



# An introduction to Oscar100

## Noel Matthews – G8GTZ

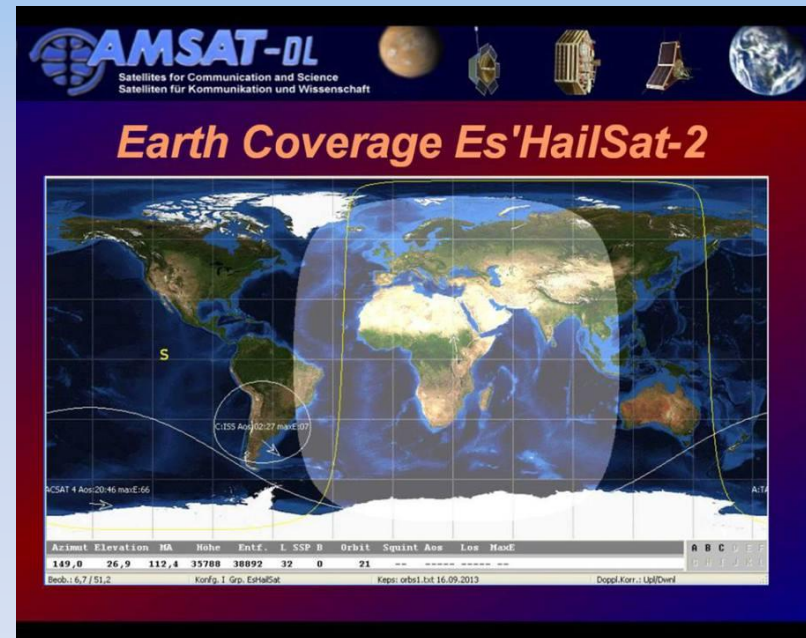









# Topics



- BATC Oscar 100 overview
- BATC Why is it a game-changer?
- BATC What does it offer?
- BATC How do I get started?
- BATC Narrow band operation
- BATC Wide band operation
- BATC The WebSDR



# What is Oscar 100

-  Oscar 100 is 2 amateur radio transponders hosted on the Es'hail-2 Direct Broadcast TV satellite
-  Owned by Es'hailSat in Qatar.
-  Built by Mitsubishi Electric Company ( MELCO) in Japan.
-  Collaborative project with Es'hailSat / AMSAT-DL / Qatar ARS
-  The first ever amateur payload on a commercial geostationary satellite



# Oscar 100

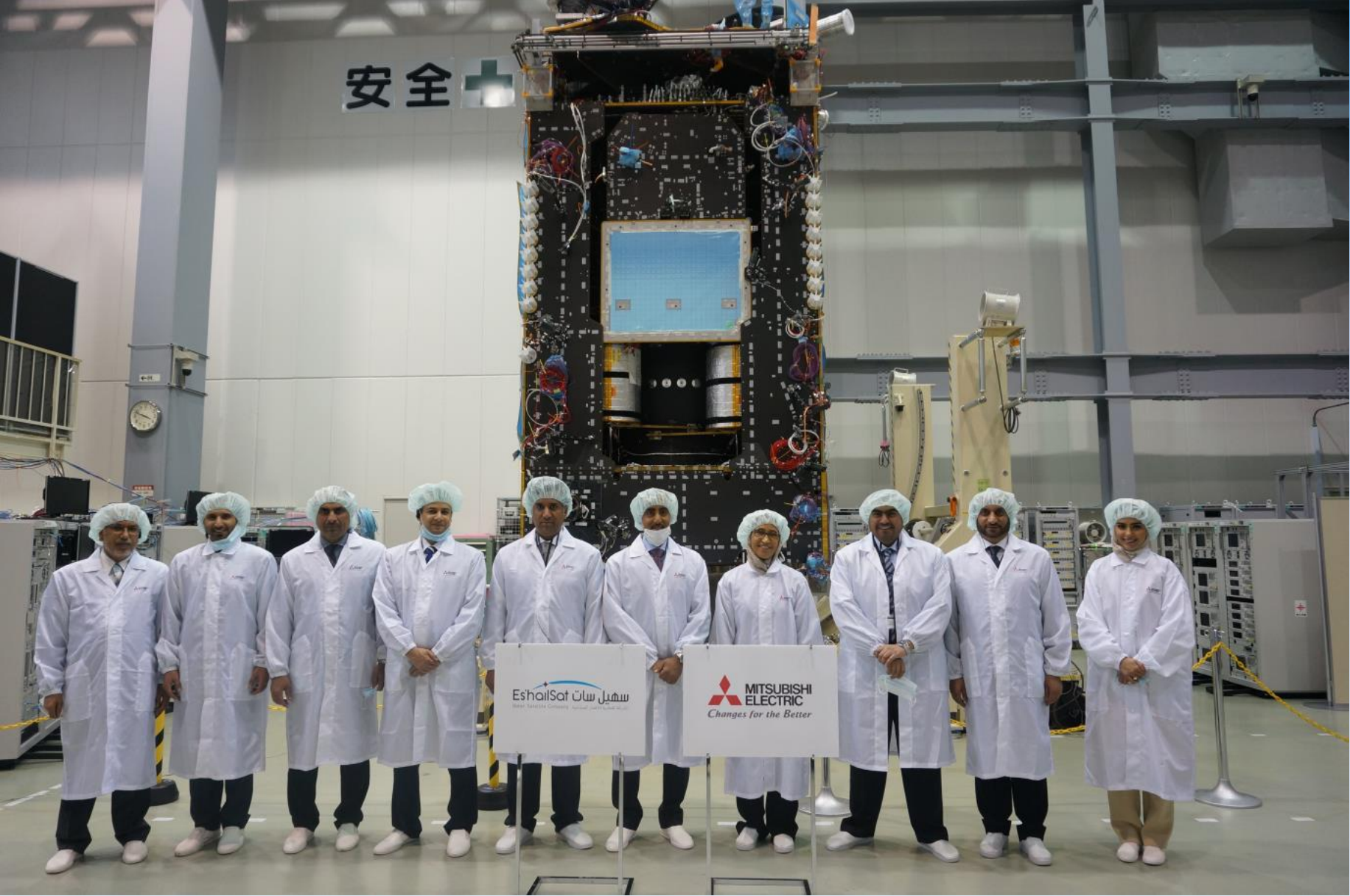
-  Project started in 2012 by Qatar Amateur Radio Society and AMSAT DL
-  Launched by SpaceX Falcon 9 from Cape Canaveral – November 2018
-  Commissioned and ready for use in February 2019



*Es'hail (Canopus) is the name of a star which becomes visible in the night sky of the Middle East as summer turns to autumn.*



