UPARC Intro to Satellites
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Overview of Amateur Radio Satellites

- Intro/Overview of amateur radio involving low Earth orbit satellites
  - What bands are used for working satellites?
    - 2m
    - 70cm
  - What satellites can I work with a technician license?
    - All of them
  - What are the modes that can be worked on amateur radio satellites?
    - CW
    - FM, incl. packet/APRS
    - SSB
    - FT4

What are the basic, required items I need to start working satellites?

- Base/Core gear needed (for FM sats only)
  - Dual band HT (full duplex highly rec., not required), or 2 HTs for Rx and Tx
  - Dual band mobile radio (full duplex highly rec., not required), or 2 radios, 1 for Rx and 1 for Tx
  - Dual band antenna (HT whip can work, better results with handheld dual band yagi, which can be a homebrew yagi)
  - Key or paddles if working CW

Portable, satellite station gear options

- Kenwood D72a, Icom 5100, Kenwood D710
  - *these radios are FM only*
- Yaesu FT-818 (all mode QRP rig)
  - This is a half duplex radio, most that have this will run 2 of these radios, 1 on receive and the other on transmit
- Arrow, Elk or homebrew handheld antenna
- Headphones and recording device

”Intermediate” level station

- Kenwood TS-2000 (all mode), Icom 9700/9100/910h (all mode), Yaesu FT-847 (all mode), etc
- Light duty TV antenna rotator (RCA, etc)
- Dual band yagi antenna (2m/70cm)
  - Fixed at ~15deg of elevation
- Satellite tracking app (list of apps later in presentation)

“Advanced” level station

- Icom 9700
- Circular polarized monoband yagi antennas.
  - 1 for 2m and 1 for 70cm
  - Example: M2 LEO Pack (pic on next slide)
- Yaesu G5500DC azimuth and elevation rotator set
- SAT Controller OR tracking control software

Circular polarized, dual beam antennas


Greencube
(IO-117)

Greencube

Greencube (IO-117) was a high-orbit packet satellite.

It is off the air now due to radiation damage but there will no doubt be more based on how popular it was.

Passes lasted 90 minutes and allowed very distant QSOs due to the wide footprint.

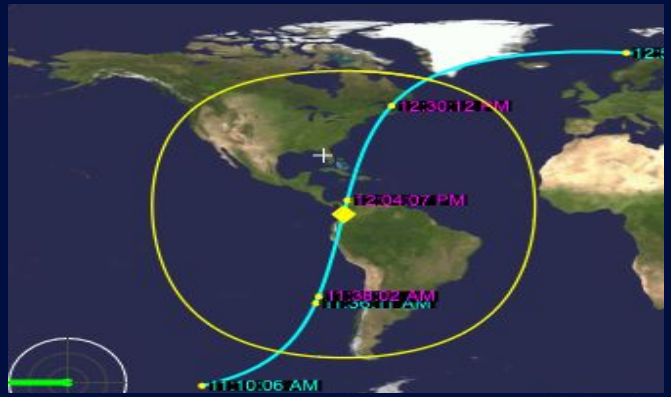
Be ready for the next one.

What was so special about Greencube?

- It was the first amateur radio satellite in Medium Earth Orbit (MEO)
  - Launched on July 13, 2022 on the maiden flight of ESA Vega C rocket
  - Carried a digital transponder on 435.31MHz USB (uplink & downlink)!
  - Designated Italy Oscar 117 (IO-117) by AmSat
- Amateur radio was not the primary mission of Greencube
  - It carried a pressurized vessel with seeds to grow in microgravity
  - Also carried a Pulsed Plasma Thruster motor

GreenCube
Microgreens cultivation in a CubeSat

HIGHER ORBIT MEANS LARGER FOOTPRINT



IO-117:

