

UKube-1 Launch Briefing

UKube-1 is a UK Space Agency pilot CubeSat mission built by Clyde Space, carrying a range of science and technology payloads contributed from across the UK space community including primes, SMEs, universities, and amateur groups. In all, over 120 people in around 25 organisations have contributed and supported the project.

The satellite is due to be launched by Roscosmos on Soyuz 2 Fregat US on 8th July 2014.

Operations are being led by RAL Space. Over the next few weeks we will be working from our primary ground station at STFC Chilbolton Observatory to commission the satellite. Following commissioning the satellite will follow an onboard schedule of nominal payload operations.

Orbit Elements

The following orbit elements and launch parameters have been received from Roscosmos for launch. These are expected to be updated with actual as measured elements within a few hours of separation.

ELEMENT	NOMINAL	ACTUAL
Launch Date	08/07/2014	
Launch UTC	15:58:28	
Separation / Osculating UTC	18:32:42	
Semi-major axis (km)	7004.2	
Eccentricity	0.0013	
Inclination (deg)	98.4	
Longitude of the ascending node (deg)	75.2	
<i>Inferred RAAN (deg)*</i>	<i>264.0</i>	
Argument of perigee (deg)	54.7	
Argument of latitude (deg)	233.6	

** based on the longitude of ascending node and osculating time*

After this period and once the satellite has been identified by NORAD we will switch to using TLEs directly.

Passes

The accompanying workbook includes estimates of passes over UK using the above orbit elements (based on a ground station at Chilbolton) over the first week.

First Receiver

The first person to receive the Morse signal will receive a small momento of their achievement and our thanks. Please email your claim, preferably including a recording to steve.greenland@clyde-space.com, with operations@funcube.org.uk in copy, or post to twitter with #UKube hashtag together with uptime (from the packet if known), local time and your approx location. Judges decision is final, etc.

Frequencies

The primary telemetry downlink frequency is 145.840 MHz

The FUNcube-2 downlink frequency is 145.915MHz.

Note that FUNcube-2 will only be intermittently operational during the commissioning phase and checkout. We will report, through the usual AMSAT-UK channels, when the FUNcube-2 payload is expected to become fully operational.

Note there is also an S Band payload which will be used to test downlink of high speed telemetry on 2401.50MHz OQPSK but this is not expected to be activated during commissioning or early stages of the mission.

VHF 145.840 MHz Transmissions

CW Morse Code

If a signal is heard whilst the spacecraft is not in overhead the UK or not in contact with the ground station at Chilbolton, it is likely UKube-1 is in its beacon comms state. In this state a hex ASCII health beacon is transmitted in A1 Morse code every 2 mins. The health beacon may be decoded as

Identifier	#	Mode	Battery V	Ant State	Array State	Uptime
UKUBE1	0	0	000	0	0	00000000
Nominal	0	2	~ 0A0 to 0F0	F	0 or 7	inc.
Decodes	const	2 = safe 3 = standby 4 = mission (eclipse) 5 = mission (sunlit)	V = -0.0095x+9.8	b0000 ANT1-4 0 = stowed 1 = deployed	bX000 DXP, DYP, DYN 0 = stowed 1 = deployed	secs

If a beacon message of "UKUBE-1 CALLING MIDORI" is heard, this may indicate an anomalous state in the OBC or reset has occurred.

AX25 Telemetry

AX25 telemetry will be transmitted using BSPK only when the satellite is in "pass mode", whilst in range of a commanding ground station. Initially this will be in vicinity of UK based on the primary ground station at Chilbolton.

When in "pass mode" the satellite will transmit at least IDLE telemetry packets once every 5 secs in AX25. By default the packets will alternate between two IDLE types, creating a total data repeat of 10 s. Nominally the packet will be transmitted as 1k2, however other data rates up to (and in particular) 9k6 will be used, this may be varied mid pass. These packets will be transmitted once every 5 s regardless of other packets, and so interwoven into the downlink stream.

Telemetry Recordings

The UKube team will welcome all reports, decodes and recordings of the CW or AX25 telemetry received – especially during the Launch and Early Operation Phase (LEOP).

For CW, please send an ASCII file of the Morse:

<TIMESTAMP: 16 hex ASCII chars><MORSE FRAME: 21 ASCII chars>

For AX25, please send decoded binary of the frame:

<TIMESTAMP: 8 bytes><FRAME LENGTH: 2 bytes><FRAME PACKET: n bytes>

Where the FRAME DATA is the contents of an AX25 frame (FRAME LENGTH bytes long) which may or may not contain a valid packet and the TIMESTAMP is the number of milliseconds since the UNIX epoch.

Send to ukube_data@stfc.ac.uk, please use a subject containing [CW] or [AX25] with and a YYYY.MM.DD HH.MM.SS UTC date and time of acquisition (start) to aid in filtering.

IDLE Decoding

The AX25 encapsulates a CCSDS packet, of the following format.

AX25 ENCAPSULATION	FLAG	ADDRESS	CONTROL	PID	INFORMATION	FCS	FLAG
	1 B	14 B	1 B	1 B	< 256 B	2 B	1 B
	0x7E	TO 0x86A240404040E0 DE 0xAA96AA848A6261	0x03	0x60*	CCSDS FRAME	FCS	0x7E
CCSDS FRAME	HEADER	BODY		FCS			
		SEC HEADER	END USER DATA				
	6 B	4 B		2 B			
	HEADER	SEC HEADER	END USER DATA	CCSDS CRC			
HEADER	PACKET VERSION	PACKET IDENTIFICATION		PACKET SEQUENCE		PACKET LENGTH	
		PACKET TYPE	SEC. HEADER	APID	SEQUENCE FLAGS	PACKET SEQUENCE	
	3 b	1 b	1 b	11 b	2 b	14 b	16 b
	0b000	0b0 Uplink 0b1 Downlink	0b1 Sec Header	APID	0b00 continuation 0b01 first segment 0b10 last segment 0b11 unsegmented	Packet #	0x0080
SEC HEADER	CCSDS SEC HEADER	PUS VERSION	ACK	SERVICE TYPE	SERVICE SUBTYPE	RESERVED	
	1 b	3 b	4 b	1 B	1 B	1 B	
	0b0 Non-standard	0b001	0b100x ACK ACCEPT 0bx001 ACK EXECUTE			0x00	

It is hoped a telemetry decoder can be made available for interested parties in the near future. In the mean time the accompanying workbook contains the idle telemetry formats for the two default IDLE packet types and the initial calibration data estimates.

Launch Web Link

It is expected that a live video link of the launch will be made available by Roscosmos, but please note they will only confirm the availability of the link on 7th July.

www.roscosmos.ru/317/

A possible alternative if the above does not work is reported as: tv-tsenki.com/live.php

The mission team will be joining the usual CubeSat IRC channel – using web browsers this can be accessed at <http://webchat.freenode.net/> using the channel name #cubesat. We will be updating this with any news as we receive it.

Twitter

We have been using the #UKube hashtag in twitter to update people of the status, join us if you like. Steve (technical lead) account is @strickengremlin, Helen (mission manager) is @SheAstronomer.

Commissioning

Commissioning of the satellite is expected to be performed over the initial weeks, while all the payloads and system operational statuses are confirmed. This is likely to be fairly ad hoc, evaluating each subsystem one by one in line with our LEOPS plan. A further announcement will be made once the satellite enters a more nominal operational cycle.

Thanks for your interest and support!