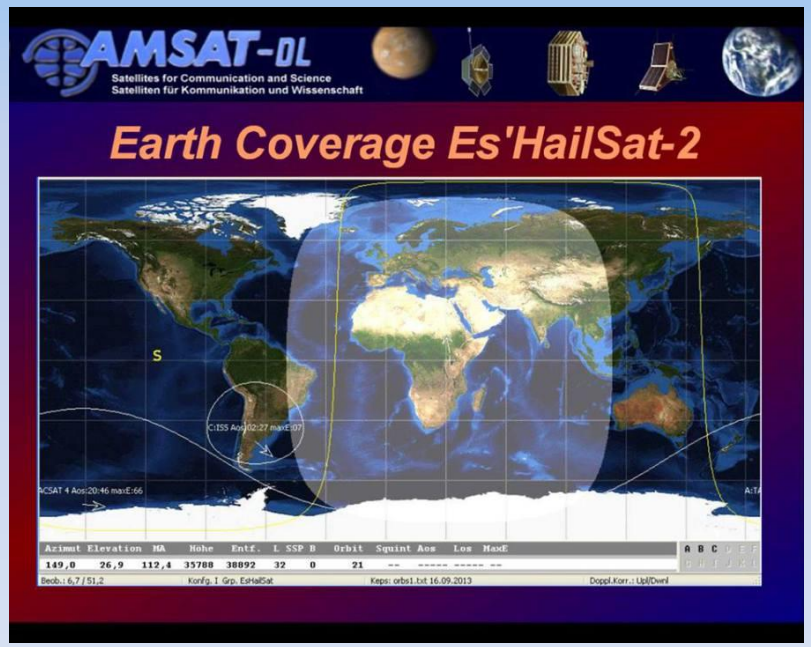
AMSAT-UK

An introduction to Oscar100

Noel Matthews – G8GTZ

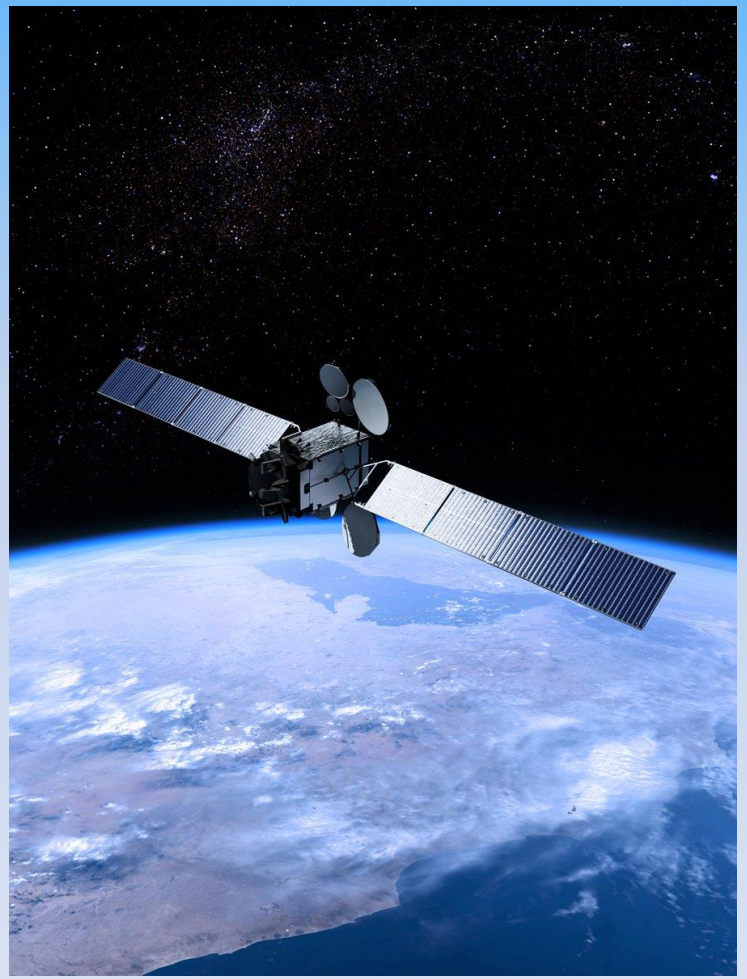
Topics

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

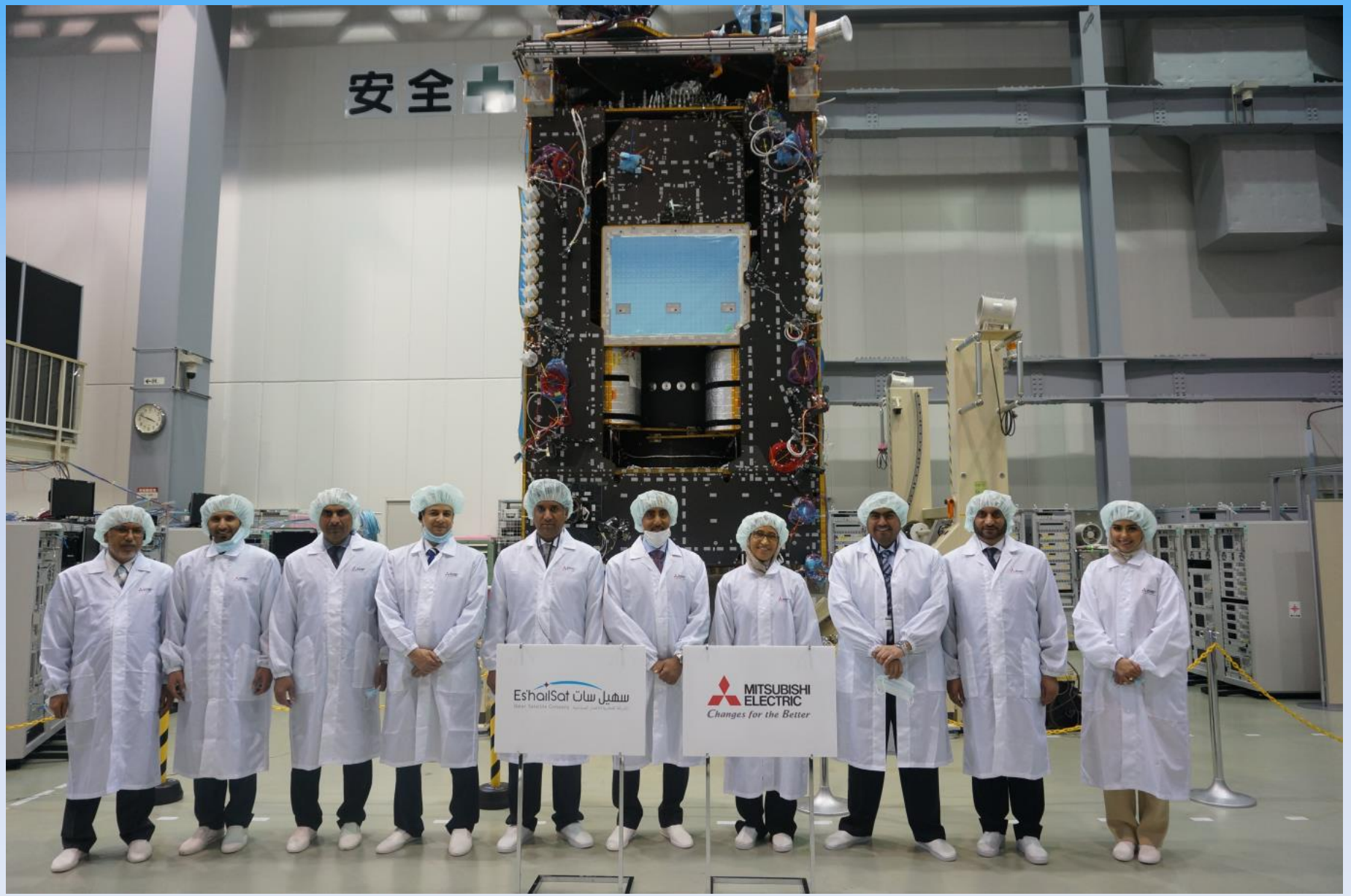


Oscar 100

- 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