# Es'hail-2



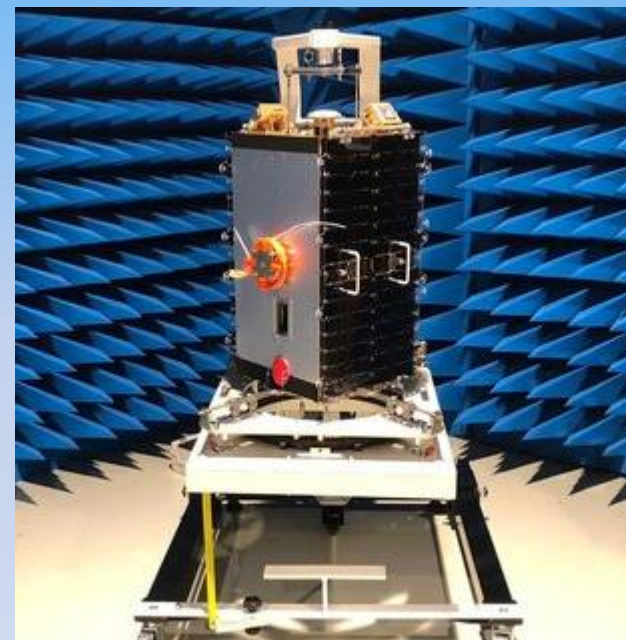
# “Normal” amateur satellites

FUNcube-1 CubeSat AO-73






Based on a 10cm x 10cm x 10cm format.  
- approximately 900g

European Student Earth Orbiter ( ESEO )



MicroSat - 50kg

# Orbits and coverage

-  Low Earth Orbit
  - Typically 400 – 700km altitude
  - Orbit once every 90 minutes = tracking
  
-  Medium Earth Orbit
  - 8000km - 20,000km
  - Used by navigation satellites
  - No amateur satellites
  
-  Geostationary
  - 36,000km altitude
  - large coverage area – 40% of the earth and 60% of population
  - No antenna tracking needed
  - Where all broadcast TV satellites are

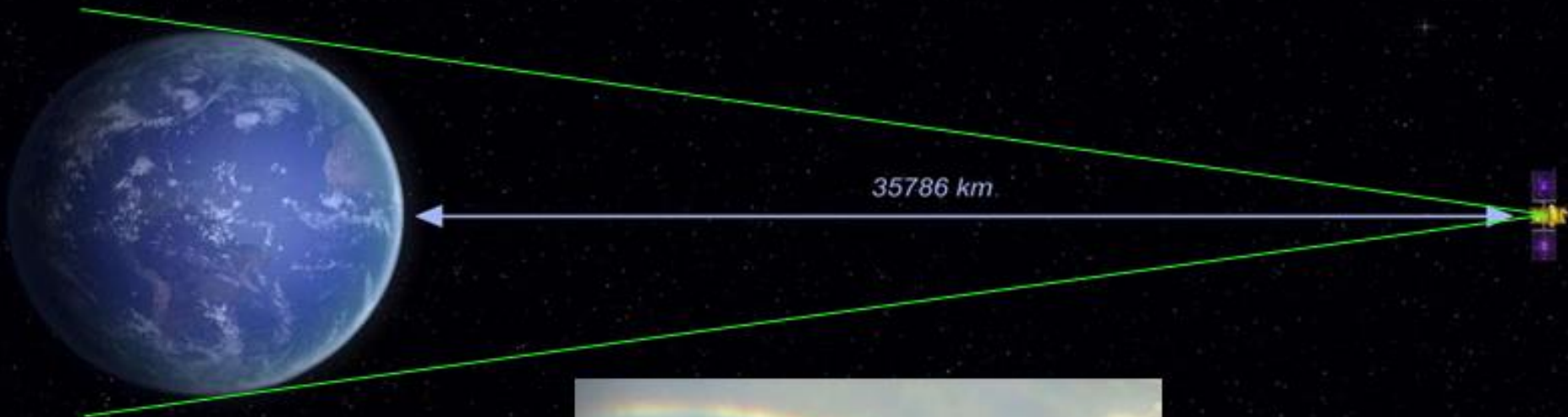




# 36,000 Km altitude



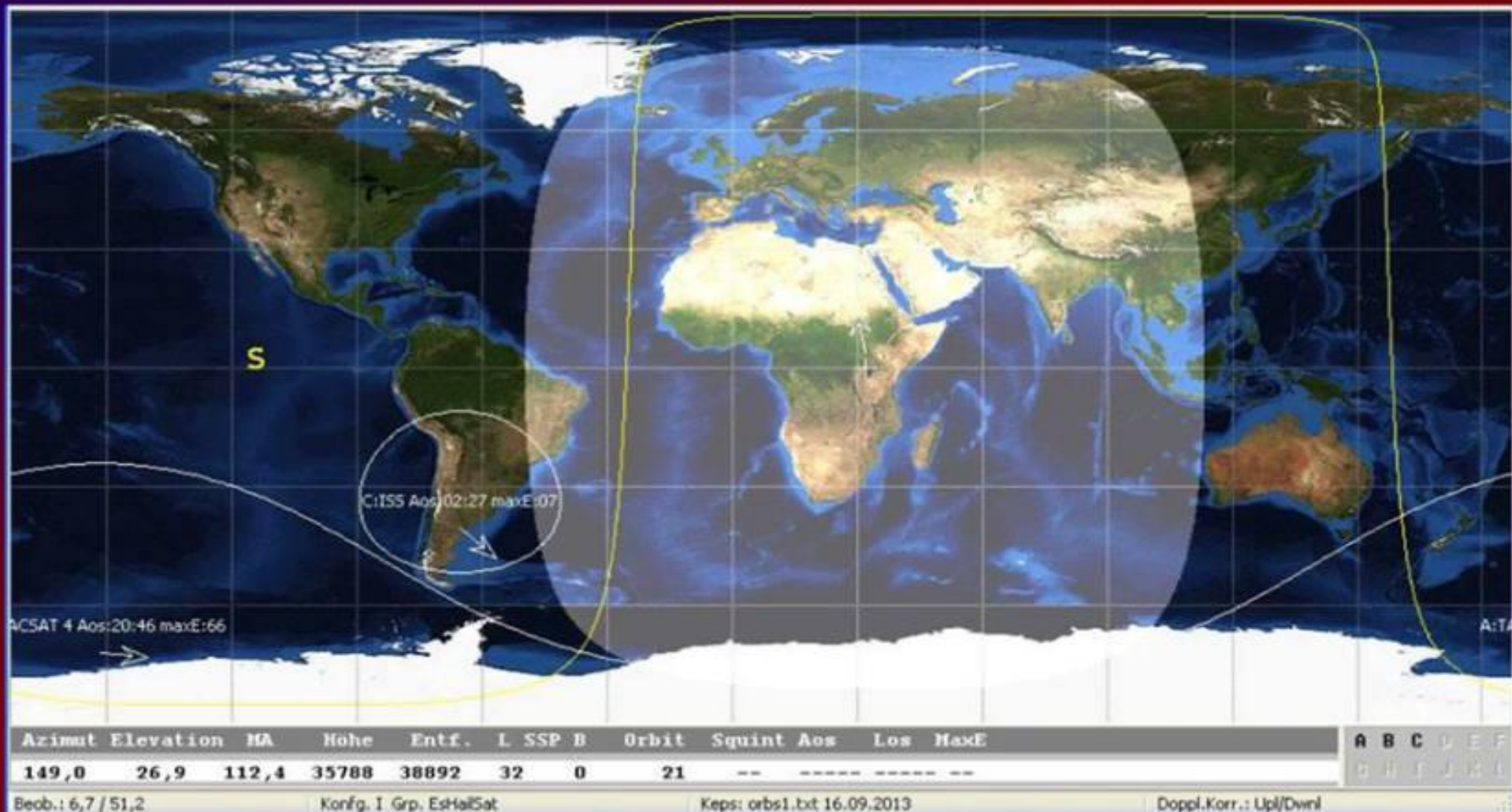
-3dB Beamwidth = 17.4° → ~20dB Antenna Gain !!










