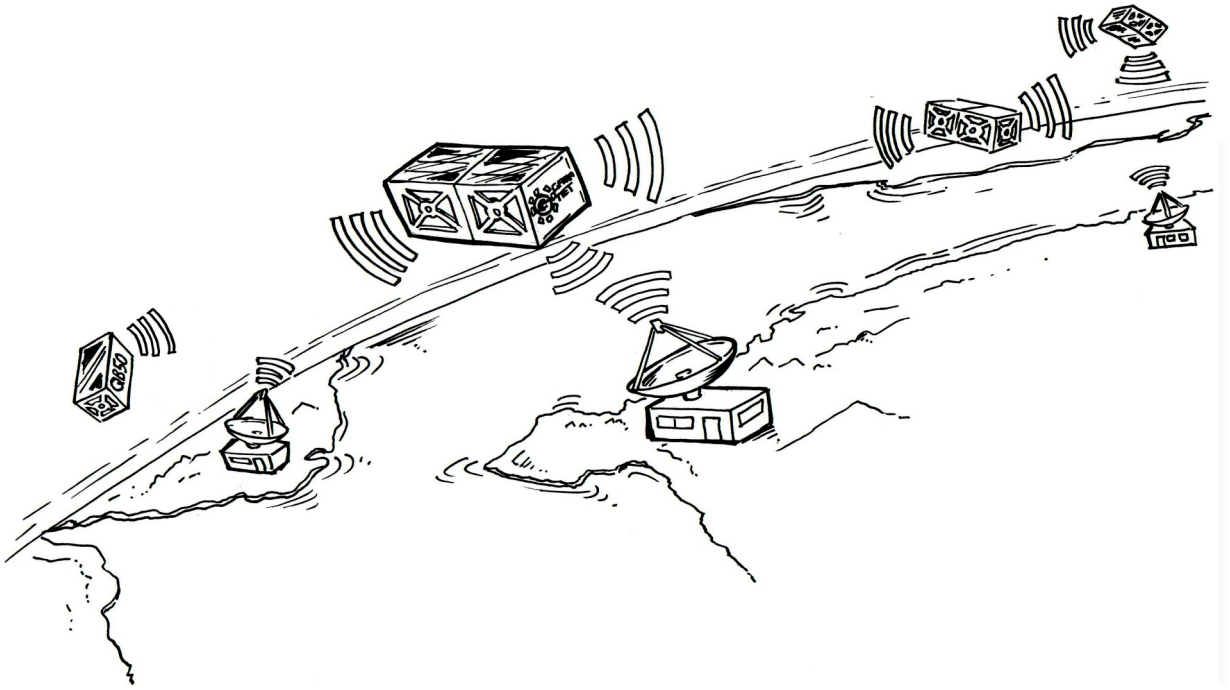
GAMANET's enabling device is GAMALINK, an advanced S-band communications platform relying on the flexibility of Software-Defined Radio to achieve data rates up to 1 Mbit/s. Present on every GAMANET node, whether a CubeSat or a Ground Station, GAMALINK enables the establishment of Inter-Satellite Links, based on mobile wireless ad hoc networks, benefitting from technology that has already been vastly tested to provide connectivity in the most demanding environments on the ground. GAMALINK also delivers accurate position determination based on GPS, which provides absolute position and timing information that may be used to achieve synchronisation between satellites. Additionally, GAMALINK also provides a S-band beacon, which is capable of being received by most existing S-band enabled Ground Stations.

INNOVATION IN SPACE: SDR AND ADHOC NETWORKS

GAMALINK is a Software-Defined Radio (SDR) Platform, an innovative concept that enables the development of various waveforms using a common hardware platform. Its characteristics can result in tremendous mass and volume savings, while increasing flexibility to



a point where a radio system could be completely modified by just sending a command from Ground. On top of the SDR platform, GAMALINK implements mobile ad hoc networking algorithms, enabling the creation of the ISLs. Their self-discovery, self-organization and auto-configuration capabilities provide the autonomy required for future space missions using flexible distributed architectures, like formation flying or planetary surface exploration. Ultimately, a mobile ad hoc space



network can enable lower communication costs and latencies between satellites, space vehicles and astronauts or satellites and ground stations. Ad hoc networks have never been tested in space, despite of their great potential and, although SDR has already been used to some extent, it is still far from being popular in space missions. This is one of the main goals of GAMANET: bring two promising terrestrial technologies to orbit.

GROUND SEGMENT

Even though GAMANET brings a huge progress to space communications, innovation continues on the Ground. The aim of GAMANET is to create one single network, combining Satellites and Ground Stations, taking the most out of the robustness of ad hoc networks. The ISL and the downlinks will be managed by the GAMANET space segment, whilst on the ground, each station will be connected to the others through the Internet, considerably increasing the overall link capabilities of the QB50 mission. Apart from a Ground version of GAMALINK, GAMANET will also include hardware and software that will enable both interfaces with the space segment and the Ground Station Network, data processing and storage management and a user interface. In the end, data blocks sent from one CubeSat can be received by different Ground Stations and reconstructed locally, at the mission control centre. This full networking capability can greatly improve the scientific return of QB50, by maximizing the number of ground visibility periods of all CubeSats and optimizing their short duration.

RADIO GAMANETEURS

GAMANET will operate in S-band, within the 2.40 - 2.45GHz amateur satellite service frequency band and will send a beacon that can be received by any radio amateur around the world, with basic satellite information. This will enable the amateur radio community to follow the creation of the first ad hoc network in space as well as to collect the most relevant network management data. Especially in the beginning of the mission, where the satellite positions are not yet known, the participation of the amateur community is extremely important to assess the network progress. Having several radio amateurs on board its development team, GAMANET will be imbued of the community spirit and of that same excitement we all get when we hear the first bits of a call from outer space. All you have to do is to keep listening!

If you want to know more about GAMANET, contact us at gamanet@tekever.com

(editors' note- this article has been reprinted, with permission, from theCQ-TV Magazine of the BATC. Although it concentrates on the impact on amateur television operations, it gives us some insight about the likely changes that will also affect our satellite activities)

Spectrum pressures continue

Noel Matthews G8GTZ
Chairman BATC

As you may have seen in the RSGB news, Ofcom are currently consulting with users about the next round of spectrum release during 2014. This is particularly relevant to the ATV community as it affects spectrum currently held by government departments such as the MoD, who have committed to hand back 500 MHz below 5 GHz, and are currently the primary user for the 2.3 and 3.4 amateur bands. See https://www.gov.uk/sharing-defence-spectrum for more details.

As part of the assessment process, the ETCC and BATC offered Ofcom the opportunity to visit a 2.3GHz ATV

repeater and also for a group of ATVers to visit the test labs at Baldock radio with typical user equipment. Ofcom readily agreed to this and on April 3rd, G8GTZ, G3PYB, G8ADM, G3XTW and G4CPE visited Baldock with 6 sets of equipment ranging from a Comtech transmitter to an SR systems digital encoder / modulator and transverter.

We were given a full site tour, during which we visited the operations centre where interference investigation is co-ordinated. We learnt that Ofcom has26 field engineers and is very willing to undertake investigation of interference to the amateur service – just use the web reporting form at

https://stakeholders.ofcom.org.uk/tell-us/abuse-amateur-radio-system

The equipment testing was undertaken using a National Instruments spectrum recorder which grabs up to 50 MHz of spectrum and saves it to the 100 Tb storage array for later analysis.

As such, no results were made available on the day, but Ofcom were particularly interested in adjacent and co-channel performance to help them plan the re-location of ATV channels in order to reduce interference to other services.

The same exercise was carried out at GB3TZ on April 10th where recordings of both the analogue and digital outputs were taken.

As was predicted at the BATC BGM last October and in the Jan 2013 Radcom article "spectrum release & amateur radio", available for download here http://rsgbbeta.org/operating/band-plans/ , it is highly likely that there will be changes to the amateur allocations at 2.3 GHz, which will almost certainly affect ATV repeaters and simplex operation. However, it is currently anticipated that the proposed new DATV channels between 3404 and 3410 MHz (GB3BA has just received an NoV for 3406 MHz) will not be affected by these changes and could be used for repeater cross band outputs.

This pressure on spectrum, particularly at 2.3 GHz, is worldwide and amateurs in Sweden and Australia have already lost the band. However, there has been a high level of co-operation between Ofcom and the UK amateur community on the proposed changes and it is hoped that the impact, particularly for ATV will be minimised. Ofcom has promised to consult further on the proposed changes during the next few months and to keep us fully informed of decisions.

We are expecting some update within the next 3 months with final decisions before the end of 2013 as the auctions are anticipated to take place in summer 2014.

It is planned to include this as a topic at the BATC "CAT2013" Convention at Finningley on October 26/27th, when Murray Niman (RSGB spectrum manager) will talk about the changes and the impact for the amateur service.

Tim Peake to be first British astronaut in space for over 20 years

It was announced on May 20th that former Apache helicopter pilot Tim Peake is to become the first British astronaut to visit the International Space Station, making him the first UK astronaut in space for over 20 years.

After more than three years of training with the European Space Agency's (ESA) Astronaut Programme, Peake has been selected to live and work on the International Space Station (ISS) for six months. He will carry out a comprehensive science programme and take part in a European education outreach programme in the build up to and during his mission.

Tim is one of six astronauts who have been selected from among 8,000 hopefuls. The flight is expected to take place in November 2015.

Speaking at a special event at the Science Museum in London, Tim Peake said:

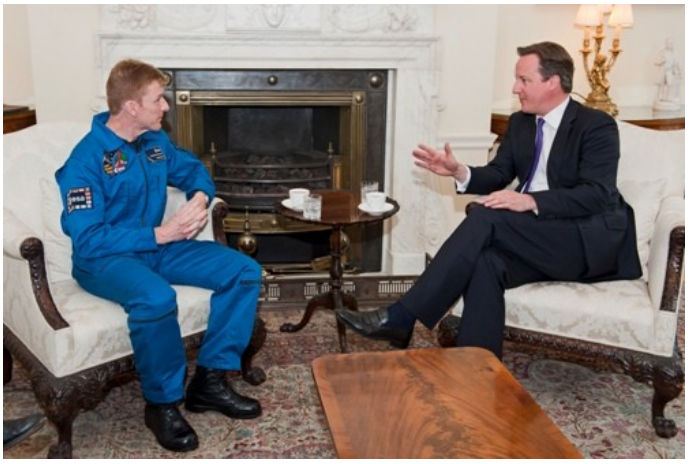
"I am delighted to be proposed for a long-duration mission to the International Space Station. This is another important mission for Europe and in particular a wonderful opportunity for European science, industry and education to benefit from microgravity research.

"Since joining the European Astronaut Corps in 2009, I have been training to work on the Station and I am extremely grateful to the ground support teams who make it possible for us to push the boundaries of knowledge through human spaceflight and exploration."

Prime Minister David Cameron said:

"This is a momentous day, not just for Tim Peake but for Great Britain. It is a great sign of our thriving British space sector, which has seen real growth thanks to our world-class research, and now supports nearly 30,000 jobs.

"What an achievement that Tim was picked for this historic role from over 8,000 applicants from around the world. I am sure he will do us proud and I hope that he will inspire the next generation to pursue exciting careers in science and engineering."



British Astronaut Tim Peake meets Prime Minister David Cameron. Credit: Max Alexander/UK Space Agency.

Tim was appointed as an ambassador for UK science and space-based careers in 2009 and is working with the UK Space Agency in developing the UK's microgravity research programme. He has been involved in the international Mission X programme, which promotes science careers and healthy lifestyles in schools, and his outreach will continue throughout his training and his time on the International Space Station (ISS).

Minister for Universities and Science David Willetts, said:

"This is a landmark moment for Britain and our reputation as a leading science nation. Not only will we have the first UK astronaut for over two decades, but Tim Peake will be the first ever Briton to carry out groundbreaking research on the International Space Station.

"*Tim represents the very best of British. He will become a powerful role model for the young people we need to bolster this country's science and engineering workforce."*

"Today's announcement builds on the continued success of the British space sector, which is worth £9 billion to the economy annually and employs nearly 30,000 people."

Tim is the first British ESA astronaut and the second British astronaut that did not have to get US citizenship to fly to space.

Today's announcement follows increased investment by the UK Space Agency in Europe's space programme to £240 million per year, including a £16 million contribution to the ISS, agreed at the ESA Ministerial last November. This is expected to secure £1 billion in orders per year for British businesses.

Space technology is an essential part of everyday life and is vital for weather forecasting, navigation, global communications, broadcasting and health. Traffic monitoring, for example, relies on the GPS satellite system. CAT scanners and MRI scanners, which allow more accurate diagnosis and reduce the need for exploratory operations, were developed from technology originally used for enhancing images taken of space.

Space can also provide the tools to manage global challenges such as climate change and natural disasters, and has helped drive the development of robotics.

Chief Executive of the UK Space Agency Dr David Parker said:

"*Tim Peake is working with the UK Space Agency to help us build a strong programme of science in the UK. With our new investment in the International Space Station and Europe's microgravity programme, his flight in 2015 could help expand our international competitiveness in areas such as health and ageing research, innovative materials and plasma physics.*

"Tim is also an inspirational role model for young people in the UK. As an ambassador for UK science and space-based careers, he is demonstrating the upper limits of what British kids of every age can aspire to."

ESA's Director of Human Spaceflight and Operations Thomas Reiter said:

"The value of Europe's astronauts and the training given at the European Astronaut Centre is reflected in the large number of mission assignments awarded to ESA astronauts.

"I am confident that all astronauts of ESA's 2009 class will have flown to the International Space Station by 2017 and that we will continue to use this unique research facility in Earth orbit for many years to come."

CUBESAT launches 2013

From information that was current at 20th May 2013. It has been a busy few weeks for launches!

The Indian PSLV-C20 launch on 25th February included two CubeSats as secondary payloads.