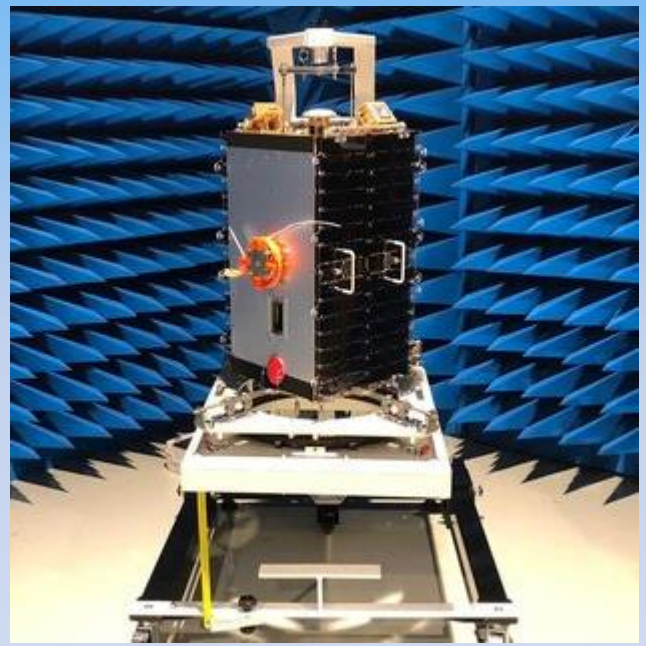

安全
EsʻhailSat سهيل سات
MITSUBISHI ELECTRIC
Changes for the Better

“Normal” amateur satellites

FUNcube-1 CubeSat AO-73

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

European **S**tudent **E**arth Orbiter (ESEO)