# Earth Coverage Es'HailSat-2





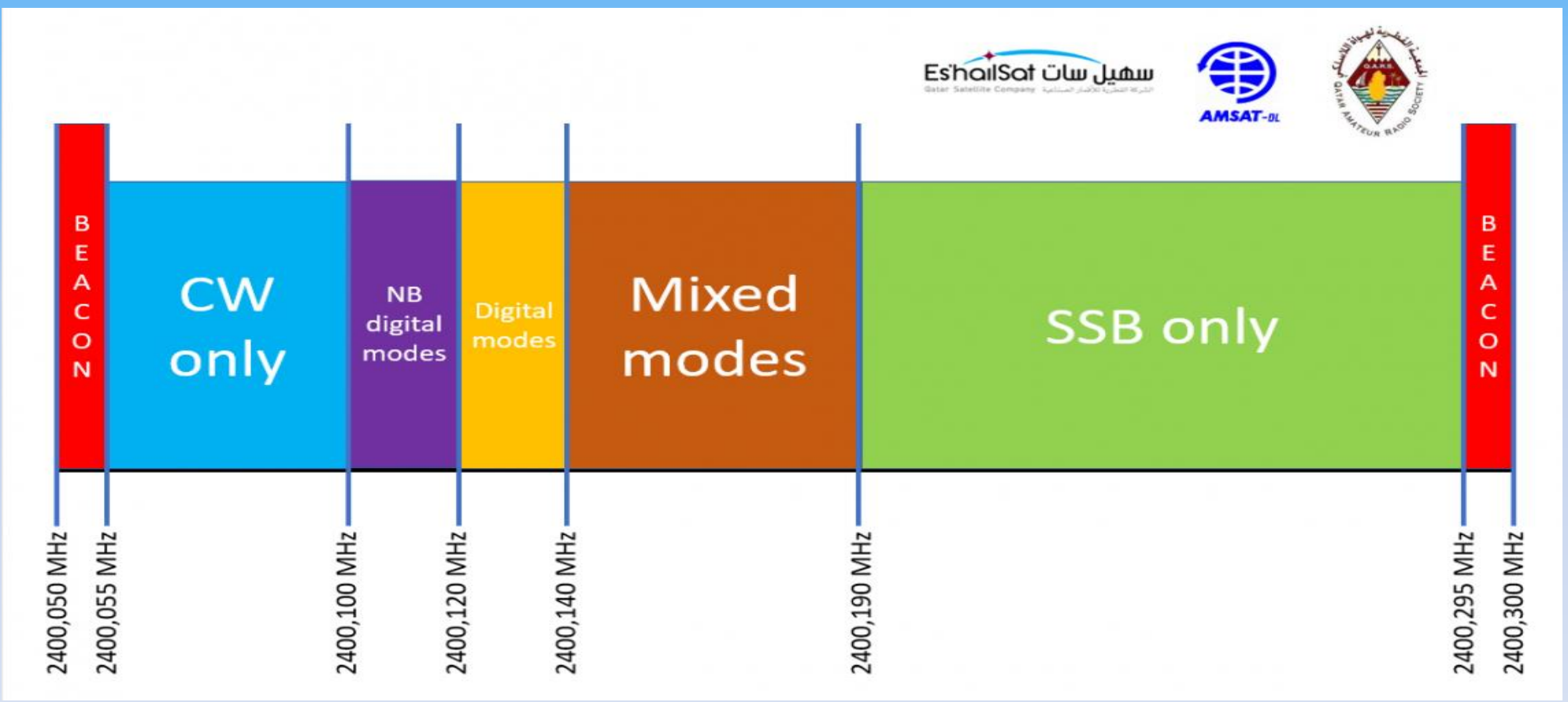
# What is on Oscar100?

-  2 transponders dedicated to Amateur Radio
  - 13cms (2400MHz) uplink
  - 3cms (10GHz) downlink
-  Narrow band transponder 250kHz wide
  - CW, SSB data modes etc
  - AGC and Leila over power warning system
  - CW and BPSK beacons
-  Wide band transponder 8MHz wide
  - Dedicated to Digital modes
  - Primarily Digital Amateur Television
  - Up to 8 DATV signals simultaneously
  - HD beacon channel