AAUSAT-3, a 1U CubeSat from the University of Aalborg in Denmark. It's main mission is to downlink AIS data from ships around the world. Their http://www.space.aau.dk/aausat3/ website shows that the spacecraft is working well on 437.425MHz and that the FEC encoding that is employed is proving very effective to improve downlink reliability. Generally they are using a 9k6 datarate

STRaND-1 from SSTL and SSC at Surrey. This is a 3U CubeSat that has a number of missions/payloads and includes an Android phone. Good signals at 9k6 were heard from this spacecraft on 437.568MHz immediately after launch but no transmissions have been received since March 31st. Mike DK3WN's website has some useful information http://www.dk3wn.info/sat/afu/sat_strand.shtml

The Soyuz Bion M1 mission was launched on the 19th April and included these secondary payloads:

A PhoneSat picture from space

SOMP The "Students Oxygen Measurement Project" from the Dresden Technical University is a 1U CubeSat operating on 437.499MHz 1k2 FSK and CW

BEESAT 2& These are a pair of 1U CubeSats from the TU in Berlin operating on 435.950MHz under experimental licences from the German government. The use 4k8 GMSK with Mobitex encoding.

OSSI-1 a 1U CubeSat commissioned and constructed by Hojun Song DS1BSO. Intended to transmit on 145.980MHz CW and 437.525MHz with AX25. It also carries a LED optical beacon. Our AMSAT-UK website at http://amsat-uk.org/satellites/ossi-1/ has some detailed information. There have been no reception reports up to this date.

The Antares-110 maiden launch on 24th April was to a low altitude and the payloads have already decayed but included:

Three PhoneSats. They were all 1U CubeSats operating under battery power only. They carried Nexus smartphones and downlinked pictures on 437.425MHz using 1k2 AFSK modulation. Our website has more information http://amsat-uk.org/tag/phonesat/

On the 26th of April a **Long March 2 launch** deployed the following CubeSats:

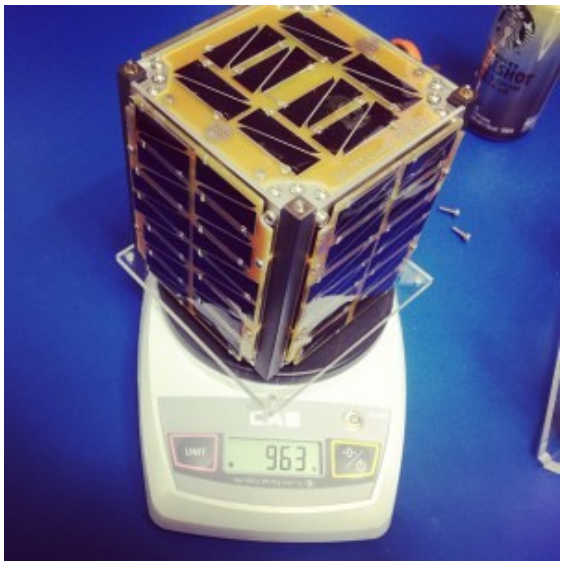
Turksat-3USat. This is a 3U CubeSat from Turkey and carries a linear V/U transponder but sadly little has been heard from it since launch.

CubeBug-1. This is a 2U CubeSat from Argentina and is active using 1k2 AFSK downlink on 437.438MHz. This signal is not continuous but comes in bursts every 30 seconds or so. See the article on page 12.

NEE01 Pegaso. This 1U CubeSat does not operate on amateur frequencies but has a TV transmitter on 910MHz. Amazing pictures and audio has been received and can be viewed on here: http://www.earthcam.com/world/ecuador/ecsa/ Quite an achievement for a 1U bird!

On the 7th of May, the second flight of the **VEGA launcher,** called VERTA-1,was successful and deployed a single 1U Cubesat ESTCube-1 from the University of Tartu in Estonia. It carries a CW beacon on 437.250MHz and 9k6 telemetry on 437.505MHz. Again our website has full information http://amsat-uk.org/2013/04/20/estcube-1-estonias-first-cubesat/

Check Mike DK3WN's website for the latest information concerning currently operations of all the above spacecraft. http://www.dk3wn.info



OSSI-1 on the scales before launch

OFCOM CONSULTATION

A statement from OFCOM

Ofcom is planning a number of policy initiatives in the next few months that will have a direct effect on amateur radio in the UK. If you want to keep up to date, you can sign up for updates on the Ofcom website at www.ofcom.org.uk/static/subscribe/select_list.htm.

Public Sector Spectrum Release is part of a commitment by government to release 500MHz of public sector spectrum by 2020. As part of these plans, the Ministry of defence is looking to release 40MHz of spectrum between 2350 and 2390MHZ and an additional 150MHz of spectrum above 3410MHz for civilian uses. These changes will have implications for amateurs (notably TV repeaters) in the release bands and may also have an impact on uses in the adjacent bands

Earlier this year Ofcom invited a group of amateur TV repeater users to Baldock to participate in testing to determine what the impact might be in the adjacent bands. Ofcom plans to publish a consultation for amateurs about any potential changes within the next month. This will be followed later this year by a statement giving amateurs reasonable notice of any licence changes necessary. Ofcom then aims to issue a full consultation in due course.

Ofcom is also to consult on the release of three tranches of spectrum in Band 1, Low Band and Mid Band respectively. One proposal is that 1MHz of Mid-Band (146 to147MHz so adjacent to the existing allocation in the 2m band) could be allocated to amateur radio. The consultation will be published at the end of May 2013. It will be aimed at all mobile users, including business radio, maritime, as well as amateur.

Finally, Ofcom wants to review the terms and conditions of the amateur licence. The current form of the licence has been around for seven years now and Ofcom is keen to ensure that it continues to meet its regulatory needs as well as the needs of licensees. The licence needs to be updated anyway to reflect the changes agreed at WRC12.

That process is at an early stage and the consultation will be published early next year.All of these consultations will result in changes to the amateur licence. To minimise disruption to licensees, Ofcom intends to effect all of the changes at the same time, probably in summer 2014.

IARU News

IARU Region 1 held an interim meeting in Vienna during April and discussed a number of subjects which relate to our part of the amateur radio world.

Most notably, the VHF Committee agreed to a proposal to make an additional 25 kHz of spectrum available for amateur satellite linear downlinks. within the Region 1 Bandplan. This would be at the very bottom of the band which has, until recently, been used for EME but which is now almost completely unused. This proposal will still need the agreement of the other two IARU Regions and work is underway to obtain this support prior to the next full IARU Region 1 Conference next year.

Additionally, the HF Committee agreed to a proposal to remove the present downlinks only restriction on the 29MHz amateur satellite portion of the HF Bandplan.

IARU Administrative Council

The AC has reacted to a number of challenges presented by the rapid growth in the licensing of numerous CubeSats with experimental licences rather than amateur licences. This has suddenly started to occur in the USA as a result of many of the proposed missions being of a semi commercial nature and therefore not satisfying the requirements for an amateur project.

The IARU has had to decide whether or not to continue to provide frequency coordination services for these experimental stations—most of them are planning to use frequencies in the 435-438MHz range.

They have formalised a position paper in advance of the forthcoming ITU WRC-15 ***Agenda Item 9.1.8*** – *Regulatory aspects for nanosatellites and picosatellites (Resolution **757 (WRC-12))*** which can be read here:
http://ukamsat.files.wordpress.com/2013/05/iaru-e-newsletter-29-may-2013.doc

As we only have secondary rights to all the amateur satellite spectrum between 146MHz and 24GHz we are not in control of who else can also use the frequencies but most of these CubeSats are being developed by University teams. This means that hundreds, if not thousands, of students (and their professors) are being introduced into amateur radio and many have got their own licences as a result. The increased activity is actually helping to protect “our” bands and the cooperation between many amateurs and university teams is helping to ensure that dual use missions can be developed.

AMSAT- FOX- launch date announced

NASA announced on May 13, 2013 that AMSAT's Fox -1 spacecraft has been assigned for launch in 2014 on the ELaNa XII mission. The expected orbit is 470 x 780 km at 64 degrees inclination. This orbit has a lifetime of about 11 years.

AMSAT Vice President Engineering, Tony Monteiro, AA2TX, reported that the software development team successfully brought up the Fox-1 system software on the Internal Housekeeping Unit (IHU). The IHU is the brains of the Fox-1 satellite and it has a 32-bit, STM32L microprocessor. The operating IHU card was shown in the AMSAT Engineering booth at the Dayton Hamvention.

The Fox-1 Engineering Team will deliver the satellite for integration with the launch vehicle during May, 2014 with the launch scheduled for November, 2014. Tony commented, *"While this is later than we had hoped, it is well within the normal variance of ELaNa launch dates and the extra time will be most welcome for additional satellite testing. This is very exciting news and really puts the focus on finishing the satellite and ground station software development."*

President Barry Baines said "*AMSAT's focus on STEM education and development of a CubeSat platform capable of flying a science mission with a reliable communications link resulted in the selection of Fox-1 in the third round and RadFxSat (Fox-1B) in the fourth round of NASA's CubeSat Launch Initiative."*

All Fox CubeSats are designed to host advanced science payloads to support future science missions that help us to continue qualify for NASA ELaNa (free) launches. The Phase 1 Fox satellites are 1-Unit CubeSats. They each include an analog FM repeater that will allow simple ground stations using an HT and an "arrow" type antenna to make contacts using the satellite. This was the mode made so popular by AO-51. The Phase 1 CubeSats also have the capability of operating in a high-speed digital mode for data communications. Phase 2 Fox satellites will include software-defined-transponders (SDX) like the one tested on ARISSat-1. These will be able to operate in a wide variety of analogue and digital communications modes including linear transponders. Since this requires more power for reliable operation, these will probably all be 3-Unit CubeSats.

AMSAT has recently requested frequency coordination for FOX-1 from the IARU Panel. The proposed uplink is on 435.120 MHz and the FM and data downlink on 145.920 MHz. The output power should be 400mW.

(Editor's note: We came across this short note on the CubeBug web site, and thought our readers might be interested! Keep up the good work! CubeBug was built in Argentina, and launched on 26 Apr 2013.)

We love the amateur radio enthusiasts!

This last few days since the launch, I felt something I haven't felt so strong before: the help and love of people I don't even know, who helped us with all they could, and sometimes even more.

Once the Satellite is in orbit, the only way to know what's going on, if it's still working, if the batteries are ok, if they are charging with energy from the solar panels, etc. Is by tuning the radio to the right frequency (437438Mhz), pointing the antenna to where El Capitan Beto is supposed to be at the moment, and crossing your fingers. Until you heard the first blip, you don't know if it even survived the forces of the launch.

After only a few hours we started receiving the first reports from all over the world. We expected to get a few emails, but the response was overwhelming, we didn't know how to handle it.

We thought we got a first report, but then found another one from earlier, and then we received another one, reporting from an even earlier hearing. It was not only us trying to hear the CubeBug-1, there was a whole community of incredible people with their antennas pointing to the sky, all looking for a small box and its tiny antenna.

We received reports from Argentina, The Netherlands, Japan, Germany, Australia, USA, France, Sudan, Ecuador, and I'm forgetting some (I can always edit the post, so please let me know).

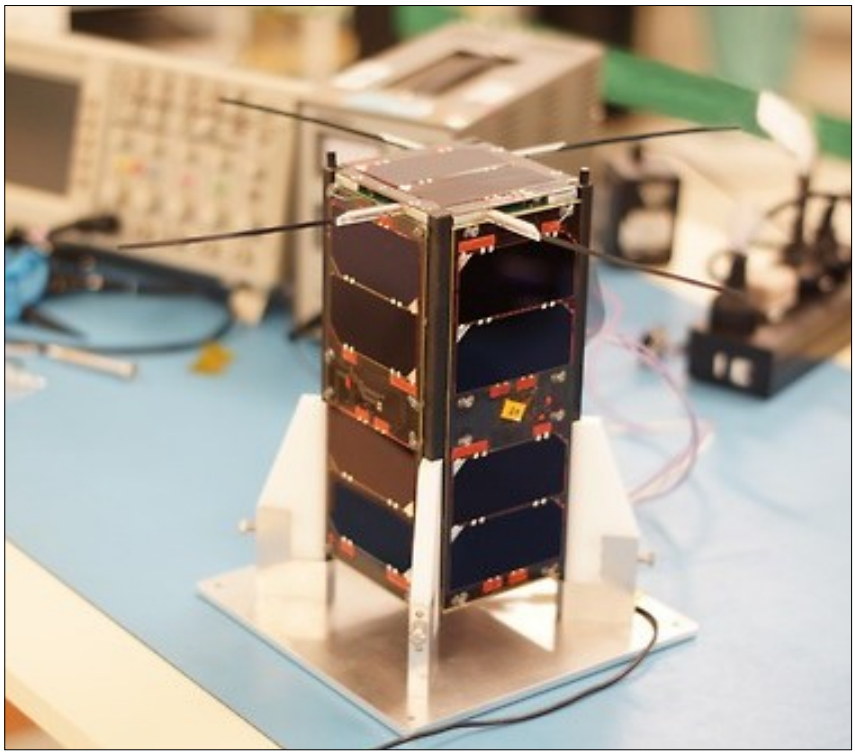
If you like the numbers, we already collected 10GB of audio and data files from people who sent them, read more than 10 blog posts on reports and technical analysis of the data, exchanged more than 200 emails in only a few days. Some even took the time to break a large file in peaces, and spend hours (literally) in a slow connection to send us the files, just because they understand how important it is for us to know if it's all going fine out there, and it really really help to soothe the spirits.

And we can also tell they enjoy doing it.

When it got difficult, because it's not easy to hear what El Capitán has to say, they go about how they are going to climb their towers and change their antennas for a better one, or improve their amplifiers, or if the rain breaks one of them, they go and fish a replacement from a big box, and are ready again for the next pass. It's just great and wonderful. There are no problems, only challenges and ideas.

We could very early tell that the CubeBug was healthy, and It was only because one sent us an audio file and a few others worked on it until one cracked it open, that we now know that all the signals that we can read from Beto are alright, even a bit too good to be true for our first satellite. Battery: Ok, Solar Panels: Ok, Temperature: Ok, Stabilization: Ok.

A few of them where there every time CubeBug-1 passed over their houses, 4 to 6 times a day, and some even apologized if they had to skip some because they had to work, eat or be with their family. I couldn't believe all the love we were getting.



CubeBug-1 in the clean room before launch

And we are all now a big group of old friends, exchanging ideas, asking questions and selflessly sharing knowledge (it's usually me who listens, of course), and it's only been a week.

That's it, now I can go again and write technical posts, which I think I do best, but just for this one:

Thank you very much, Domo arigato gozaimasu, Vielen Dank, Heel hartelijk bedankt, Shoukran jasilan, Merci beaucoup y Muchas gracias to all LU1VZ, LU4EOU, PA3WEG, @PE0SAT, VK5HI, JA0CAW, ST2NH, JE9PEL, @DK3WN, @JR8LWY, @JA5BLZ, @NW_PolySat, F1GZV, VK5DG, and all to come (I just had to go and add one more after I finished writing, it's wonderful).