MicroSat - 50kg

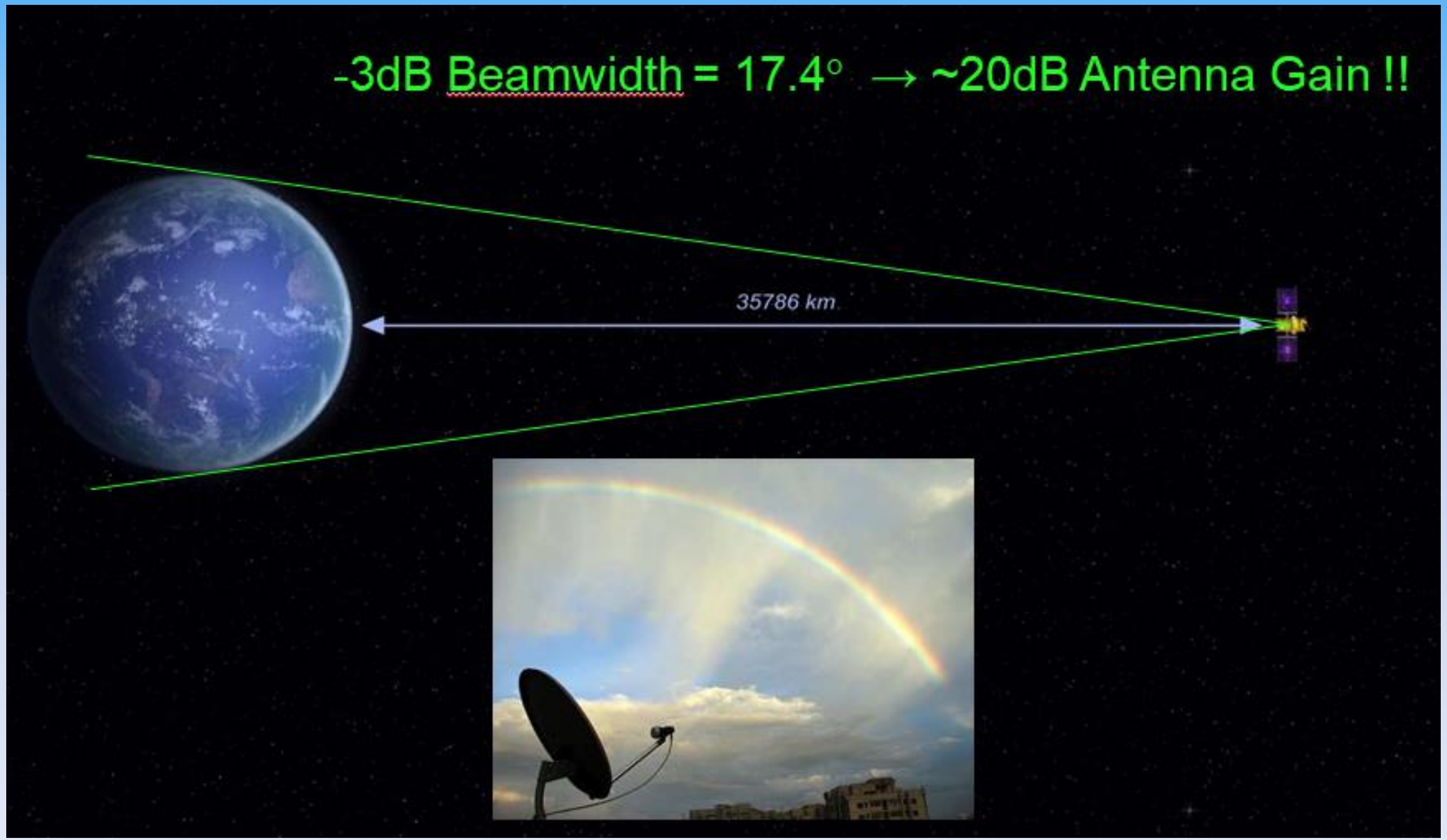
Orbits and coverage

- 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