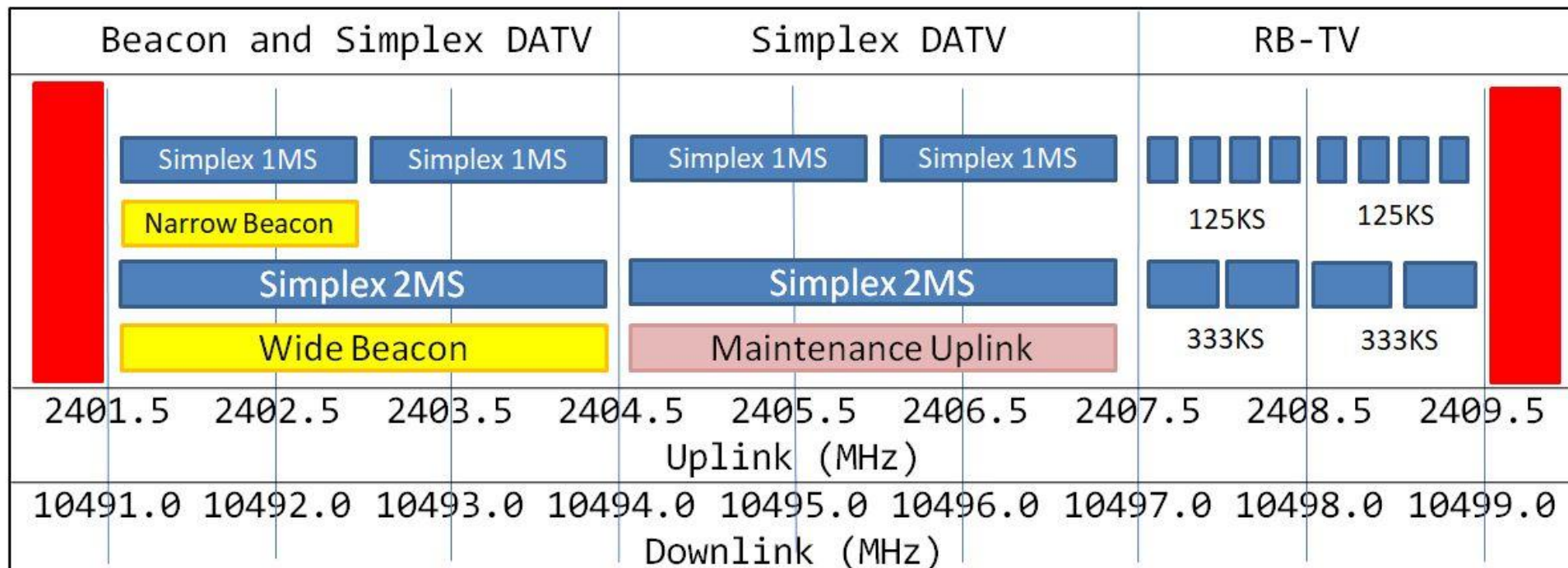


# Narrowband Band plan









# Wideband band plan








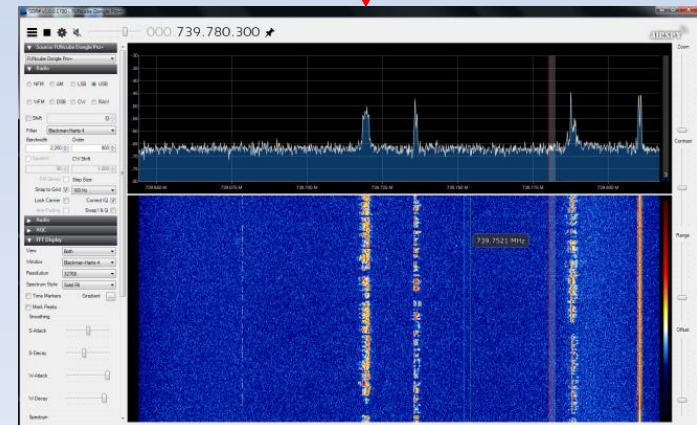
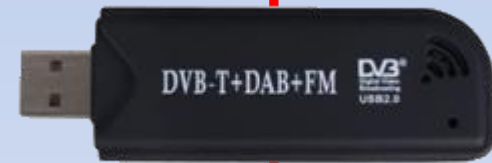
# How do I get started?

-  Whether going for Narrow band or Wide Band DATV – start with receive...
-  Satellite dish pointing at 26 degrees
  - 60cms (Sky) for NB
  - 90cm - 1.2m for DATV
-  <https://eshail.batc.org.uk/point/>
  - Just south of Sky/Freeview
-  Use a new PLL LNB for greater stability
  - Available for approximately £10



# Is it this simple?

-  Yes!
-  A simple NB rx system is:
  - Sky dish
  - New PLL LNB
  - ~ £10 RTL dongle or Funcube, LimeSDR or Pluto
-  Bias Tee to supply 12v
-  Free SDR software
  - SDR#
  - SDR Console
-  Tune to the IF frequency of 739 MHz








# Can I use a VHF / UHF rig?

- BATC Yes – but...
- BATC The output from the LNB is 739MHz
- BATC A downconverter will shift this to 432 or 144MHz
- BATC Frequency stability is an issue
  - Lock all oscillators to external ref
  - Use SDR locking



# NB Transmitting - 1

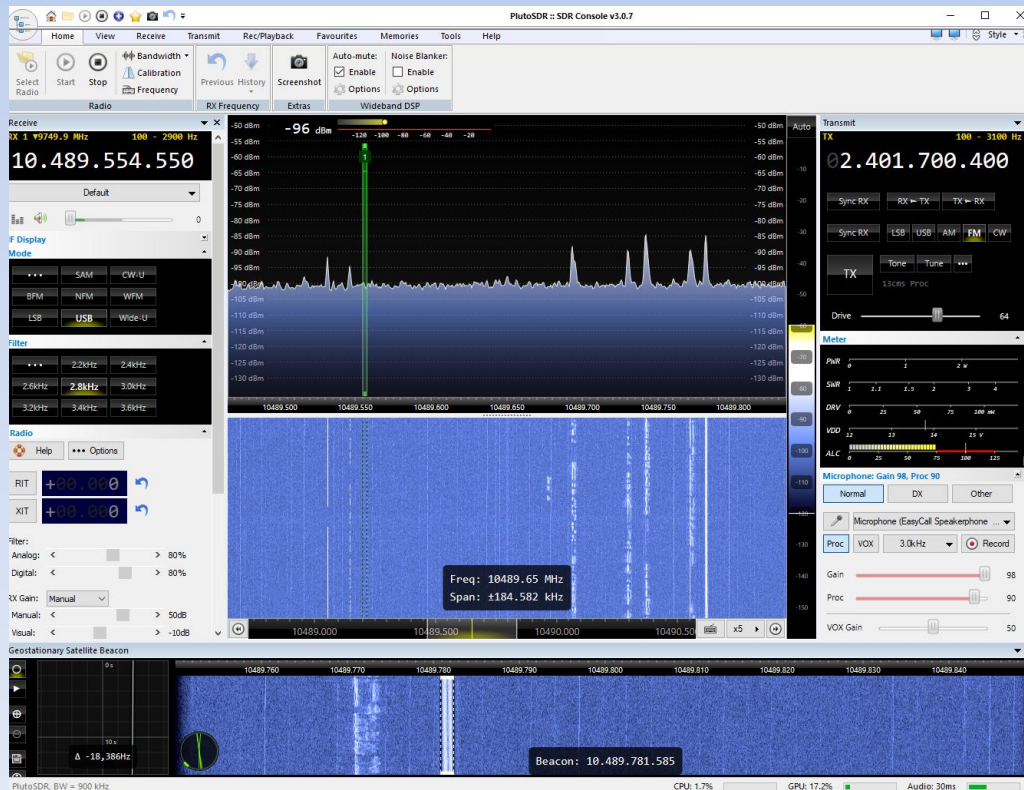
-  The NB transponder is VERY sensitive
-  Transvert up from a VHF or UHF rig
-  Small PA ~ 4 watts
  - wi-fi booster
-  LHCP helix dish feed
-  Separate dish or dual band patch feed








# NB transmitting - 2

- SDRconsole by G4ELI
- Tx and Rx via Pluto or LimeSDR
  - Full duplex
  - Frequency lock to BPSK beacon