D-STAR digital amateur communications in space with OUFTI-1 CubeSat

Jonathan Pisane – ON7JPD, Amandine Denis – ON4EYA, Jacques Verly – ON9CWD

University of Liege, Liege, Belgium

Abstract – OUFTI-1 is a nano-satellite currently being constructed by the students of the University of Liège, Belgium. Its main payload is the D-STAR amateur-radio telecommunication protocol. In this paper, we explain how hams will be able to operate OUFTI-1 for D-STAR space communications. The large footprint of OUFTI-1 results in a larger number of users being able to communicate via D-STAR.

1. Introduction

OUFTI-1 is a nano-satellite entirely developed by the students of the University of Liege (ULg), Belgium, along with two other engineering schools. The students develop the different subsystems of OUFTI-1, including the power system, the on-board computer, the thermal system, the communication system, and the ground station. Details about all these subsystems can be found in [1]. OUFTI-1 will carry two payloads; the first on-board D-STAR-dedicated repeater and new generation solar cells. This paper describes the different aspects of the D-STAR payload. Section 2 briefly presents the D-STAR protocol. Section 3 details the classical D-STAR ground communications. Section 4 presents the possible communications using the D-STAR repeater aboard OUFTI-1. Section 5 details the management of the Doppler shift. Section 6 concludes.

2. D-STAR amateur-radio protocol

The D-STAR amateur-radio protocol has been developed by the Japanese Amateur-Radio League (JARL). Its main features are the simultaneous transmission of voice and digital data and callsign-based roaming through the Internet. A D-STAR frame is composed of a header, digital data, and digital voice, as shown in Fig. 1. The header contains information such as callsigns of the users and of the repeaters used for the communication. Both the header and the digital data undergo various error-correction algorithms, including a scrambler, an interleaver, and a convolutional coder. The input voice is coded on the ICOM transceivers using the AMBE codec [2]. Details about the structure of a D-STAR frame can be found in [3].

The digital frame passes then through a Gaussian filter and an FM modulator in order to be GMSK-modulated. The operating frequencies used on OUFTI-1 are the 145 MHz and 435 MHz ham bands.

3. D-STAR for ground communications

In order to establish a D-STAR communication, a user must set the four following callsigns: its own callsign, the callsign of the ham he wants to reach (companion callsign), the callsign of the repeater he uses to enter the D-STAR network (departure repeater callsign), and the callsign of the repeater needed to reach the companion ham (destination repeater callsign). Please note that, due to the roaming and routing capabilities of the D-STAR network (exactly as for mobile phone networks), the destination repeater callsign can simply be set as the callsign of the gateway of the departure repeater. Event though callsigns are needed, a user must still use the appropriate frequencies.

4. D-STAR for satellite communications

The reasons for having a space-based D-STAR repeater is that ground repeaters are not present everywhere, and that their footprints are limited. The OUFTI-1 D-STAR repeater will be available either as a direct communication repeater between two users, and as an extension of the ULg D-STAR repeater. Figure 2 shows the case of two users communicating through OUFTI-1, thus used as a repeater in space. The distance between the two users can be large, since OUFTI-1's footprint is foreseen to be around 2000 km, depending on its final orbit.

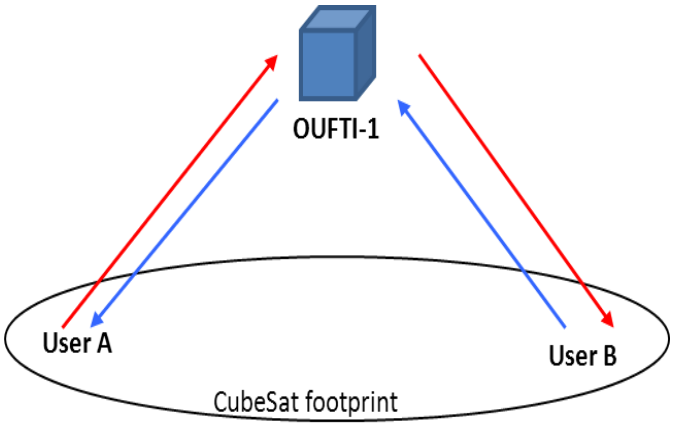


Figure 2: OUFTI-1 as a direct space-based repeater for two ham users.

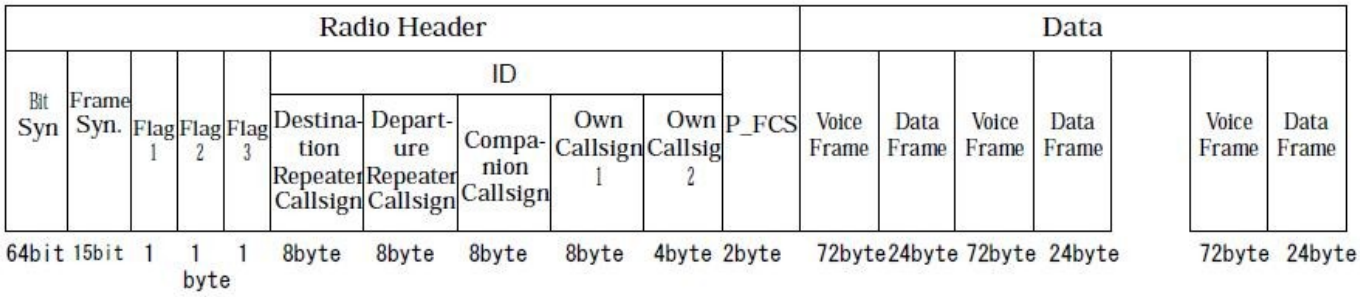


Figure 1: Structure of a D-STAR frame [3].

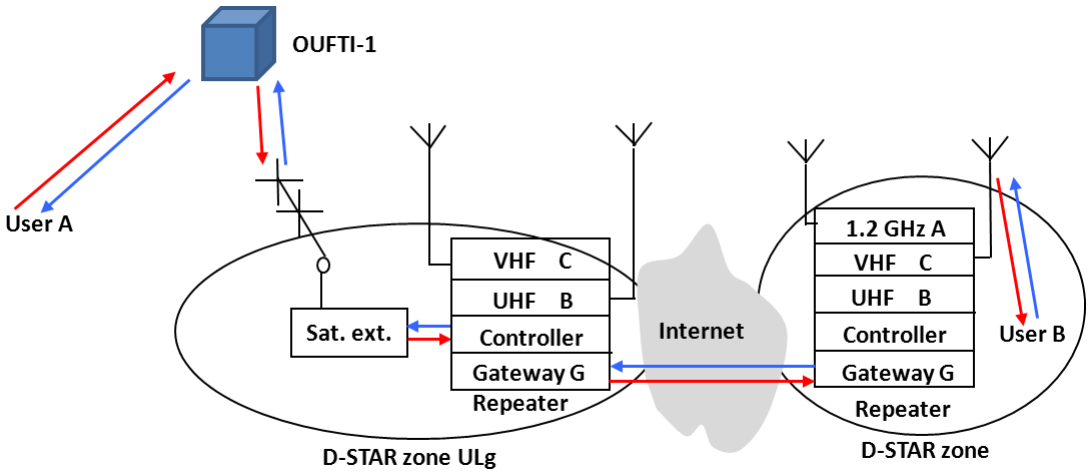


Figure 3: OUFTI-1 as an extension of the ULg ground-based D-STAR repeater.

Figure 3 shows the case where OUFTI-1 is used as an extension of a ground D-STAR repeater, here again augmenting the range of communication between two users. In this case, any user A located within OUFTI-1's footprint is able to communicate with any user B located within the footprint of any D-STAR repeater in the world.

5. Management of the Doppler shift

A major issue in the design of a D-STAR radiocommunication system for a satellite is the Doppler shift compensation. The constraints that we face are that (1) the Doppler shift ranges from -3 kHz to +3 kHz at 145 MHz (used for downlink), and from -9 kHz to +9 kHz at 435 MHz (used for uplink), and (2) the commercial D-STAR transceivers have a tolerance of 1 kHz and a frequency step of 5 kHz. Therefore, as illustrated in Fig. 4, there are blind frequency regions, in which commercial transceivers are unable to compensate the Doppler shift correctly.

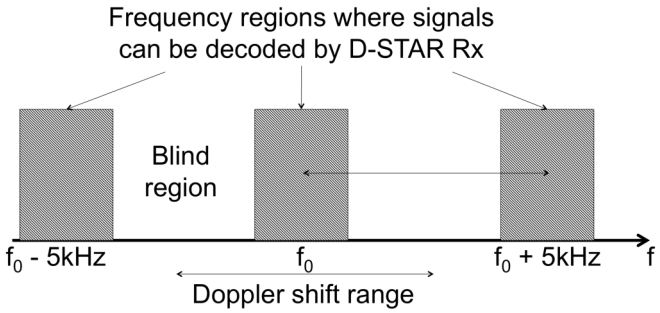


Figure 4: Illustration of the inability of commercial D-STAR repeaters to compensate the Doppler shift.

Two solutions are implemented for OUFTI-1, in order to compensate the Doppler shift without having hams buying new, perhaps expensive, equipment. First, we implement an original on-board solution, which consists in the compensation of the Doppler shift for two different geographical areas, as illustrated in Fig. 5. Any user that will want to use OUFTI-1 for D-STAR communications will have to book the repeater for a particular pass, at a particular time instant. The OUFTI-1 ground station will then compute the Doppler shift for this pass, and send it to OUFTI-1. The user will then be able to communicate as if the OUFTI-1 repeater was ground-based. Any user who would be able to compensate the Doppler shift for D-STAR communications would then need to compensate the Doppler shift compensation. Details of implementation can be found in [4].

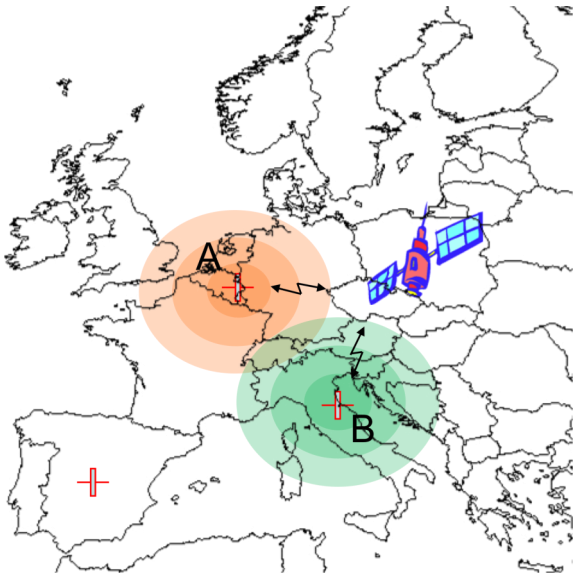


Figure 5: Illustration of the compensation of the Doppler shift for two geographical areas.

The second solution is ground-based. It consists of two parts. The first part consists in the addition of D-STAR capabilities to conventional, non-D-STAR, ham-radio transceivers ready for satellite communications. This work is detailed in [5]. The second part, currently being implemented, is to adapt a ground-based D-STAR repeater to satellite communications. The adaptation consists in the Doppler compensation and in the frequency adaptation. Indeed, while a D-STAR repeater module, e.g. UHF as illustrated in Fig. 6, works on a single frequency band, OUFTI-1 receives and transmits on two different frequency bands, which are 145 MHz for the downlink and 435 MHz for the uplink. We therefore

need to compensate the Doppler shift for both the uplink and downlink signals, and to shift the downlink 145 MHz signal to 435 MHz The plan is to drive frequency converters with the appropriate Doppler-compensated frequency. Details about this frequency conversion can be found in [6].

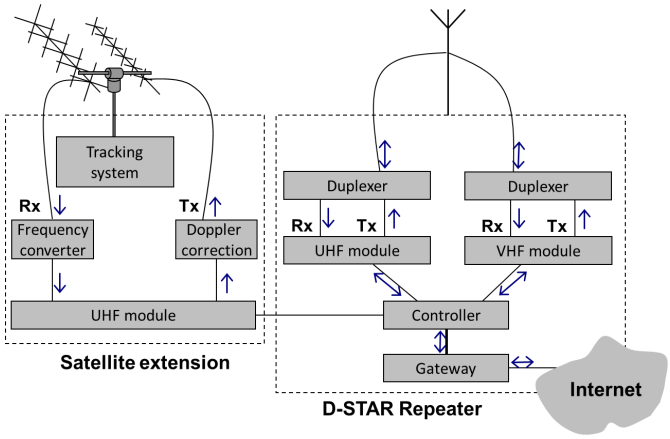


Figure 6: Complete D-STAR repeater, including the extension for satellite communications.

6. Conclusion

OUFTI-1, the CubeSat built by the students of the University of Liege, Belgium, will carry the first space-based, D-STAR-dedicated repeater. In this paper, we briefly reviewed the digital D-STAR ham-radio protocol, allowing hams to transmit simultaneously voice and data. We then presented the two communication modes users will use OUFTI-1 in, which are either as repeater, or as extension of a ground-based repeater. We eventually presented both the ground-based and the space-based solutions implemented to face the issue of Doppler shift.

References

[1] *OUFTI-1 nanosatellite website*, http://www.leodium.ulg.ac.be/, May 2013.

[2] Digital Voice Systems, INC., AMBE-2020 Vocoder Chip User's Manual, version 4.9, 2008.

[3] Pisane J., Design and implementation of the terrestrial and space telecommunication elements of the student nanosatellite of the University of Liege, MS thesis, 2008.

[4] Crosset N., Implémentation du relais D-STAR à bord du nanosatellite OUFTI-1, MS thesis, 2010.

[5] Werner X., Implémentation du protocole D-STAR sur un transceiver radioamateur classique, MS thesis, 2011.