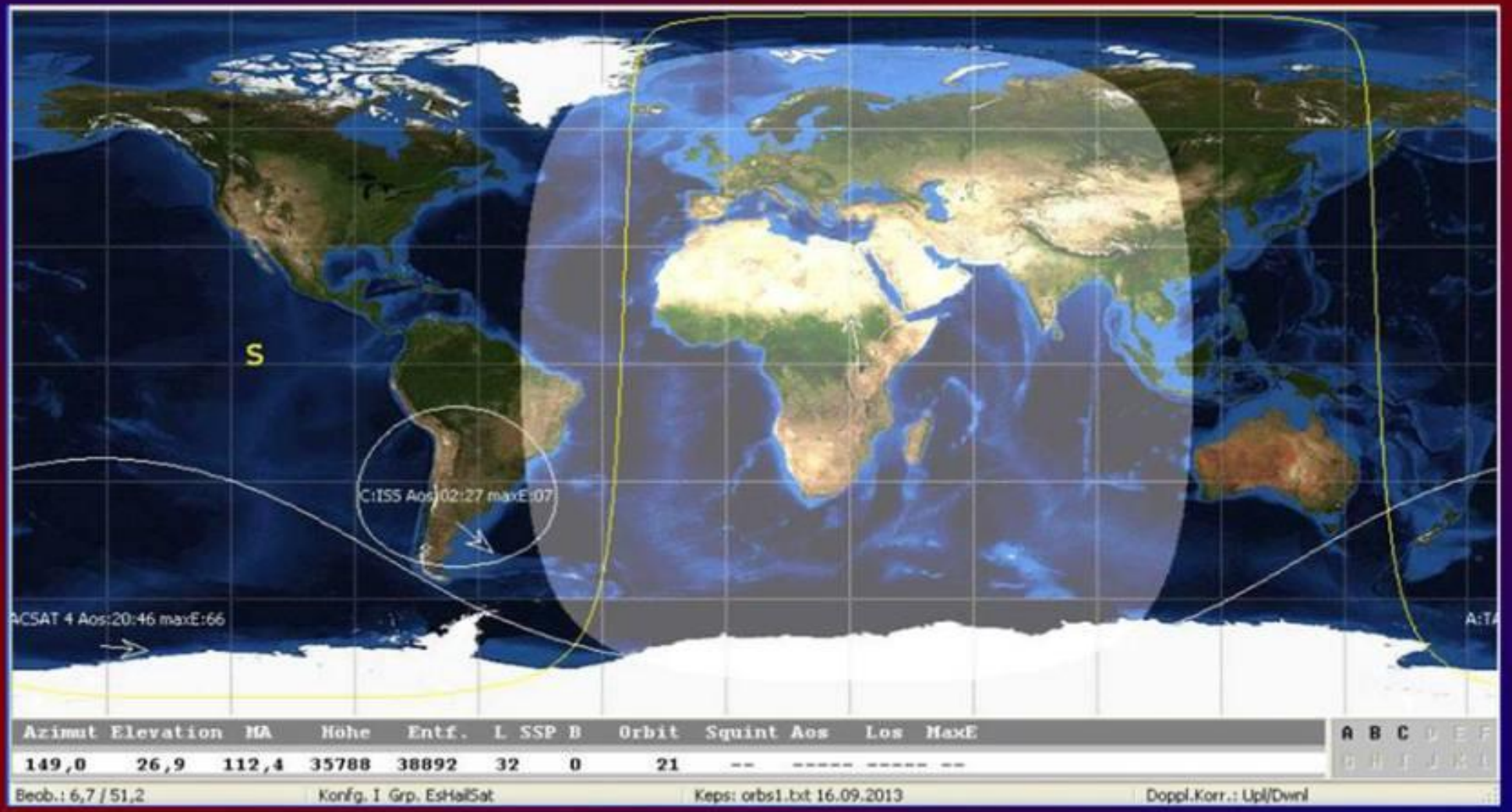
36,000 Km altitude



AMSAT-DL

Satellites for Communication and Science
Satelliten für Kommunikation und Wissenschaft