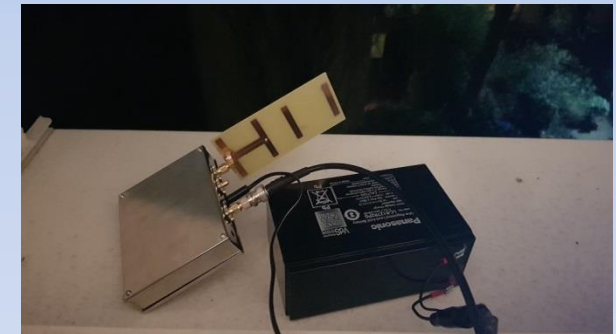
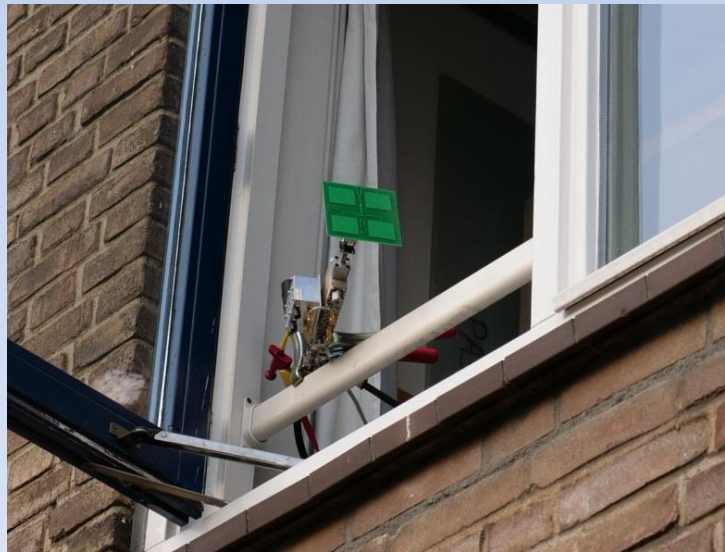


# NB operation

-  All modes permitted
-  Digital, SSB, CW, Hellschreiber....
-  Great for experimentation and easy to receive

## DL7NX






- 1 watt to 4 ele PCB Yagi.



## PA3WEG

- 1 watt to a PCB quad patch

# Oscar 100 Wideband

-  Oscar 100 wideband is an “8 MHz bent pipe” transponder for wideband digital use
-  Occupied bandwidths can be 200 kHz – 8 MHz
-  Most signals are <math><1\text{MHz}</math> wide
-  Some experiments below 100Khz
-  DVB-S2 with H264 / H265 video









# Receiving DATV

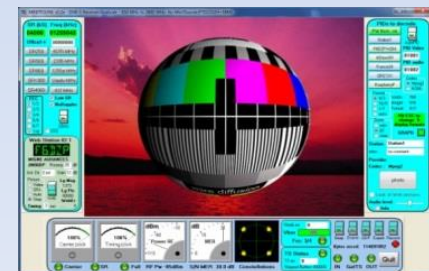
- Downlink frequency is 10,491 – 10,499 MHz and within pass band of standard consumer LNB
- PLL LNBS should be used to give stability for Reduced Bandwidth TV signals
  - Locking can cause phase noise problems
- However 9,750 MHz LO puts IF outside consumer set top box tuning
- 90% of signals are Reduced Bandwidth (RB-TV) and cannot be received on a consumer STB



# MiniTioner USB tuner



-  A wide frequency range tuner
  - Covers 143 – 2450 including 741 MHz
-  Available as kit or built unit
-  PC based with software by F6DZP
  - Gives totally flexible receive system
  - MPEG-2, H264 and H265
  - 33Ks to 27 Msymbols DVB-S, DVB-S2, for HD-TV, DATV and RB-TV
-  See <https://batc.org.uk/>



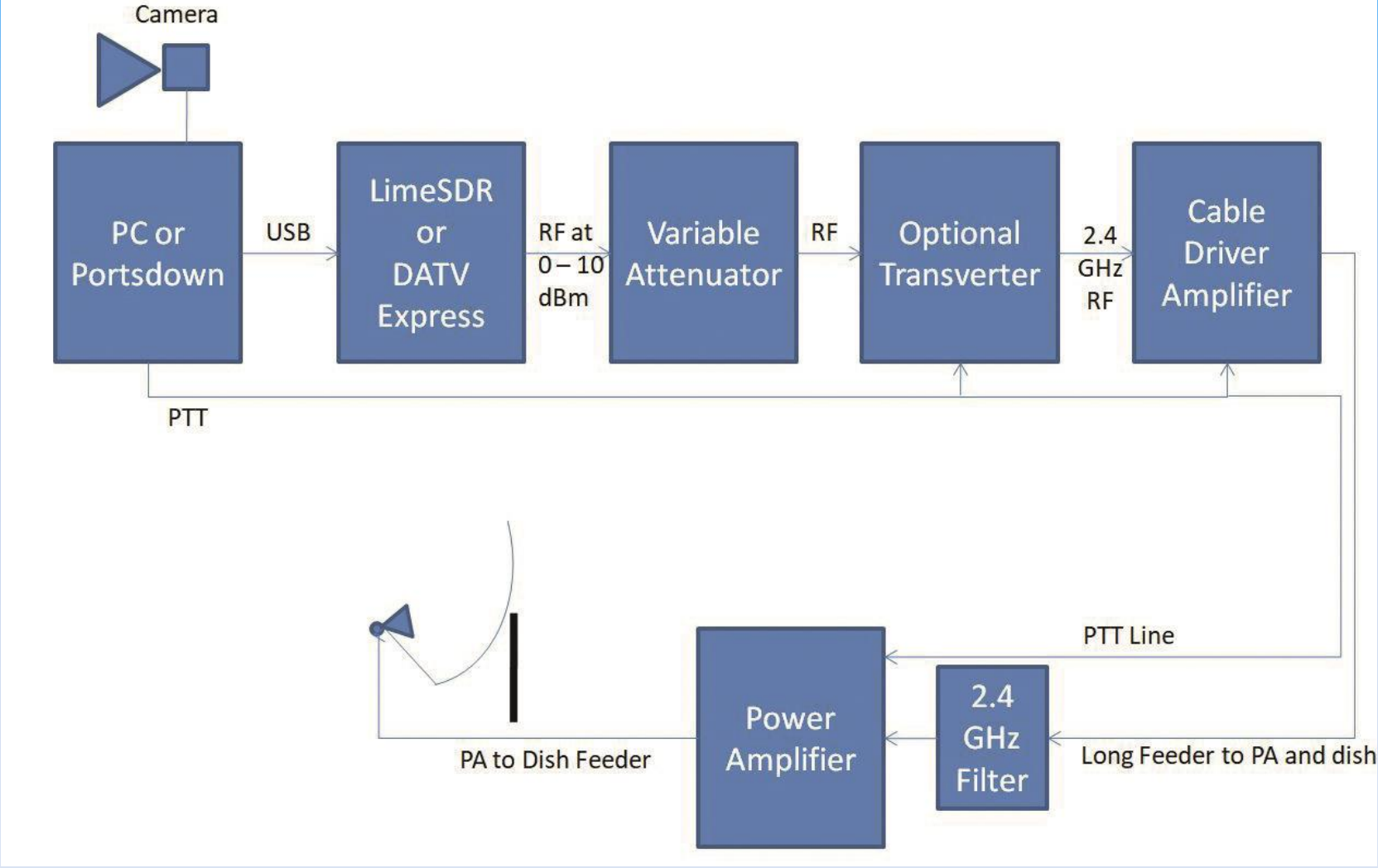
# Receiving DATV

-  Aim for a 1m dish
-  Check your dish direction using
  - <https://eshail.batc.org.uk/point/>
-  Align using BADR-4 TV services
  - 12,597 MHz, 27500 Ms, Horizontal
  - ~11dB MER
-  Check the WB beacon
  - 2Ms DVB-S2
  