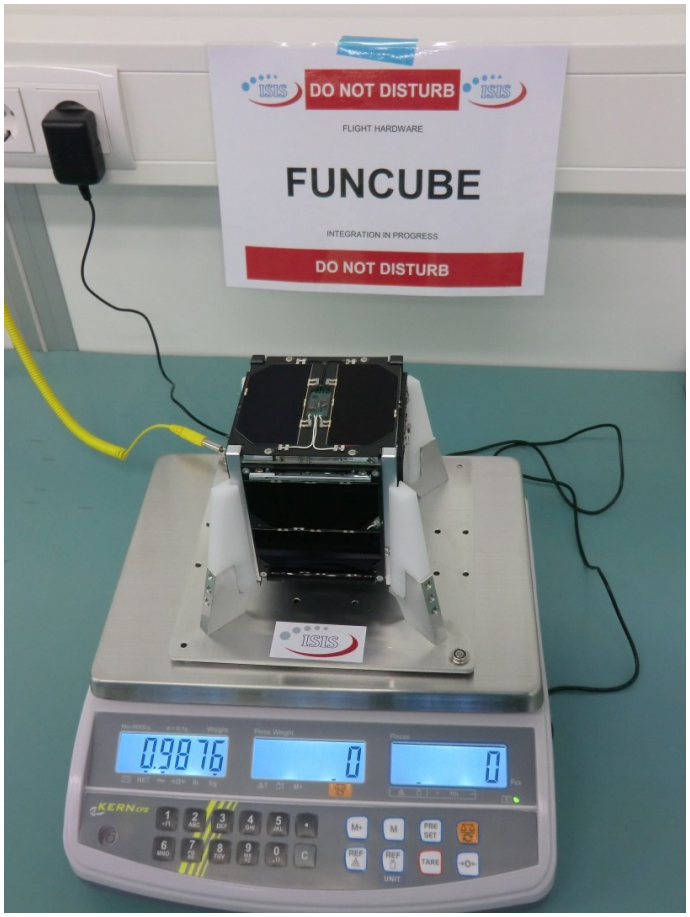
[6] Melchior J., Réalisation d'un convertisseur de fréquence pilotable dans le cadre du projet OUFTI-1, MS thesis, 2011.

FUNcube Report

Jim Heck G3WGM

So here we are, May 2013, some four years after we started the project in 2009. I recall discussing at the Colloquium of that year, a possible tie up with our friends at ISIS bv in Holland, which resulted in a contract between them and AMSAT-UK being signed in Oct 2009. Basically this contract covered the supply of several sub-systems and parts for the spacecraft, eg solar panels, structure, Electronic Power Supply (EPS), Attitude Control System (PMASS), and the antenna deployment system (AntS). It also covered the all important testing and integration of the completed spacecraft. Some of the things we anticipated all those years ago, have not come to pass, but suffice it to say that our relationship with ISIS has remained extremely friendly. They have been extremely generous by making available to us many resources which we didn't see we might need at the beginning of the project

So where are we now? As previously reported, the building, integration and testing of the spacecraft is completed, and as our picture shows, it is now sitting peacefully in the clean room at ISIS, waiting for its launch opportunity. We are still able to reload the flight software, if needed, but this is the only change we can make, and we are extremely loathe to make any



FUNcube-1—the completed hardware—well within mass budget!

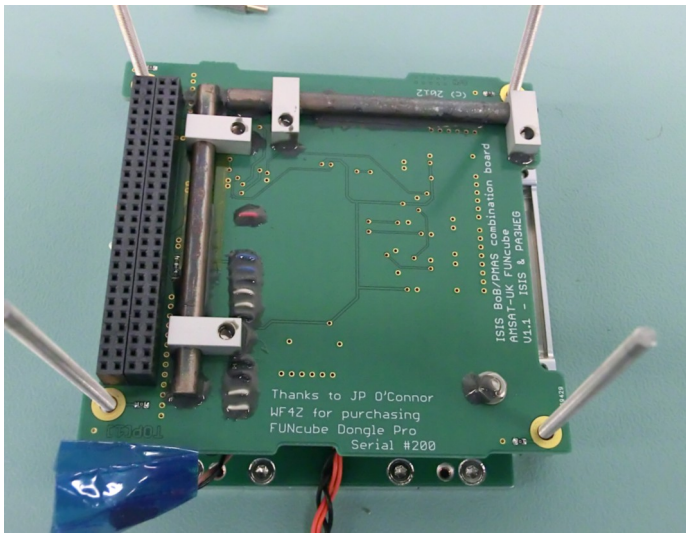
changes, however minor, because the current build has been to exhaustively tested.

So have the development team been sitting back, relaxing, resting on their laurels? Hell no!! Whilst we have been worrying about the launch date, we have also taken the opportunity over the last few months, and will do so right up until launch, to review our work, and do more and more testing. We have two test beds, one is known as the Engineering Model (EM), and is currently located at the home of Wouter Weggelaar, PA3WEG, who is an ISIS employee as well as being on the volunteer development team. Over the last few months, this is more or less constantly powered up, and is sending telemetry, via the on board radio and a Dongle ground station, to the data warehouse, provided by Dave Johnson, G4DPZ in the UK, via the internet. At the time of writing, it has sent over 800,000 packets of data. From time to time we can make some tests using the EM as it is as close as possible identical to the Flight Model (FM), except that it has no solar panels, and no antenna deployment system.

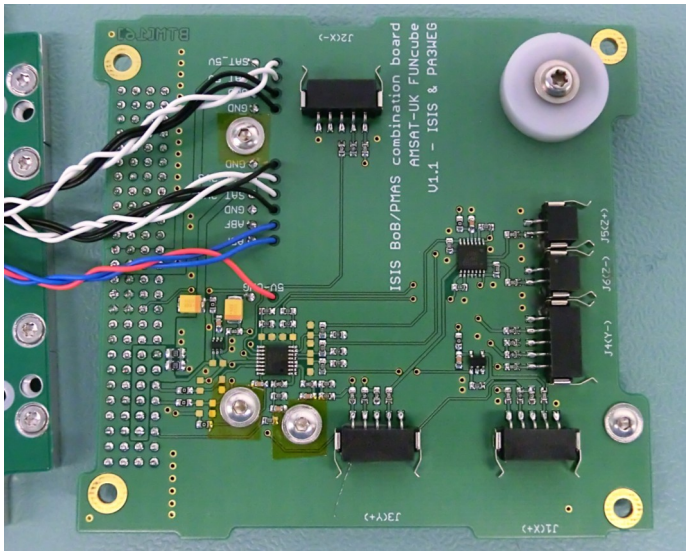
The other testing facility is less representative of the FM, and is known as the Test Model (TM). This is located at Duncan Hill's home in Martlesham. It is used primarily for software development (for both FC-1 and FC-2). It is less representative of the real hardware, but does have the all important antenna deployment system (AntS) simulator so Duncan can deploy the antennas, which the simulator indicates buy illuminating diodes rather than causing bits of metal to shoot out! (Rearming a real AntS is a day-long job, and very finicky).

Introducing the ASIB and the Sun Sensors.

One of our very early thoughts was to provide as much opportunity for schools to carry out experiments using the data from FUNcube, either by receiving its live data



The ASIB (Amsat Special Interface Board). Top view. Picture: PA3WEG



The ASIB—Bottom view. The round component top right hand side is the permanent magnet, which will keep the spacecraft Z axis aligned with the earth's magnetic field. Picture PA3WEG

directly from the spacecraft, or by downloading from a website. One of the lessons learnt from good old UO-11 was that it is a requirement for pupils to appreciate data presented in different forms, eg tabular, and as a graph. One of the 'experiments' with UO-11 was to collect the voltage data from the solar panels over a period of a few minutes, and then plot that data as a graph against time. Result, something akin to a sine wave. Reason, the spacecraft is spinning, and hence the illumination of each panel varies as it passes in and out of sunlight. Of course, inspection of the sine wave graph will reveal the rate of spin.

So with FUNcube, we thought it a good idea to provide similar data. Indeed by providing Whole Orbit Data (WOD) and 'High Speed' tlm we can give further opportunities for studying sunlight changes. The 'normal' tlm is sampled at a rate of each channel every 5 secs. We

anticipated that if the spacecraft is spinning faster than 1 rev every 5 secs, there would not be sufficient resolution, hence the 'high speed' tlm, with a sample rate of once per second. The WOD is sampled one per minute, and should be downloadable in a single pass. 104 readings will be available. From this, it will be possible to observe the spacecraft entering and leaving eclipse.

Fairly late on in the integration process, we came across some photo diodes which have been used on other spacecraft as sun sensors. We understood that they would be on in sunlight and off in darkness. After some investigation, we determined that it would be possible to mount one on all but one of the solar panels, sadly the -X panel is missing a sensor, as it would have been obscured by the MSE (Material Science Experiment) metal strips. In this way a further method of determining if one particular side of the spacecraft was in sunlight would be provided. We had to make sure that we had sufficient capacity in the downlink for the extra channels, and also that the mass and power requirements were acceptable. The spacecraft is stabilised in its Z axis along the earth magnetic field by a permanent magnet (the PMASS).

The next stage in the process, was for someone to ask "What are the characteristics of these diodes", eg at what stage do they 'switch off' completely. So we found that we needed to calibrate them, even if only fairly crudely. (After all this is amateur radio). So at a meeting of the development team held at Martlesham in April this year, one of the aims was to carry out just such a calibration, using real sunlight (albeit attenuated by the atmosphere). We wanted to use real sunlight so its spectral characteristics would be the real thing, as opposed to a torch or flood light. David Bowman, G0MRF, managed to obtain the loan of a calibrated light meter for the weekend, and our picture shows him and Wouter busy at work. Some measurements were made in the shadow of a building, some in full sunlight.

The sun sensors were the last items to be calibrated. Prior to this we had spent several weekends in Delft (courtesy of ISIS) using their temperature chamber to put FUNcube through its paces. We slowly changed its temperature from -10 to +55 degs C over a period of several hours. External temperature sensors (Thermo couples) were mounted adjacent, or as close as we could get, to the ones being calibrated. By observing the resultant telemetry values being transmitted and displayed in the dashboard, with the readings from the thermo couples, we were able to deduce a calibration 'curve' which can now be added to the dashboard, so its displays a real temperature value, and not just the raw binary data. It was interesting to note that the temp of the PA transistor was usually about 10 degs C above the rest, indicating that it was getting slightly warmer, which, of course, is to be expected. It will be interesting to observe any significant changes to this result (performed in air) with the actual readings in space (in a vacuum). We had actually observed a similar difference in temperature, when doing the thermo vacuum testing at the Rutherford Appleton Laboratory back in 2011.

David, G0MRF and Wouter, PA3WEG, in the BT Martlesham car park, calibrating the sun sensors April 2013. Thank heavens the sun was shining!

So what's this all about an ASIB? ASIB stands for AMSAT Special Interface Board. It became apparent some months ago that the standard interface offered by ISIS would not be suitable for FUNcube for a variety of reasons. So we decided to design and make one of our own. Actually the design was carried out by Wouter, PA3WEG, who did it partially in ISIS's time, and partially in his own time, so the 'ownership' of the IP of the design is delightfully obscure!

In fact it is not a complicated pcb, with few active components, but it does provide some very important functions. One of these is to interface between some of the sensors (eg the sun sensors) and the PC104/CubeSatKit bus. It does this by using a chip called a MAX11611 analogue to digital interface. This chip can nominally interface to 11 input channels, but if using its internal voltage reference, can manage up to 12 (which is what we are doing). It is a clever little chip, as the output is connected directly to the I2C bus from the CCT board. Chips from the same series are used on the PA and RF boards.

Of the 12 channels available on the A to D chip

- Five are used for the sun sensors (there are no sun sensors on the -X face of the spacecraft as there is no room for one because it has the MSE metal strips mounted on it).
- Four are used for the temp sensors on the solar panels. The + and - Z solar panels have no temp sensors as the decision to include them was made after these panels has been constructed, and they could not be retrofitted.
- Two channels are used to measure the bus voltages (3.3v and 5.0 volts)
- And the last remaining one is used to measure current drawn by the 3.3v bus using a 680 milli Ohm resistor and amplifier.

You can see from our picture that the ASIB has quite a few connectors to handle the incoming wires from the sun and temp sensors. It also has other functions, however:

- Supplying the MCU with a signal line, telling it that the spacecraft has been ejected from the POD. This is vital, as it is the trigger for the commencement of the antenna deployment phase.

- The original design of the spacecraft called for a separate PMASS (Passive Magnetic Attitude Stabilization System) board, a standard ISIS product. When we decided to produce an ASIB board, we realised that to save space and mass, we could easily mount the PMAS components onto the ASIB to save having a separate board. The two long rods in the picture are for providing hysteresis (damping) and the small round object is the permanent magnet, aligned along the spacecraft Z axis.
It provides an interface between the PC104 bus and the Apply Before Flight (ABF) socket. This socket is on the outside of the spacecraft, and a special connector is attached just before launch to 'arm' the antenna deployment system. It is also used for charging the batteries, if necessary, before launch.

And finally a word about software. Over the last couple of months, we have paid particular attention to ensuring that both the Flight Software and the Ground based 'Dashboard' are up to the job. Whereas changes to the Dashboard can be made after launch, it isn't possible to change any of the Flight Software when the spacecraft is in space.

Have we found any errors in the Flight Software? Answer: Yes, albeit a relatively minor one. The MCU uses some flags so as to 'remember' various parameters; these generally are a single bit. An example is the bit which 'remembers' whether or not the MCU should switch to safe mode or analogue transponder mode when it enters eclipse.

A vigorous review of the software documentation, indicated that these bits (all 16 of them) were not being transmitted in the down link. Whereas their absence is not flight critical, it would have been very inconvenient for the Ground Control stations not to have this information. All that was required was a change of two lines of code, and we decided that this would be an acceptable risk.

So let me conclude with a tribute to our software team, which has spent many many hours in writing code, and will probably continue to 'worry' about it for many months to come!