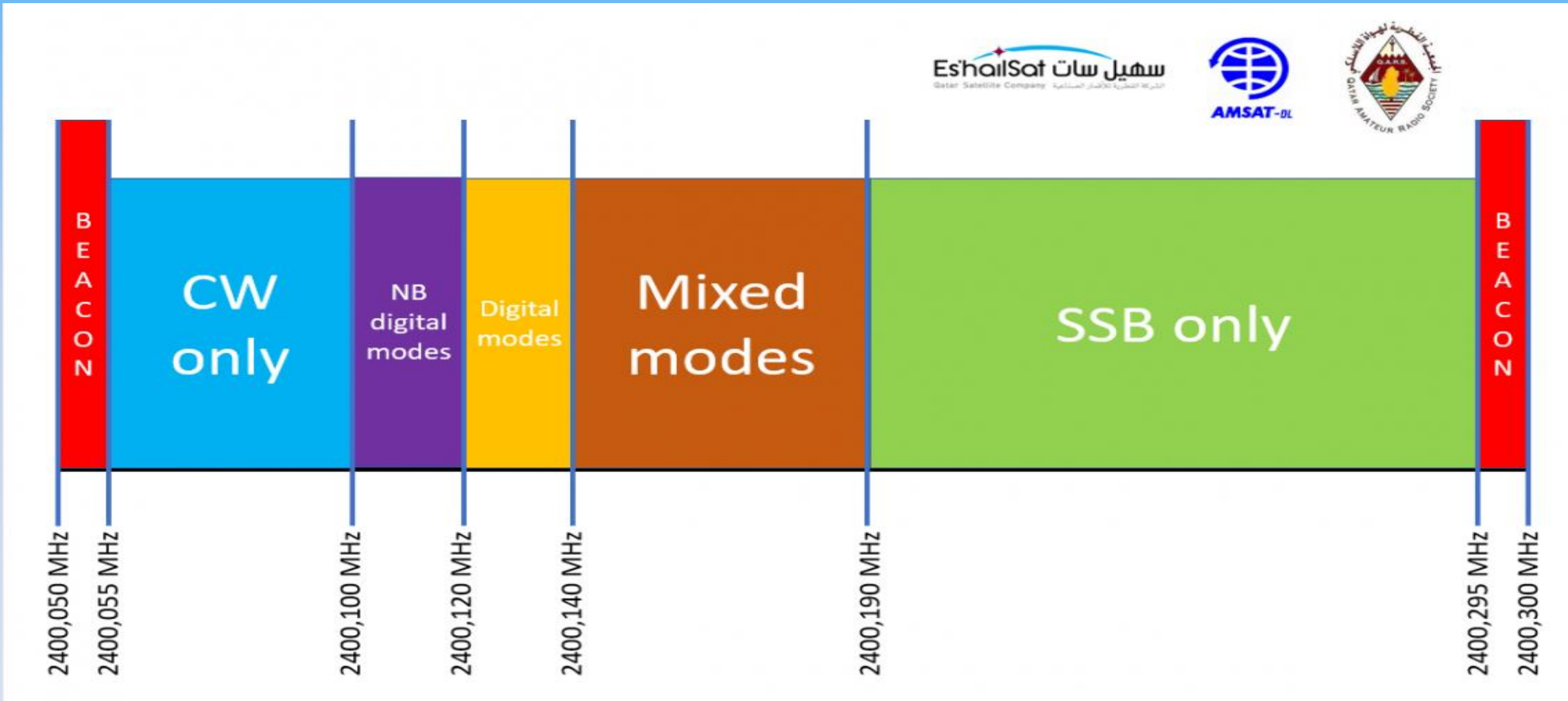
Earth Coverage Es'HailSat-2



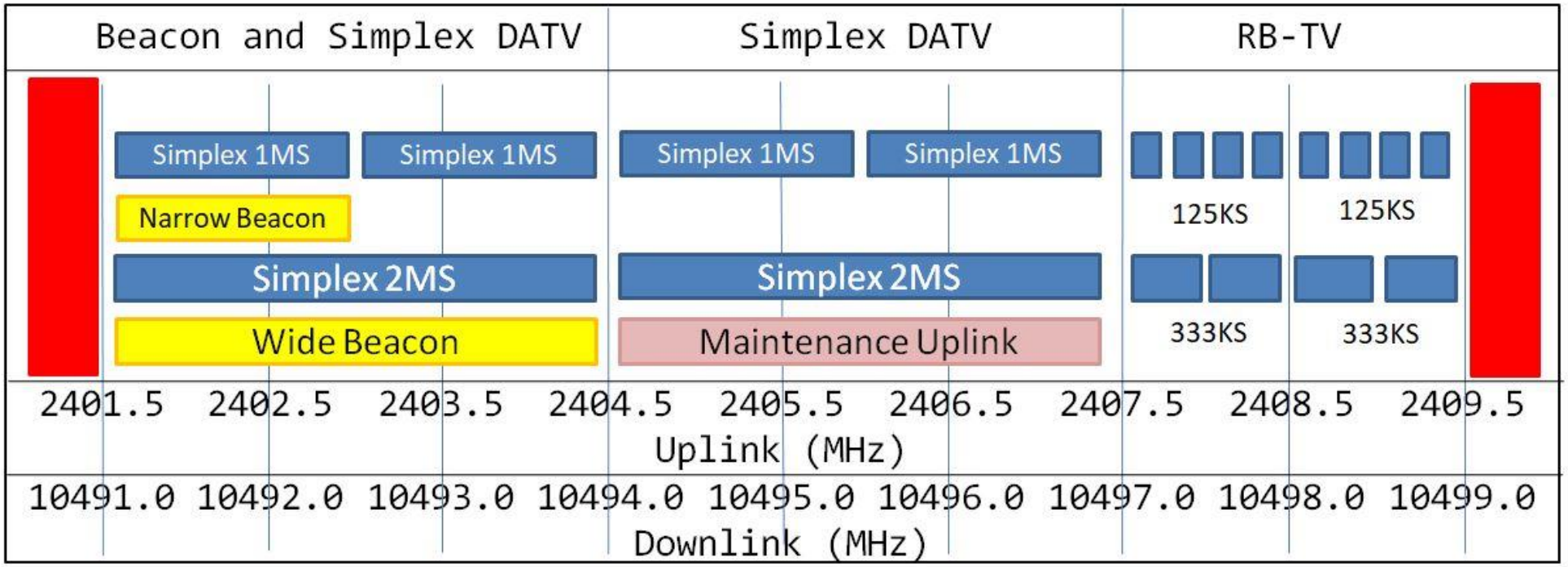
What is on Oscar100?