-  More details:  
[https://wiki.batc.org.uk/Receiving Oscar 100 DATV signals](https://wiki.batc.org.uk/Receiving_Oscar_100_DATV_signals)






Dish size	Received MER
1.8m	10dB
1.2m	8dB
1m	6dB
80cm	5dB

# DATV transmit system



# DATV transmit

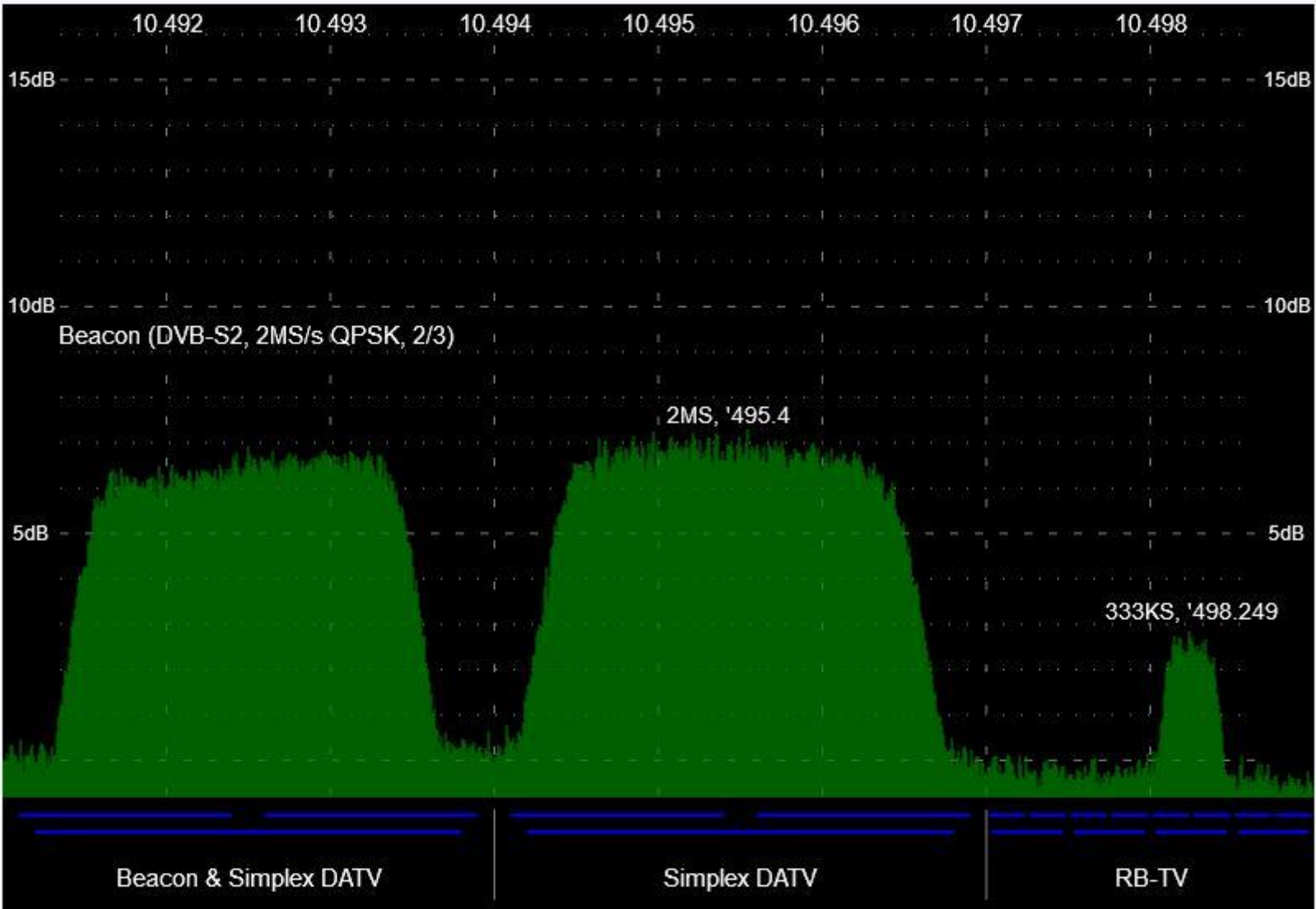
-  ~30 watts in to a 1.2m dish
-  PA at dish and VERY short feeder
-  Dual band dish feed
  - 2.4GHz patch
  - LNB 22mm waveguide







# 3 signals



Users: 149

[DATV Bandplan Link](#)

[Open fullscreen](#)



# F4HSL ~ 80KHz!

MINITIIONE v0.9beta8\_9 - Receiver/Analyser DVB-S/S2 144 MHz to 2450 MHz - SRmini=32 kS/s - for MiniTouner/MiniTouner-Pro

**SR (kS) Freq (kHz)**  
**00066 10498250**  
**Offset-> - 09749918**

SR2000 Q-beacon  
 SR1000 Q-4.75MHz  
 SR500 Q-6.25MHz  
 SR333 Q-7.25MHz  
 SR250 Q-7.75 MHz  
 SR125 Q-8.25 MHz  
 SR66 Q-8.75 MHz  
 SR27500 437MHz

Oscar 100

DVB mode:  DVB-S  DVB-S2  Auto  
 FEC DVBS:  All  1/2  2/3  3/4  5/6  6/7  7/8

Wide scan  
 Low SR

Fplug:  A  B  
 LNB volt:  0  13(V)  18(H)  
 22kHz:  OFF  ON  TS

Store into Memory: M1 M2 M3

**PIDs**

Pid from .ini  
**F4HSL** Auto PID  
 F6DZP-Mpeg  
 HDlowSR  
 France24  
 QRZ DX  
 RaspberryP