5,841km x 5,860km 70.1° orbit
224 minutes period

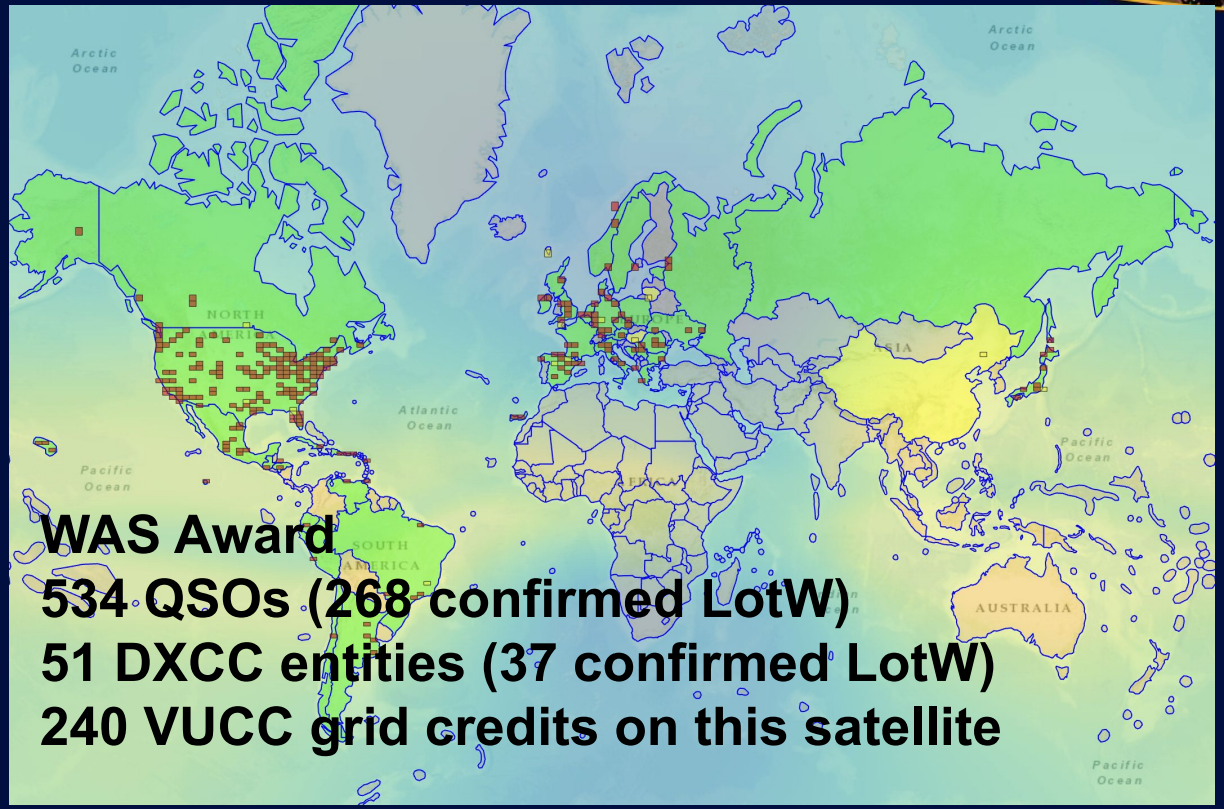
Typical pass > 1 hour

RS-44:

1,175km x 1,511km 82.5° orbit
112 minutes period

Typical pass about 17 minutes

LARGER FOOTPRINT MEANS MORE DXCCs!



KB4DSL SATELLITE STATION

Hardware:

- ICOM IC-9700 Transceiver
- CSN S.A.T. Controller (controls radio and antenna)
- Yaesu G-5500 Az-El Antenna Rotor
- M2 LEO Pack Antennas (only UHF needed for Greencube)
- SSB SP-70S UHF Pre-amp (helps boost receive signal)

Software for working IO-117:

- OZ9AAR Greencube Terminal
- UZ7HO Soundmodem

LAST QSO TRANSCRIPT

```
23.08.24 20:35:40.781 KB4DSL G1AAK EA3A EL87 FL TX:2
23.08.24 20:35:43.623 Telemetry: eps/obc/radio
boot=65447/13232/512, Vbat=7.203V, last RSSI=-110 dBm
23.08.24 20:35:45.932 KB4DSL G1AAK EA3A EL87 FL RX:2
23.08.24 20:35:53.309 W7FN HB9RYZ CN88 QSL? RX:0
23.08.24 20:36:07.472 KB8CR EA3A G1AAK EM79 RX:1
23.08.24 20:36:08.242 EA3A KB4DSL RR UR 599 TU RX:0
23.08.24 20:36:13.615 KB4DSL EA3A TU LoTW 73 TX:2
23.08.24 20:36:18.015 ES4RM KK4TW KO49AL QSL? RX:3
23.08.24 20:36:18.737 EA3TA CQ JN11 WAS NV RX:0
23.08.24 20:36:19.379 ES4RM KK4TW KO49AL QSL? RX:3
23.08.24 20:36:20.136 OK1IN CQ JO60 LoTW ClubLog RX:0
23.08.24 20:36:27.493 KB4DSL EA3A TU LoTW 73 TX:2
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TX Call from: KB4DSL
To: G1AAK and EA3A
Message: EL87 FL

Message Digipeated

Message from EA3A

TU message to EA3A did not get digipeated

GREENCUBE OBIT

9/15/24:

The GreenCube satellite, developed by S5LAB, has likely ceased functioning due to radiation damage. After a successful mission that exceeded expectations, the satellite is no longer responding to commands, and its onboard radio is believed to have been compromised by the harsh radiation environment in Medium Earth Orbit (MEO).

Approximately ten days ago, GreenCube experienced a reboot, and telemetry data from the event did not indicate any anomalies. However, the S5LAB team now suspects that the satellite's radio was damaged, leading to the current communication blackout. MEO is notoriously challenging for satellites due to its high radiation levels and GreenCube was not the only satellite affected. Several other CubeSats launched alongside it only lasted a few days, making GreenCube's extended mission duration a remarkable achievement.

Additional Resources & Information

- Sat passes tracking & prediction apps
  - SatSat (iOS)
  - W1ANT (android)
  - NY2O.com
- https://www.amsat.org/status/
- https://www.amsat.org/two-way-satellites/

Additional Resources & Info

- Links to resources for further info
  - https://www.amsat.org/
  - UPARC Slack site, Satellite channel
  - https://www.ariss.org/
  - https://www.amsat.org/product/macdoppler/
- Links to gear mentioned:
  - http://www.igatemini.com/sat
  - https://tinyurl.com/5yankhfb (light duty TV rotator)

- ~70sec video of ISS contact
  - https://photos.app.goo.gl/w1gLNg6nVJKTj8aZ7