- 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

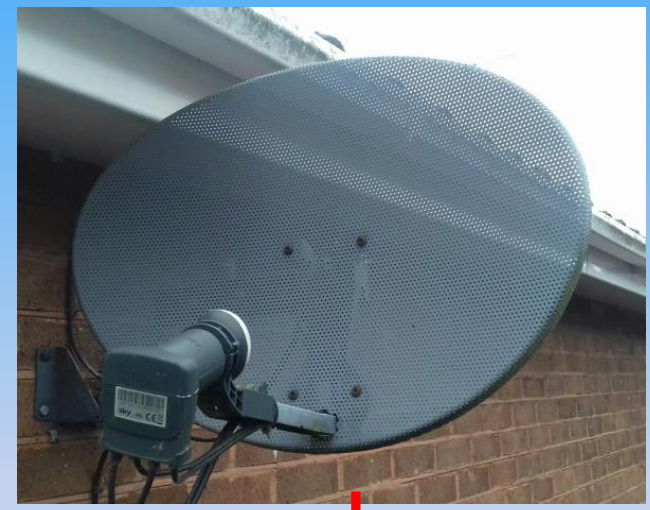


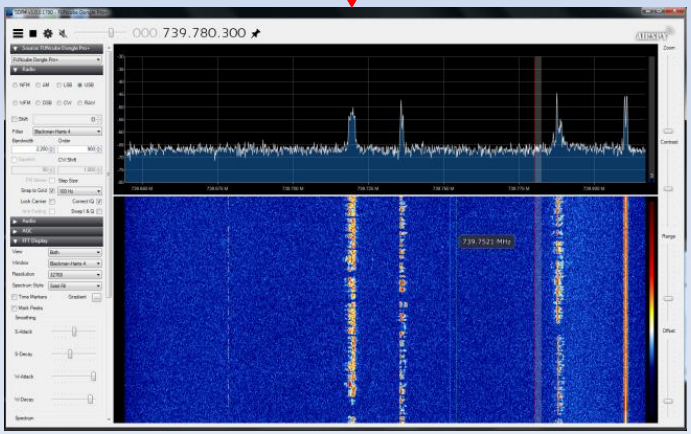
How do I get started?