The ESEO Project – Spring Update

The ESA ESEO project is now proceeding towards a Preliminary Design Consolidation Review (PDCR) meeting at their ESTEC facility between the 1st and 3rd July 2013

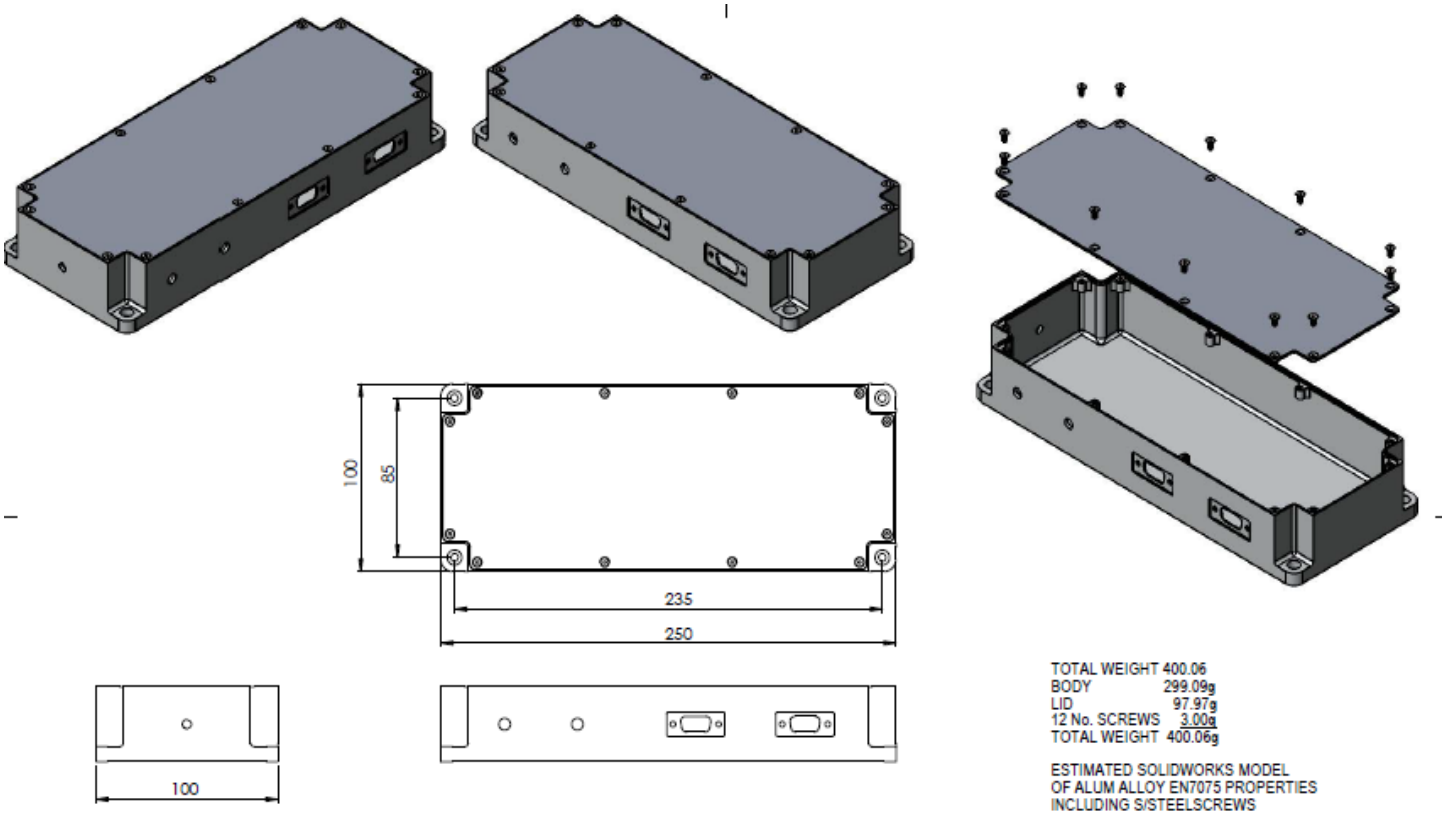
The AMSAT-UK payload for ESEO includes a L/V FM transponder with a concurrent telemetry downlink that is based on our existing FUNcube "standard". The on-board transmitter is planned to be approx 3 dB stronger than on FUNcube-1 and FUNcube-2 as the microsat configuration provides rather more power than does a 1U CubeSat!

We have slightly redesigned the system to enhance performance and reliability and this is the current Functional Block Diagram

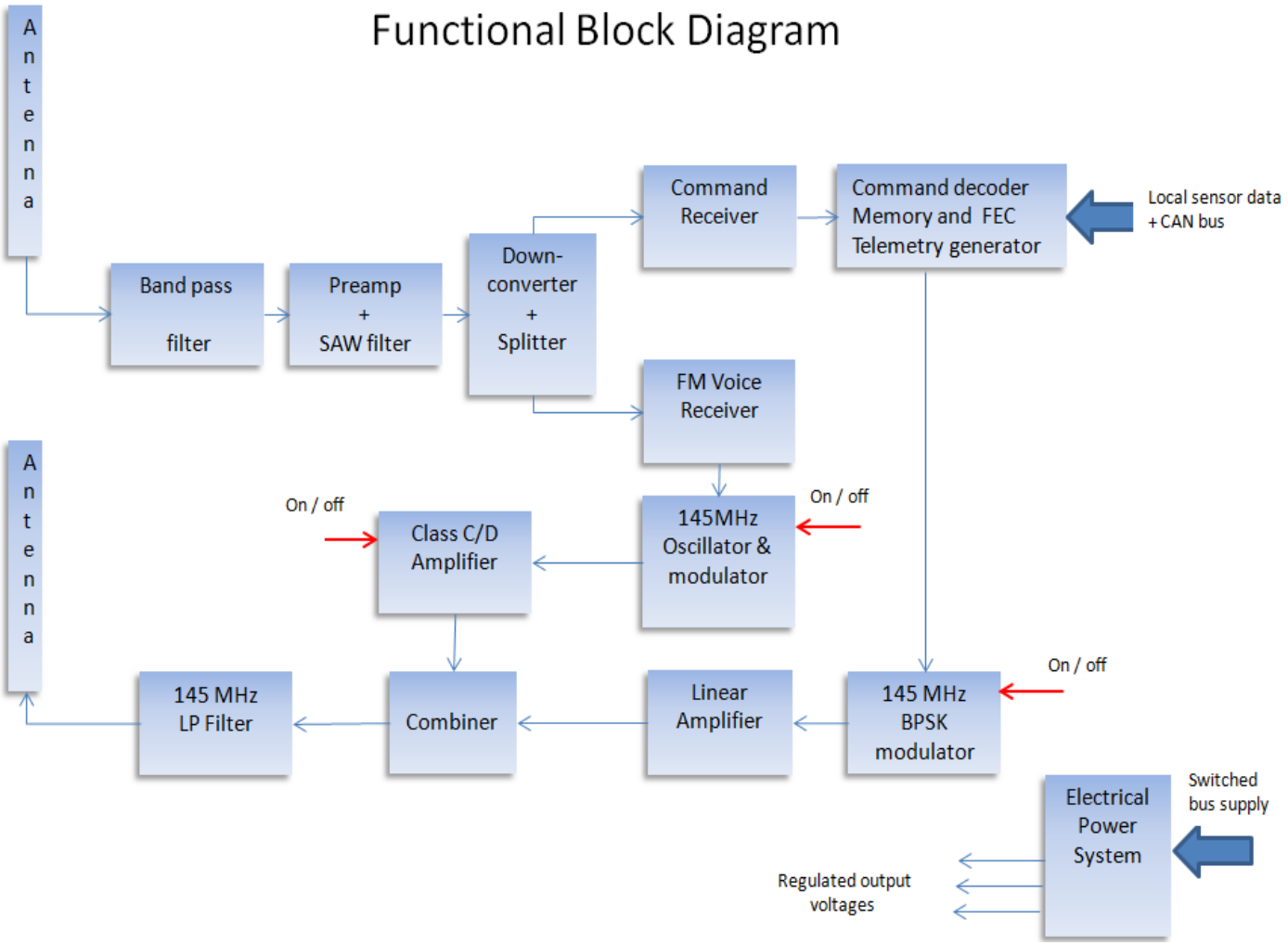
In advance of the PDRC we have submitted a completed Interface Document so that everyone can see how we will fit in with the rest of the system, mechanically, electrically and in terms of software systems.

We have also developed the outline of an enclosure that will meet our requirements and also the volume and mass budgets.

Up to now we have been developing this payload using the team that is responsible for FUNcube but we would be very pleased to welcome new volunteers to create an additional team of developers for ESEO. We are presently especially in need of help with regard to the CAN bus interface! Please contact G3VZV @ amsat.org in the first instance.



AMSAT European Student Earth Orbiter - Initial enclosure proposal 23rd May 2013



Ham Video—a DATV transmitter on Columbus

Gaston Bertels ON4WF
ARISS-Europe Chairman

The Columbus project

As far back as the year 2000, a proposal for an ATV system on the International Space Station was submitted to the ARISS Project Selection and Use Committee was submitted by members of AMSAT-UK.

Subsequently, in November 2002, a request for amateur radio facilities on the then, under construction, Columbus module was submitted to Mr Jörg Feustel-Büechl, Director of Manned Spaceflight and Microgravity Directorate of the European Space Agency (ESA).

The request was to install wideband amateur radio antennas on the nadir of Columbus, facing the earth. With such antennas, the onboard amateur radio facilities could be extended to amateur TV.

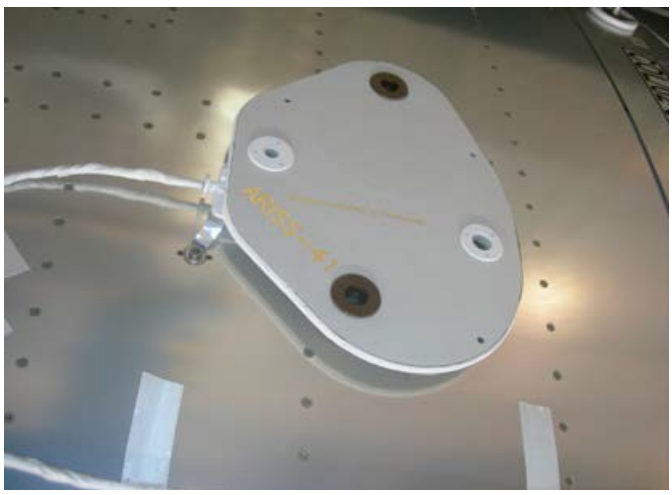
In 2003 the request was examined in detail and finally accepted. ARISS would pay for the development, manufacturing and qualification of the antennas. ESA would support the installation cost.

ARISS-Europe started a funding campaign, with all donations being published on the website.

In 2004 coaxial feed throughs were installed on the port cone of Columbus. This was needed for accessing the antennas with feedlines from inside the module.

In 2005, the Royal Belgian Amateur Radio Society (UBA) signed a contract with the Wroclaw University of Technology, Poland for the development and manufacturing of the antennas. Whereas initial plans were for UHF, L-band and S-band antennas, only L- and S-band antennas could be ordered by lack of funding. The cost of the project was 47.000 Euro.

Early 2006 the antennas were delivered to ESA. Meanwhile main Columbus contractor EADS and subcontractor Alenia Spazio had reviewed mechanical and thermal constraints. Wroclaw University proceeded to qualifications tests (cost 3.000 Euro) and the antennas failed.



ARISS L/S band patch antennas

In 2007 an additional contract was signed with the Wroclaw University for the development of modified antennas. This amounted to 36.000 Euro. These antennas were accepted and installed on Columbus, October 2007.

The cost of the antennas finally amounted to 86.000 Euro and was covered by a wordwide funding campaign.

ESA supported the total installation cost of the antennas, including feed throughs and coaxial cables.

After the successful launch of Columbus and its integration into the International Space Station complex, an ARISS-Europe working group started a study for the development of an amateur television transmitter on Columbus, using one of the S-band antennas. A debate started between the supporters of analogue television (ATV) and the proponents of digital television (DATV). The working group, which met monthly per teleconference, made progress, but was stuck by the lack of funding.

Meanwhile a possibility opened for the installation of VHF/UHF antennas on Columbus. The European Space Agency wanted a VHF antenna for a specific payload and was interested in the manner ARISS antennas had been attached to handrails on the Russian service module. A similar system was adopted for Columbus and, in the same time, ESA accepted the installation of a dual band VHF/UHF antenna for ARISS. This antenna project was funded entirely by AMSAT-NA and volunteers who built the antennas for both the ESA experiment and for ARISS. The installation was done per EVA, 21 November 2009. Soon an Ericsson UHF transceiver, which had served in the early ARISS days, migrated from the Russian to the American segment of the Space Station and started Packet Radio operation.

As time went by, the debate on ATV versus DATV evolved at the advantage of the latter, but no funding was in sight… Then, suddenly, supported by the enthusiasm of Italian astronaut Paolo Nespoli IZ0PA, who had performed many ARISS school contacts during his 2010-2011 expedition aboard the Space Station, at the initiative of AMSAT Italia, an Italian manufacturer, Kayser Italia, presented a project for an amateur radio DATV transmitter to ESA's educational services. In 2012, this proposal was accepted and ESA signed a contract with Kayser Italia for the development and the manufacturing of a DATV transmitter on S-band. This transmitter, dubbed "Ham Video", is presently slated for launch on HTV-4, August 4, 2013.

Ham Video

The Ham Video DATV transmitter, developed for installation in the Columbus module, features the following characteristics:

Canon XF-305 camera

Downlink frequencies:
2.422 GHz
2.437 GHz
DVB-S standard (QPSK modulation)
Symbol rates: 1.3 Ms/s and 2.0 Ms/s
FEC : ½
SIF: 352x240 or D1:720x480
RF radiated power : approximately 10 W EIRP

Ham Video will operate with a Canon XF-305 camera, provided by NASA.

Power will be provided by a Kups power supply, another Kayser Italia product. The Kups is a standard equipment on Columbus, used for several experiments. It converts the 120VDC, which is the standard main voltage in the American segment, to 28VDC.

Ham Video is downlink only. No DATV receiver is presently considered onboard Columbus.

From a technical perspective, Ham Video is a standalone payload.

ESA puts Ham Video at the disposal of ARISS for educational outreach.

When video enhanced ARISS school contacts will be performed, the downlink audio and video signals will be produced by **Ham Video** and the uplink audio signals will be received with the Ericsson transceiver. In this two way setup, the global system is dubbed **Ham TV**.

Ham TV

An important element of the Ham TV system is the ground segment.

Receiving DATV signals from Columbus will be far more demanding than receiving VHF or UHF. A careful study of the link budget, conducted by Piero Tognolatti I0KPT, shows that DATV decoding should be possible, for a ground station equipped with a 1.2m dish, when the ISS is within a range of about 800 - 1000km. This limits the time of DATV reception to about 3 – 4 minutes during a favourable pass.

A 1.2m dish has a beam width of about 4 degrees (between -1 dB points). ISS tracking will be far more demanding than it is for receiving VHF signals.

With ESA's support, ARISS will establish a chain of 5 volunteering amateur ground stations, located at carefully chosen places along a typical ISS pass over Europe. These stations will receive and decode the DATV signals and stream the audio and the video over the Internet to the BATC server in UK. The school will connect to the BATC server which offers the possibility to visualise up to 6 images simultaneously. With this setup, Ham Video reception is expected to reach the 15 minutes goal ESA has fixed.