**PID Video**  
00256  
**PID audio**  
00257

Codec:  
 Mpeg2  
 H264  
 H265

Format:  
 4/3  
 16/9  
 1/1  
 auto

Width: 500  
 Height: 375

Audio:  
 MPA  
 AAC  
 AC3

Zoom:  
 adapt  
 x1  
 maxi

**GRAPH**  
Reset

Program: **F4HSL**  
 infos: DVB-S2  
 Provider: **GO-100**  
 Codec: **VH265 + AAC**

photo

Audio level

Info

Carrier Lock

SR Lock

Full RF Pw -45dBm

C/N MER 12.2dB

BCH errors: 0

LDPC: 3% 205

FEC: 3/4 8PSK\_S35

C/N must be > 8.71 dB

**D3**

TS:     err: 0

Bytes recvd: 155 kb/s 193ms

Beep

Dsave

UDP

Record

Quit

Expert Web

BATC

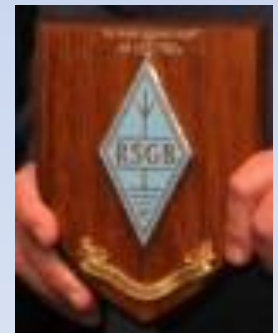
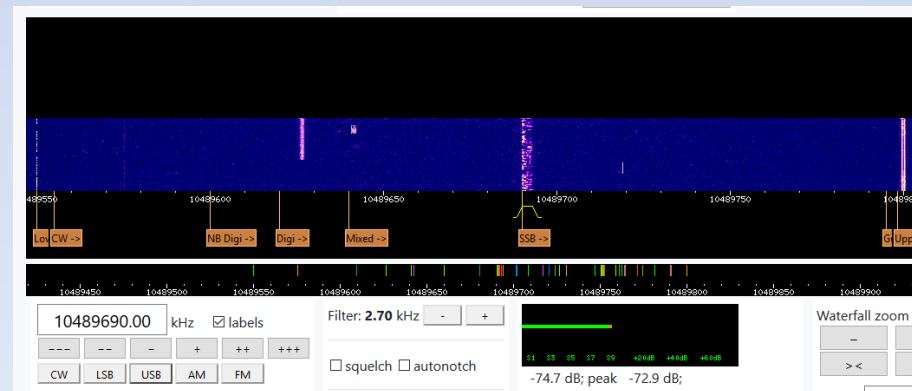
# ON4BHM ~ 2MHz






# The WebSDR

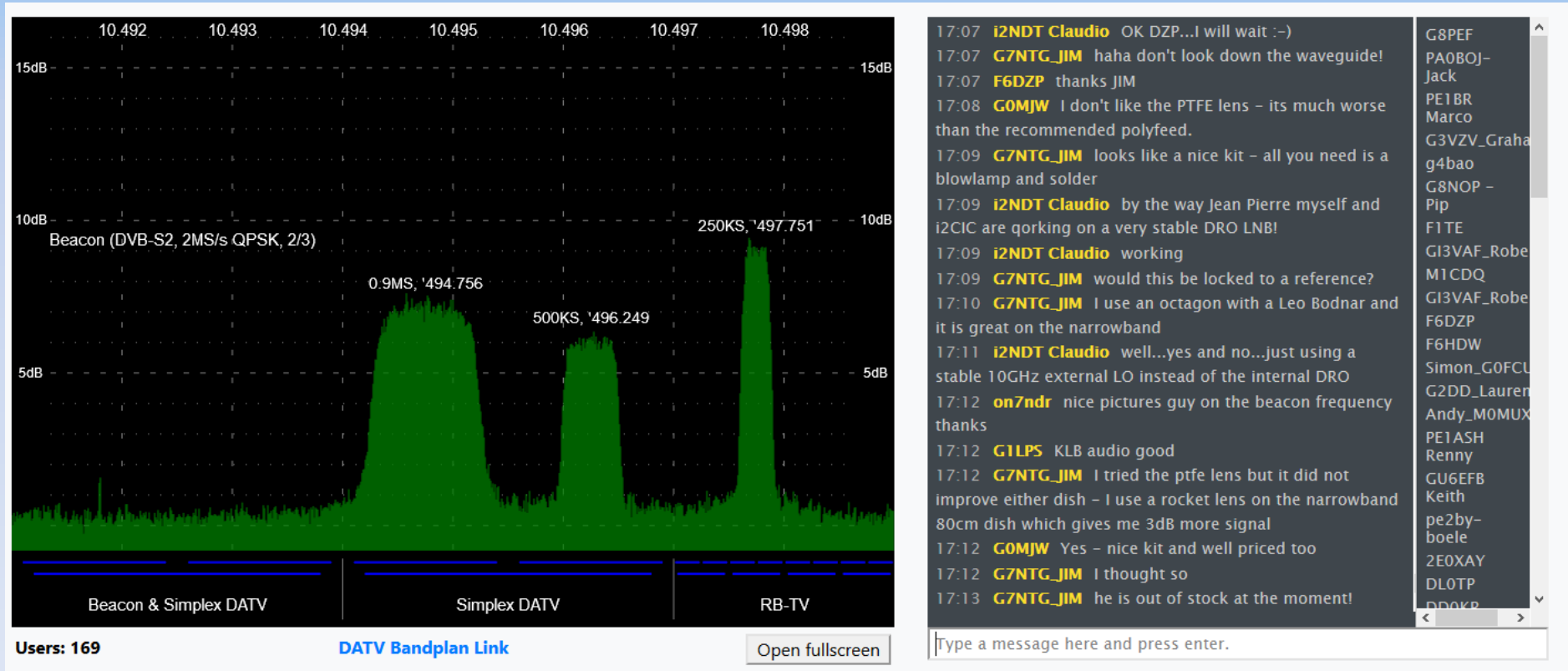
- AMSAT-UK and BATC wanted to make Oscar 100 accessible to everyone
- An on-line WebSDR which only needs a standard web browser
- Full coverage of NB transponder with waterfall and full audio decode.
- 350+ users on first weekend





# Spectrum Monitor

 An essential tool to enable the Wide Band transponder usage



The screenshot displays the Spectrum Monitor interface. On the left, a spectrum plot shows signal strength in dB (5dB to 15dB) versus frequency in MHz (10.492 to 10.498). Three distinct signals are visible: a wide signal labeled 'Beacon (DVB-S2, 2MS/s QPSK, 2/3)' at approximately 10.494 MHz, a narrower signal at 10.496249 MHz labeled '500KS, 496.249', and a very narrow signal at 10.497751 MHz labeled '250KS, 497.751'. Below the plot, three frequency bands are identified: 'Beacon & Simplex DATV', 'Simplex DATV', and 'RB-TV'. At the bottom left, it shows 'Users: 169' and a 'DATV Bandplan Link'. At the bottom right, there is an 'Open fullscreen' button.

On the right side of the interface is a chat window with a list of users on the far right and a message input field at the bottom. The chat log contains the following messages:

- 17:07 **i2NDT Claudio** OK DZP...I will wait :-)
- 17:07 **G7NTG\_JIM** haha don't look down the waveguide!
- 17:07 **F6DZP** thanks JIM
- 17:08 **G0MJW** I don't like the PTFE lens – its much worse than the recommended polyfeed.
- 17:09 **G7NTG\_JIM** looks like a nice kit – all you need is a blowlamp and solder
- 17:09 **i2NDT Claudio** by the way Jean Pierre myself and i2CIC are gorking on a very stable DRO LNB!
- 17:09 **i2NDT Claudio** working
- 17:09 **G7NTG\_JIM** would this be locked to a reference?
- 17:10 **G7NTG\_JIM** I use an octagon with a Leo Bodnar and it is great on the narrowband
- 17:11 **i2NDT Claudio** well...yes and no...just using a stable 10GHz external LO instead of the internal DRO
- 17:12 **on7ndr** nice pictures guy on the beacon frequency thanks
- 17:12 **G1LPS** KLB audio good
- 17:12 **G7NTG\_JIM** I tried the ptfе lens but it did not improve either dish – I use a rocket lens on the narrowband 80cm dish which gives me 3dB more signal
- 17:12 **G0MJW** Yes – nice kit and well priced too
- 17:12 **G7NTG\_JIM** I thought so
- 17:13 **G7NTG\_JIM** he is out of stock at the moment!

The user list on the right includes: G8PEF, PA0BOJ-Jack, PE1BR, Marco, G3VZV\_Graham, g4bao, G8NOP-Pip, F1TE, GI3VAF\_Robert, M1CDQ, GI3VAF\_Robert, F6DZP, F6HDW, Simon\_G0FCU, G2DD\_Lauren, Andy\_M0MUX, PE1ASH, Renny, GU6EFB, Keith, pe2by-boele, 2E0XAY, DL0TP, and DD0KP.

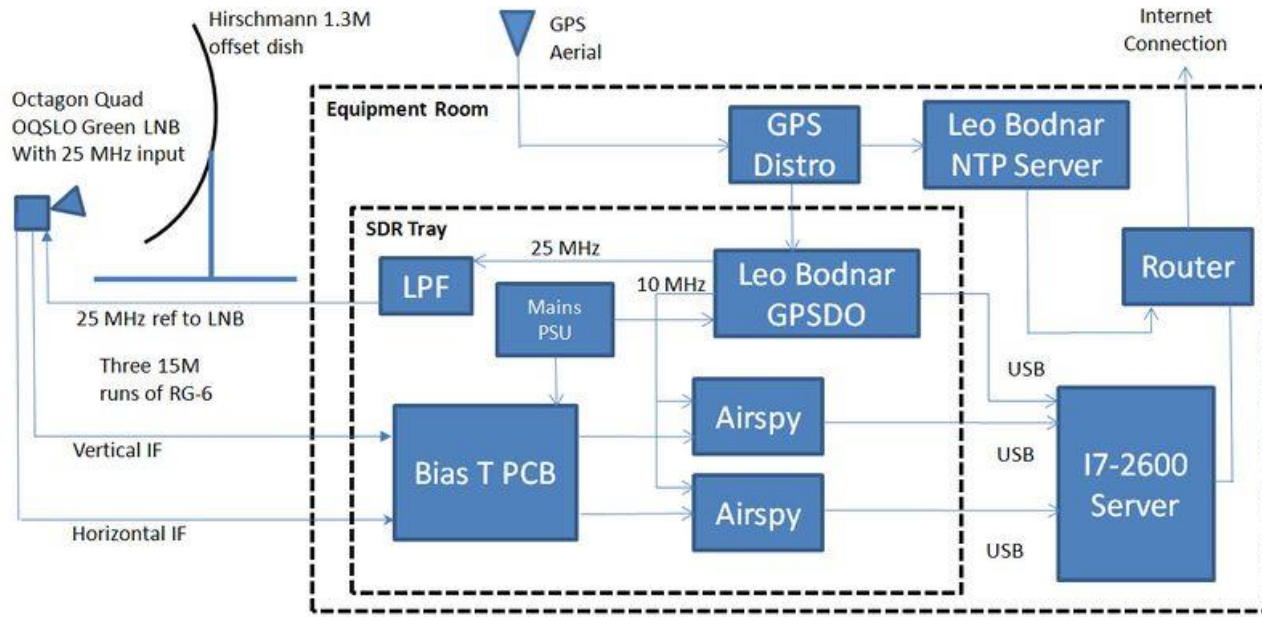
At the bottom of the chat window is a text input field with the placeholder text: 'Type a message here and press enter.'

## Located at Goonhilly Earth Station

- Quiet secure location (IO70JB)
- Excellent network connectivity
- Scaled for 500+ users






Goonhilly Es'hail-2 Spectrum Monitor and WebSDR - Hardware









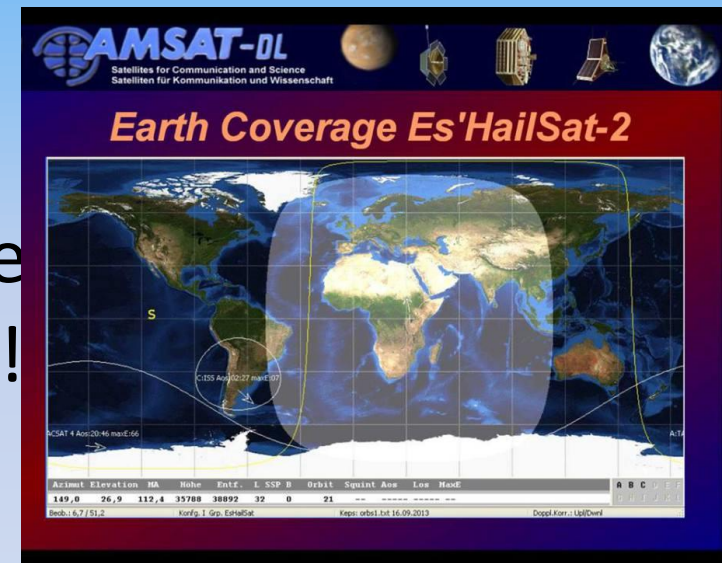
# Is it really amateur radio?



-  Absolutely - hundreds of people are engaged in that most vital aspect of amateur radio:
  - Self training in wireless telegraphy
-  It has breathed new life in to the satellite and microwave communities
-  As well as providing 24/7 communications to 1/3<sup>rd</sup> of the earth

# Conclusions

-  Oscar 100 is a fantastic opportunity for amateur experimentation
-  Receive is easy!
-  A good transmit capability is more of a challenge but not impossible!!
-  Start simple
  - Get a receiver working!







# WebSDR demo

- Usable by anyone with a web browser
  - Scaled to support 500 simultaneous users
- All listening to different frequencies and decoding different modes!
- Runs s/w developed by [www.websdr.org](http://www.websdr.org)
  - More than 150 systems around the world
- <https://eshail.batc.org.uk/nb/>
- Wideband spectrum monitor
  - <https://eshail.batc.org.uk/wb/>