ARISS' expectation is, that similar chains of ground stations will be established in other continents, allowing more flexibility for Ham Video enhanced ARISS school

The Flight Model of the Ham Video DATV transmitter

contacts.

Ham Video transmissions will not be limited to school contacts. Automated transmission of recorded video is also planned. Several amateur radio experiments can be developed, within the limits proper to the ISS.

A new era opens for amateur radio on the International Space Station.

Main Specifications

Parabolic dish:
polarisation : RHCP
gain about 26 dB

AZ-EL rotor
accuracy : +/- 2 degrees (1.2 m dish)
slew rate : 5° per second
range : 0-180 elevation & 0-360 az

LNB (Low Noise Block downconverter)

input frequency : S-band
output frequency : L-band
gain : at least 40 dB
frequency stability : +/- 20 kHz
noise figure : about 0.7 dB

Tracking software

allowing flip mode

DVB-S receiver

Ground station components

Comments – References - Sources

Parabolic dish with AZ-EL pointing

The dish shall be mounted for azimuth and elevation pointing and moved by precision motors. with a total system pointing accuracy of 2° or less (including motor precision, antenna alignment, and pointing control software).

The elevation movement shall cover 180 degrees (flip mode capability).

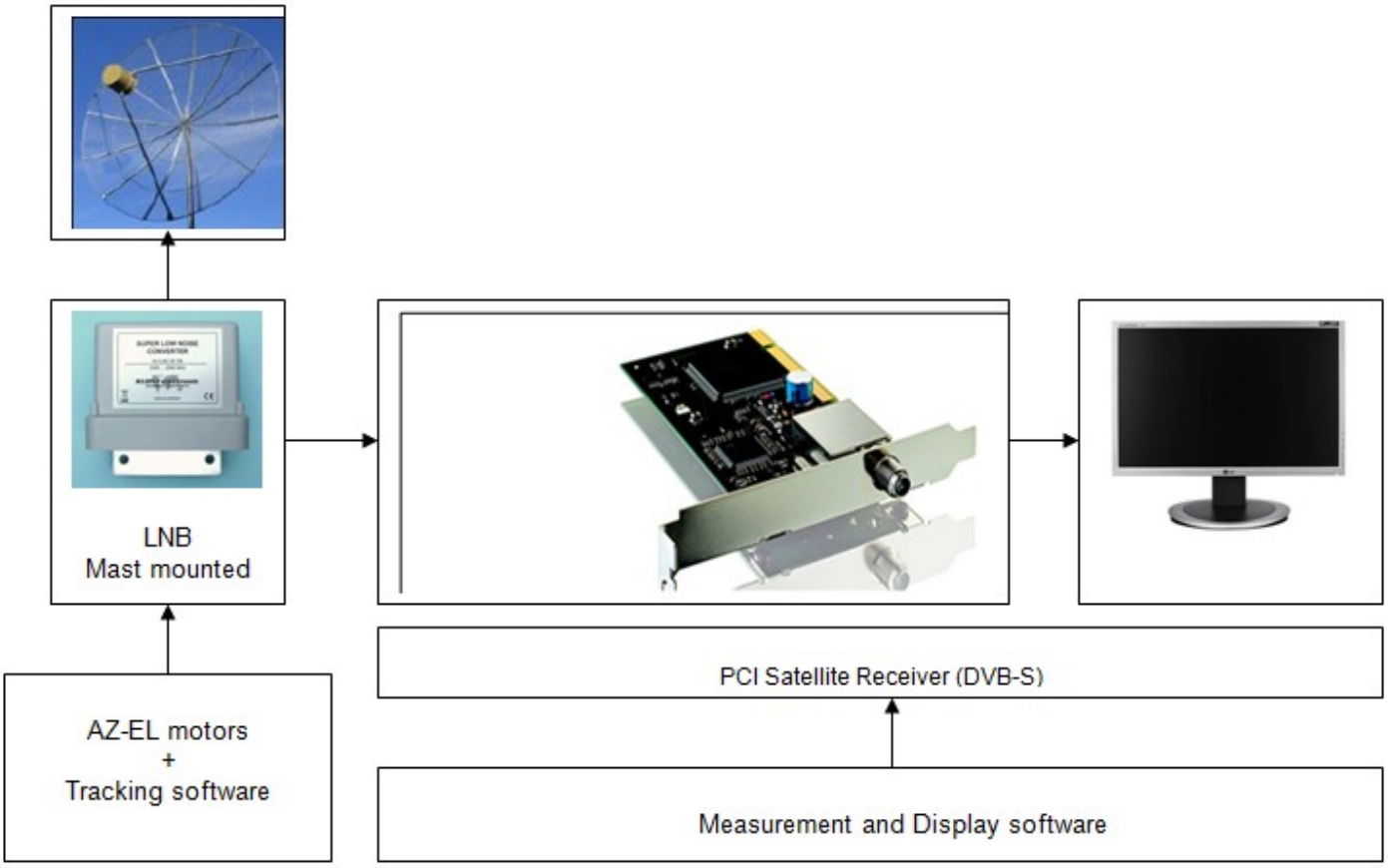
The azimuth movement shall cover 360 degrees or more.

A possible alternative to the flip mode for the elevation movement is the capability of azimuth movement up to 540 degrees to allow for reception of ISS passes over north.

Azimuth angular speed greater than 5°/sec allows for reception of ISS passes up to 90° elevation. Less angular speed will allow reception of passes with lower elevation.

The AZ-EL motors for the main European ground stations are made by Prosistel (http://www.prosistel.it).

The driver is WISP DDE by CX6DD (http://



www.mederoscnc.com/CX6DD/wispdde/wispdde.htm) modified by AMSAT Italia in order to interface Prosistel rotors in the Azimuth extended-range mode. This modified version of WISP DDE also allows automatic sweeping of the antenna around the Sun direction, in order both to check correct Az/El alignment and to measure G/T of receiving system.

Tracking software

A number of shareware, freeware, cardware and commercial tracking softwares are available on the web.

Selection of the software shall take care of the capability to drive the AZ-EL motors, flip mode included.

The tracking software used for the on-going tests is Orbitron (http://www.stoff.pl/).

LHCP dish feed

ARISS antennas on Columbus are right circularly polarised. Hence, for single reflector antennas, the feed shall be left hand circularly polarised, since each dish reflection reverses the polarisation.

The dish feed can be a patch type or a helix type, positioned in the focus of the parabola.

The dish feed used for ARISS-Europe ground stations is a product of

RF HamDesign (http://www.rfhamdesign.com)

Type LH-13XL 2.1 - 2.7GHz Connector N-Female 50 ohm

LNB

ARISS-Europe ground stations are equipped with an LNB downconverter produced by Kuhne Electronic. The LNB is designed for mast mounting near the parabola.

Two options are suitable :

Option 1 :
KU LNC 25 TM (centered 2450 MHz)
Frequency range : 2350 – 2550 MHz
IF : 1433.5 – 1633.5 MHz
Amplification : 40 dB
http://www.kuhne-electronic.de/en/products/down-converters/ku-lnc-25-tm.html

Option 2 :
KU LNC 23 TM (centered 2385 MHz) – specific DATV
Frequency range: 2320 – 2450 MHz
IF : 1404 – 1534 MHz
Amplification : 40 dB
http://www.kuhne-electronic.de/en/products/down-converters/mku-lnc-23-tm.html

The KU LNC 23 TM has a notch filter on 1.3 GHz for duplex operation : 1.3 GHz (transmit) and 2.3 GHz (receive). This could be useful from the perspective of a planned cross band voice transponder on Columbus.

DVB-S satellite receiver

A suitable DVB-S satellite receiver PCI tuner card is produced by Techno Trend
http://www.technotrend.eu/2920/TT-budget__S2-1600.html

The Techno Trend card fits in a PCI computer slot and supports HD TV (MPEG2 and MPEG4/ H.264) :
Computer OS : Windows XP, Vista, Windows 7, Windows 8
CPU for SDTV: at least 800 MHz
CPU for HDTV: at least P4 3,4 GHz or comparable AMD Athlon (Dual Core recommended) - not needed for Ham TV
512MB main storage (1024MB recommended) at least 1GB free hard disc storage
Graphics card with at least 64MB and DirectX 9 support
Sound card with DirectX 9 support
Besides the TT-budget S2-1600 card, TechnoTrend produces the TT-S2-3200 card, also suitable.
In addition to the PCI card ground station solution described, it is understood that some specific DVB-S "set top" boxes are able to operate correctly at the symbol rates that will be used by the Ham TV system.

Measurement and Display software

Jean Pierre Courjaud F6DZP has developed a free software utility providing radio amateurs and DVB technicians a tool that allows Digital ATV (DVB-S) to be measured precisely. Please see :
http://www.vivadatv.org/page.php?p=tutioune-en

This software comes in two versions :
Tutioune V2.0 for use with the TT S2-3200 card
http://www.vivadatv.org/viewtopic.php?f=60&t=205

Tutioune 1600 V0.1 for use with the TT S2-1600 card
http://www.vivadatv.org/viewtopic.php?f=60&t=214
With the above mentioned setup, Ham Video from Columbus can be received, decoded and visioned on a computer screen. Audio is also available.

Noise Power Measurement for antenna alignment

As suggested by Piero Tognolatti I0KPT and with his collaboration, Jean Pierre F6DZP developed a special software for Noise Power Measurement.

With this software, a TT-S2-3200 or a TT-S2-1600 PCI card can be used for Dish alignment by measuring the Sun noise on S-band.

http://www.vivadatv.org/viewtopic.php?f=67&t=212

Streaming video on the Internet

For H264 encoding and streaming video on the Internet,

several software solutions exist:

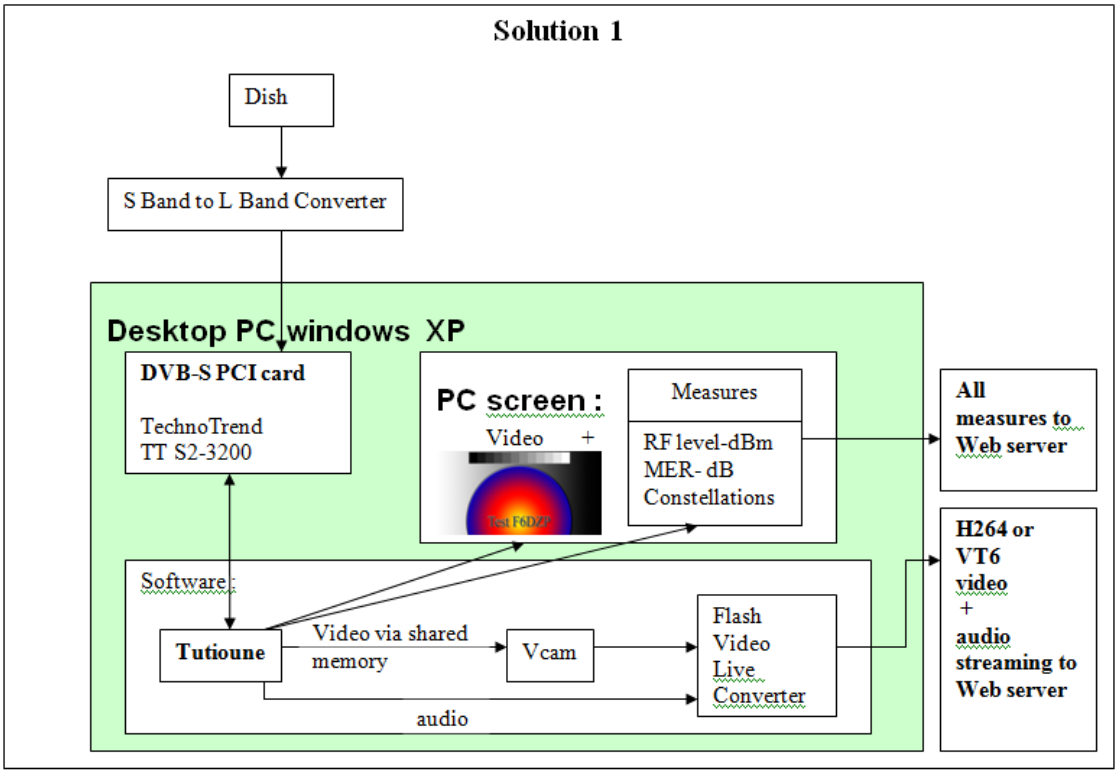
Adobe Flash Media Live Encoder (FMLE) – free – Win XP, Win7, Win8
FFsplit – free – Win7, Win8
Open Broadcaster (OBS) – free – Win7n Win8
Xsplit – only basic functions are free – Win XP, Win7, Win8

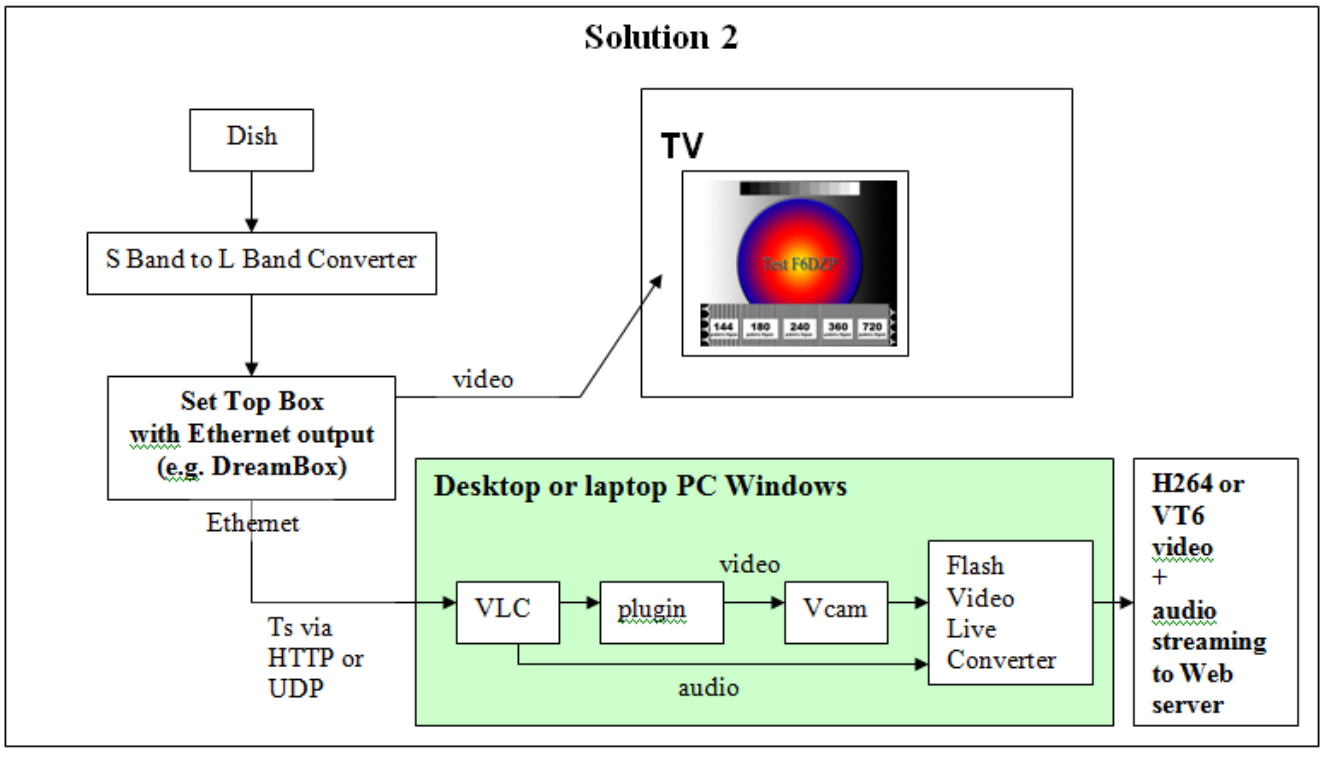
Under Windows XP, the best solution is FMLE.

For H264 encoding and streaming, a good Dual Core or a Quad Core CPU is needed.
Sending the video stream, produced by the DVB-S receiving software, to the Internet encoder/streamer software (FMLE, OBS…) needs additional software such as Vcam.

The general ground station setup is shown in these two charts :

Solution 1 : based on a DVB-S PCI card
Solution 2 : based on Set Top Box with Ethernet output





Editor's note.: Many AMSAT-UK members regularly track these balloon flights as they reach almost halfway to space! They generally use RTTY with 10mW transmitters on 434.xxx MHz. For more info visit http://www.ukhas.org.uk

The following is reproduced with permission from Dave Akerman's blog at http://www.daveakerman.com/?p=1154. Sadly, space doesn't allow us to reproduce all the excellent pictures from Dave's web site.

Raspberry Eye in The Sky

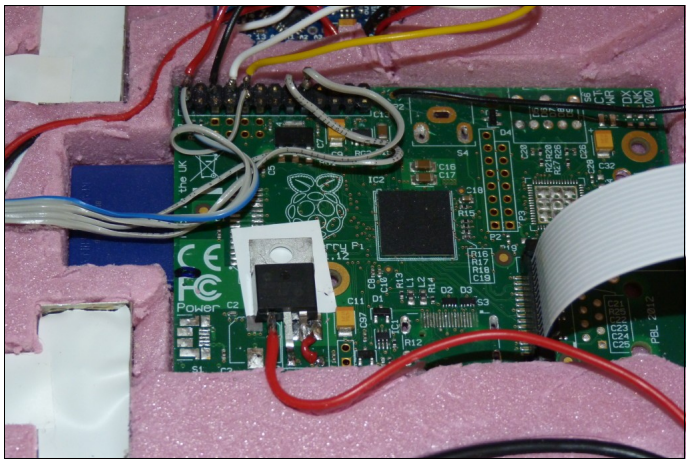
Dave Akerman M6RPI

Back in March I built a lightweight Raspberry Pi tracker comprising a model A Pi and a pre-production Pi camera built into a foam replica of the Raspberry Pi logo.

The aim was to send images from higher than my record of just under 40km, so the tracker was pretty much as light as I could make it. A launch was planned in April but the wind predictions back then were poor for such a flight with a "landing" out to sea. That was the flight with Eben and Liz from the Raspberry Pi foundation, so rather than lose a precious slot in their over-full diaries I decided to launch a "floater" which was eventually lost over Switzerland and is probably still in hiding somewhere in France. For that I made a more suitable payload box, keeping the original for a later date.

That was a great flight with, as far as I know, the only live images sent from a flight of that type. It was also the first flight to use the new Raspberry Pi camera, and it got some good images though overall the success rate was much lower than I hoped for. Part of the reason was the solid white cloud cover which makes exposure very difficult, but also I didn't realise that the camera was defaulting to spot metering which is the worst of all possible options for the challenging lighting conditions when the balloon is high. Spot metering basically makes the centre part of the image a certain luminance, which means that if it's pointing at the blackness of space that turns grey whilst anything else in the image whites out. There are always going to be some useless images during a balloon flight, unless the camera is "aimed", but on that flight almost all the downloaded images were poor (and that's despite the on-board software selecting the better ones!).

So, I wanted to get that resolved plus do the flight that I'd intended to do before. Liz and Eben weren't available but the predictions for wind and weather were both so good that I decided to launch anyway. I'd applied for permission from the CAA and that was granted a few days before launch, and the predictions continued to look good (though at one point I was going to need to use a different launch site to avoid a landing near Bristol). I ordered some more hydrogen as I wasn't sure my cylinder had quite enough left, and with the weather forecast saying "sunny all day" everything looked good. Last but not least was to get the latest Pi camera software and configure it to use matrix metering mode. I also changed the code a little to take 3 types of image each about once per minute: small images for one radio channel, medium for the other radio channel, and large just for storage on the SD card. Oh, and also I replaced the main voltage regulator on the Pi for a better one so that the entire tracker could run off a lower voltage so it could run for longer on the batteries. I tested that down to a mere 3V from a power supply (that's 3V going IN to the regulator) and the Pi booted and ran normally. Here's the regulator soldered in place of the normal one:



I had some people coming along to see the launch, so they know a bit more about how things work before I help them on a commercial launch in a few weeks time. Originally I intended the tracker to run from 4 AAA lithium cells but the runtime on those was around 4.5 hours, which would mean connecting the batteries at the launch site shortly before launch. Instead I decided to use AAs so I could have the tracker running and glued up much earlier, keeping things simple for the launch itself and meaning that I wouldn't have to worry about delays while I explained things. The extra weight does reduce the maximum altitude somewhat, but I thought on balance it was worth doing.

The day was sunny as expected, and the wind was mostly still but with some gusts. I showed my guests how the payload is attached to the parachute and then inflated the balloon, tied to the parachute, and re-checked that the tracker was still running. It was, and of course it had been transmitting images during our prepara-

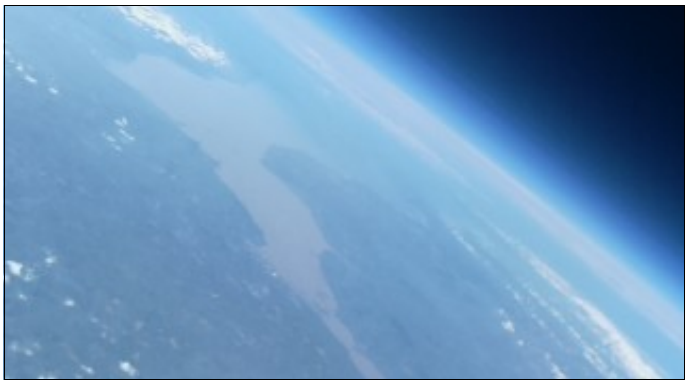
tions, including this one overhead.

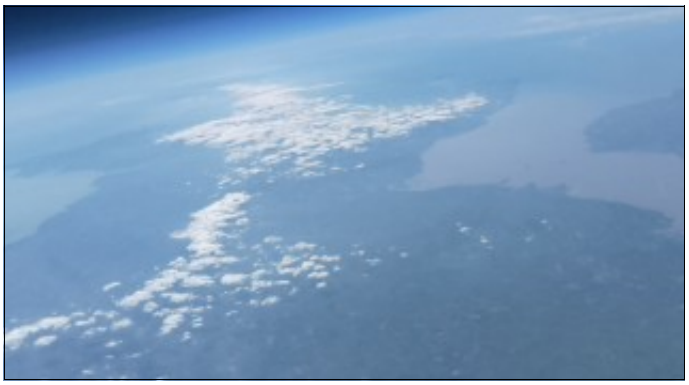
For launch the wind was very still so I just held the payload in front of the live streaming webcam and let go. Easiest launch ever!

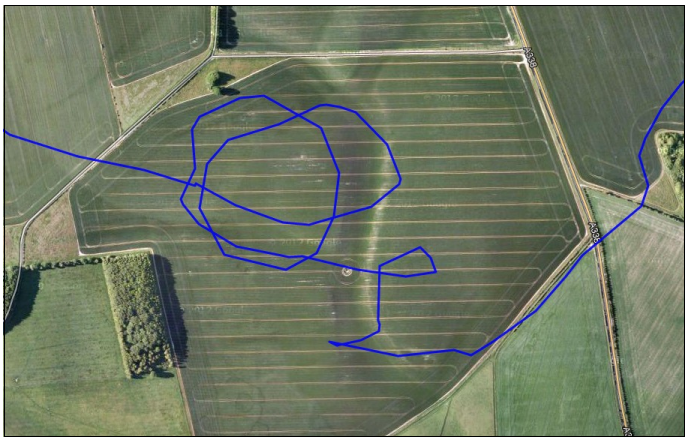
The expected flight path showed a landing about 1 hour away by car.

And with an expected flight time of over 3 hours that gave us plenty of time to return to my house and watch the images come in. Thankfully the matrix metering on the Pi camera worked very well and the images were excellent thanks to the good weather and camera. Here are some of the low-resolution ones from the first radio channel:

I was pleasantly surprised by how well the other balloonists collected almost all of the image packets. Remember that my payload had 2 radio transmitters, meaning that people had to choose which one to listen to (unless they happened to have 2 receivers). Also I was using a fairly high baud rate which limits the range, but even so there were listeners in Northern Ireland, Holland and France contributing! The image quality was excellent and the matrix metering was certainly working well. Here are some of the larger images sent by the second channel, including this one of southern England and the Isle of Wight:

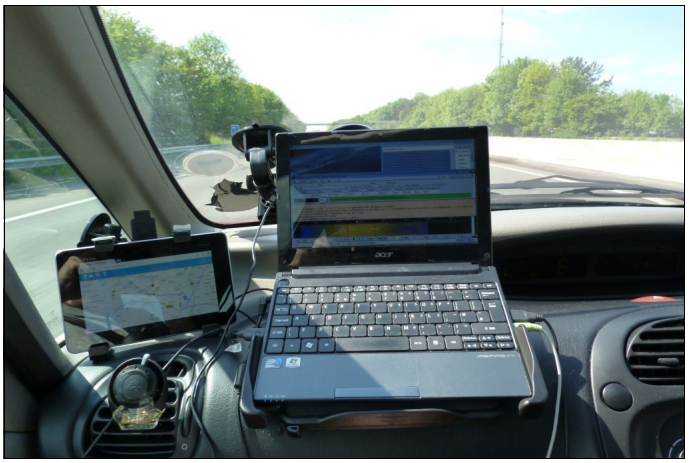






The flight path itself was interesting, with many changes of direction, including a few loops!

Whilst it's great to sit and watch the images come in



from your own flight, eventually you have to go and chase the thing down and recover it! Julie drove us in her car with me running the tracking:

Then I made a mistake. The original prediction (shown above) was for a flight earlier in the day, but the launch was delayed by more than 2 hours (partly to avoid a frequency clash with an earlier flight, and partly because we took our time). The later launch meant the balloon flew in more gentle winds so wouldn't travel as far. Forgetting this, I asked Julie to drove close to the original landing spot. Also, it's generally best in the first part of the chase to just get to a good position and wait for the burst, instead of assuming it will land where you thought. Once the burst has happened then you have a much better idea of the actual landing point. The end

result of all this was that when the balloon did burst, and came down more quickly than expected (more on that later) we were in completely the wrong place.

By the time we got to the landing area, the payload had been on the ground for a few minutes. We had a rough idea of where it was and we went along both of the small roads nearby. Normally I'd get a radio signal within say 1 mile of the landing spot, but we got nothing at all. It seemed very unlikely to me that the radio transmitters had stopped working altogether – the batteries were soldered on so it would need a really hard impact to break the connection. The landing had been hard but not that hard. We tried a few highish points where I got the Yagi aerial out (much more likely to pick up a weak signal) but still got absolutely nothing. Very confusing.

I was about ready to declare the payload lost when my mobile phone rang. I thought it was going to be one of the other balloonists with advice, but instead it was someone who asked if I'd lost "a parachute with a raspberry and a big lump of latex"! My payload had been found! I asked for his address and said we'd be there right away. Typing the address into my phone it said we had a 14 minute drive – also strange! I reported to the other balloonists on IRC what had happened and they then saw my car travelling several miles into Swindon. They were probably as confused as I was as to how the balloon had managed to move that far from its last known position a few hundred metres up!

We got to the address and were happily reunited with the payload, parachute and almost all of the balloon! Then we found it what had happened – the lot had landed nearby (and right at the position given to me on IRC!) when he was out in the countryside at this place (exactly where I was told it would be on IRC – thanks Mike G0MJW!):

First he heard a loud thump as it landed, then he looked and saw a big lump of latex etc on the tarmac a few metres in front of him! He took it home and then, because of the smell of latex, put it in his garage. Of course I'd put my mobile phone number on the outside so once home he called me. We picked up the signal again when within a mile of his house, and were decoding when about half a mile away. The picture coming in was completely black, because the camera was face down! Now of course we understood why we couldn't get a signal earlier – it had been driven several miles away from us! The reason for the rapid descent was also obvious – about 70% of the balloon (1.1kg) was still in one piece and had wrapped itself around the parachute.

The eagle-eyed may notice the small hole in the side of the raspberry, and that's where the camera looked out.

Back home I copied all the images from the SD card, including of course all the full-resolution ones, including the ones below. The first and in my opinion the best is image file "snap314.jpg" – some coincidence! This is a view over Devon and Cornwall, taken at about 38.9km altitude and almost directly over the house of the guy who recovered it!

Finally, and thanks to Geoff Mather, here's the flight path:

and the view from the payload, in Google Earth, with part of one of the actual images overlaid:

Editor's Note. The request below was received by e-mail a few weeks ago. Can any of our members in the Manchester area offer assistance? If so, Please contact Carl directly. Thank You!

Pegasus Explorer scouts is open to young people of any background, race, sex or religion. Our young people take part in a wide range of activities including Duke of Edinburgh Award, amateur radio, canoeing, hill walking etc.

We use amateur radio to support our expeditions and many of our Explorers already hold Foundation Licences or want to work towards one. Every October we host Jamboree On The Air for our Scout District and introduce around 30 scouts to amateur radio. These events are always well attended and some scouts come back year after year. We are constantly looking for new ideas to make this event even better and for some time we have wanted to introduce AMSAT, but we need some help in going about it. We are based in Astley, Manchester and any help you can give will be greatly appreciated by our scouts.

Regards

Carl

Carl Thorp
Explorer Scout Leader
2E0LVO - GB1ASG Station Manager

Pegasus Explorer Scouts
Astley
Lilford District

www: http://www.1stastleyscouts.org.uk/1/explorers.html

Facebook: http://www.facebook.com/PegasusExplorers

Twitter: @PegasusESU

24-26th April- 10th Annual CubeSat Developers' Workshop

This annual event covered the full range of CubeSat subjects over three days last April.

The full programme can be seen here
http://www.cubesat.org/images/stories/2013presentationschedule.pdf

You can also view recordings of the proceedings, which include close-ups of the slides and the presenters themselves at http://mediasite01.ceng.calpoly.edu/Mediasite/Catalog/pages/catalog.aspx?catalogId=36b100d1-069a-4bac-b7e3-8a9512655e78
Well worth spending an evening in in front of the computer screen!

Articles for Oscar News

The editors always welcome contributions from AMSAT-UK members – these can be full articles or simply news, views or gossip!
Please send them to g3wgm@amsat.org and/or g3vzv@amsat.org
As you will be aware we are presently producing four issues each year so please get in touch with us if you have any concerns about deadlines.
Please submit your articles in any of the following formats:– Text: txt, rtf, rtfd, doc, docx, odt,
Spreadsheets: Excel or OpenOffice,
Images: tiff, png, jpg
Schematics: pdf
(Ideally please send graphics/pics separately, ie not embedded in doc files, etc)
The editors are here to help you so please shout if you have any concerns
Many thanks in advance for your contributions!
Jim & Graham

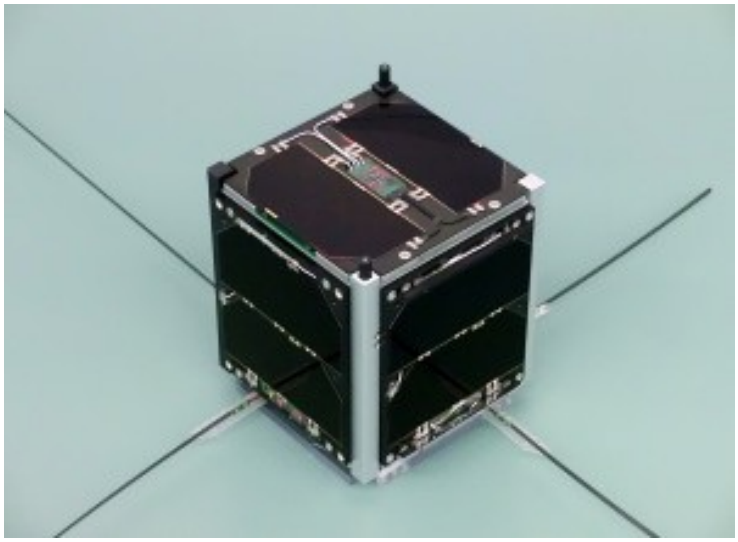
The 2013 AMSAT-UK International Space Colloquium

This year's Colloquium will start late afternoon on Friday, July 19 and will run through until the afternoon on Sunday, July 21 at the Holiday Inn, Guildford, GU2 7XZ, UK.

It will be preceded by an exciting "Hands-on" CubeSat Workshop which will take place at the nearby University of Surrey on the Friday and this will be followed, at the hotel, by the usual Colloquium "Beginners Session" in the late afternoon.

A number of keynote presentations have already been arranged for the Colloquium. These include **Alistair Scott**, the President of the British Interplanetary Society. The BIS has, over many decades, developed ideas and concepts about the future of space travel and both Patrick Moore and Arthur C Clarke were members. Alistair has had many years experience working in the space industry and will be reviewing the future possibilities for ventures into space both small and large. The BIS is presently developing one of the Sprites for the Kicksat mission and **Andrew Vaudin** will be presenting a paper about this and also providing a demonstration.

It is anticipated that both the FUNcube-1 and FUNcube-2 missions will be launched later this year and the FUNcube team will be on hand to talk about the missions and the planned educational outreach. A full demonstration of the Engineering Model, which has been performing flawlessly for almost a year, will also be provided.



FUNcube-1 flight model – Image credit Wouter Weggelaar PA3WEG

On the Sunday, the General Manager of the RSGB, **Graham Coomber, G0NBI** will be talking about the Society's vision of the future of amateur radio and how amateur satellites can play a major part in helping to secure that future.

We will also have updates on a number of the other current amateur satellite projects including HAMtv from the ISS, spectrum matters, operating methods, new products etc.

Additionally there will be a satellite demonstration station operating over the weekend and visits to the new technical facilities at the University are planned.

There are still a few slots available for additional speakers, so if you would like to make a presentation, please contact Dave Johnson G4DPZ e-mail: dave at g4dpz dot me dot uk as soon as possible.

The AMSAT-UK organising committee looks forward to welcoming both regular attendees and newcomers – you can be assured of a warm welcome and an exciting weekend.

The event is open to all, full details of the accommodation, travel and booking arrangements are at http://amsat-uk.org/colloquium/colloquium-2013/

You can also complete the form enclosed with this edition of OSCAR NEWS

Details of the free "Hands On" CubeSat Workshop are at http://amsat-uk.org/colloquium/cubesat-workshop-2013/

MEETINGS and EVENTS CALENDAR

*3-5th June - 5th European CubeSat Symposium – Brussels Belgium
*6th June – 6th QB50 Workshop (by invitation) – Brussels Belgium
*16-17th July – UK Space Conference –Glasgow
*19th July -AMSAT-UK & SSC Hands-on Cubesat Workshop – Guildford
*20/21st July – AMSAT-UK Colloquium – Guildford
10/15th Aug - Small Sat Conference Utah State University
23/27th Sept – International Astronautical Conference - Beijing
27/28th Sept - RSGB National Hamfest
11/13th Oct - RSGB Centenary Convention
1/3rd Nov – AMSAT-NA Symposium – Hobby Airport Marriott – Houston

*= AMSAT-UK is planning to attend.

AMSAT-UK Shop

The AMSAT-UK shop is an important source of funds and every purchase from the shop helps to contribute towards our Satellite Building fund.

The currently available stock items available from the shop are:-

- **G7HIA 2.4GHz Patch Antenna kit**
- **G0MRF 2.4GHz Signal Sources**
- **G0MRF Filtered 2m PreAmp Kit**
- **LVB Tracker – Motherboards, USB interface boards, full and partial kits.**
- **SatPC32 and WiSP Software Licenses.**
- **Elk Antennas**

Full details are now on the AMSAT-UK web site together with the prices.

Suggestions from AMSAT-UK members for additional products are always welcome and a dedicated email address (amsat-uk-shop@amsat.org) is available for contact with the shop. Please send in the suggestions and keep checking the website for updates and new items.

73
Ciaran
M0XTD

Electronic membership of AMSAT-UK

- Are you fed up with high postal rates, so are we!
- Want to get your Oscar News earlier than the paper version?
- Old Oscar News copies gathering dust on your shelves?

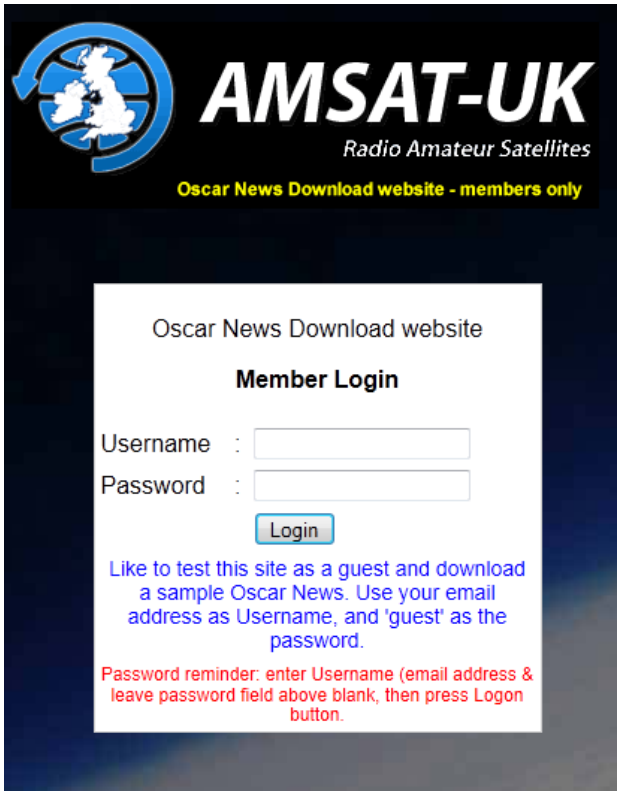
Here's the answer!

You can now join (or renew) your AMSAT-UK membership as an electronic member. You won't get your Oscar News through the post in paper format, but will be able to download your personalised copy in pdf format from the members only download web site.

The cost is only £15 per year, wherever you live! After you subscribe, you will receive an email, containing your login password for the download web site, from where you can download the latest edition of Oscar News.

Please note, that adding the logins to the download site is a manual process, and may take up to a couple of weeks, so please be patient!

Normal (paper/postal) classes of membership are still available.



The download web site is at **amsatuk.me.uk/on/**
You can give it a try by using your email address as the username, and 'guest' as the password.
The AMSAT-UK shop is at **shop.amsat.org.uk**, where you can renew your membership of AMSAT-UK

AMSAT-UK Colloquium 2013 – Information Sheet

The AMSAT-UK Colloquium 2013 will be held at the Holiday Inn, Egerton Road, Guildford GU2 7XZ starting at 1000 am on Sat 20 July, and finishing at approximately 17.00 pm on Sunday 21 July 2013. There will be a beginner's session starting approximately 4pm on Friday 19 July.

All the 'normal' activities will be taking place, presentations, discussions, shop, raffle, Gala dinner, etc.

There are two Packages available

Package 1
Attendance on Sat and Sun, Sat Gala dinner, plus one overnight stay on Saturday. Includes breakfast on Sunday, but does not include lunches on either day. Includes tea and coffee. Price £139.00

Package 2
Attend all sessions on Fri, Sat, and Sun, two nights bed and breakfast, Sat Gala dinner (evening). Does not include lunch on any of the three days. Includes tea and coffee. Price £206.00

Some additional options are available

Thursday night Bed and Breakfast, incl full English on Fri morning. Price £90.00
* Attend Beginners Session only Friday afternoon/evening. Price £12.50
Attend Gala Dinner on Sat evening. Price £20.00
* Attend Colloquium presentations, etc Sat, inc tea/coffee, excludes lunch and dinner. Price £24.50
* Attend Colloquium presentations, etc Sun, inc tea/coffee, excludes lunch and dinner. Price £24.50
Sunday night Bed and Breakfast, incl full English on Mon morning. Price £90.00

* These items need not be booked in advance, please pay at Hotel Reception on arrival.

DO NOT BOOK WITH THE HOTEL, BUT WITH AMSAT-UK AT THE ONLINE SHOP AT http://shop.amsat.org.uk. If for any reason you cannot book online, you may send your cheque payable to AMSAT-UK to JD Heck, Badgers, Letton Close, Blandford, Dorset DT11 7SS. Please state clearly what you are booking, and your name, callsign, address etc.

All accommodation will be at the Holiday Inn hotel. Please note that the hotel will only hold our reserved rooms until 3 weeks prior to the event, ie until 21st June 2013. If you book after this date, you risk there not being a room available. Bookings for Fri/Sun nights, or ones made after this date cannot be guaranteed.

Friday Night dinner. This will be held at the hotel. If you wish to attend, please contact Jim Heck, at the address above, or email at g3wgm@amsat.org at least one week before the event.

Please note that prices are set by the hotel, not AMSAT-UK. AMSAT-UK makes no profit from Colloquium fees (but we do from raffle, auction etc!)

Attendees may wish to note that the Surrey Space Centre at the University is holding a "Bring Your Own Board" cubesat workshop on Fri 19 July. More details at http://www.surrey.ac.uk/ssc/news/events/ssc_and_ee/byob_cubesat_workshop.htm. Attendance is free, but the organiser, Chris Bridges, would appreciate an email if you are planning to attend. His email address is c.p.bridges@surrey.ac.uk

Notice of Annual General Meeting of AMSAT-UK

The AGM of AMSAT-UK will take place on Sunday 21 July 2013 at 4.30 pm at the Holiday Inn, Egerton Road, Guildford, GU2 7XZ , England. All fully paid up members are welcome to attend and have voting rights. Non-members may attend as guests for the period of the AGM, but may not vote.

Members of AMSAT-UK and their guests who are not attending as delegates to the Colloquium on this date should contact the Hon Sec by 10 July to ensure that their entry to the Hotel is not impeded due to any security restrictions, etc.

Agenda of the Annual General Meeting

1. Welcome by the Chairman of AMSAT-UK Prof Sir M.S. Sweeting G3YJO.
2. Apologies for Absence.
3. Minutes of the 2012 AGM to be read and agreed as a true record
4. Chairman's Report
5. Hon Secretary's Report
6. Treasurer's Report
7. Election of the 2013/2014 Committee
8. Any Other Business

Notes:

Attendees are free to raise matters for discussion under para 8 from the floor. However a more informed discussion and more time may be allowed for discussion if items to be raised are notified in writing to the Hon Sec at least 7 days prior to the meeting.

Any member of AMSAT-UK is eligible to join the committee, but must have one proposer and one seconder who are both also members. You are welcome to put yourself forward as a committee member, or (with their agreement!) anyone else! If you are considering putting yourself or someone else forward for election, please contact the Hon Sec before the meeting.

JD Heck, G3WGM,
Hon Sec AMSAT-UK,
Badgers, Letton Close,
Blandford
Dorset DT11 7SS, UK.
g3wgm@amsat.org