- 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?

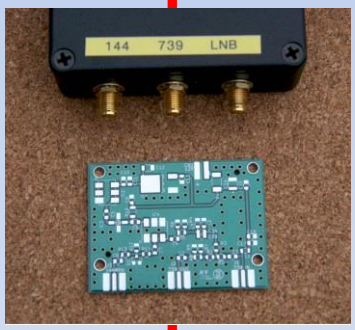
- Yes!
- A simple NB rx system is:
  - Sky dish
  - New PLL LNB
  - ~ £10 RTL dongle or Funcube, LimeSDR or Pluto
- Bias Tee to supply 12v
- Free SDR software
  - SDR#
  - SDR Console
- Tune to the IF frequency of 739 MHz





Can I use a VHF / UHF rig?

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

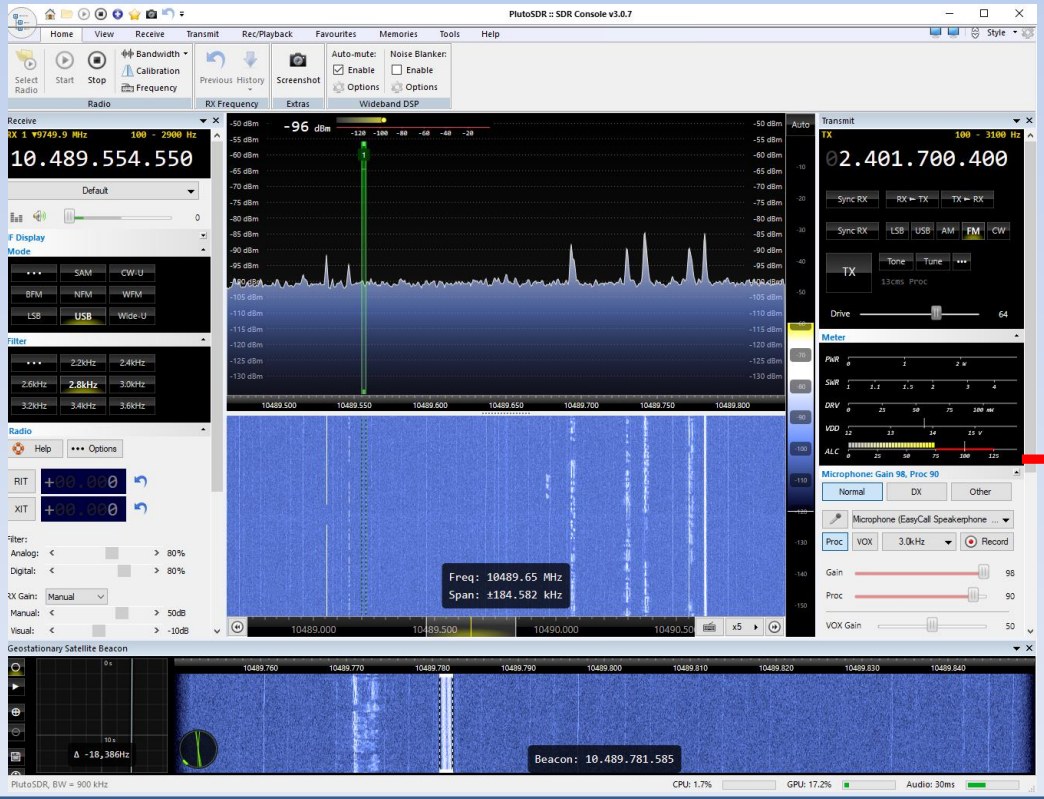


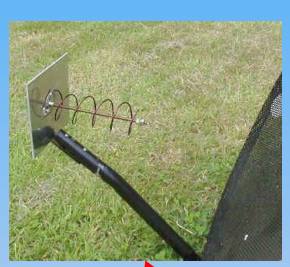
NB Transmitting - 1

- 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



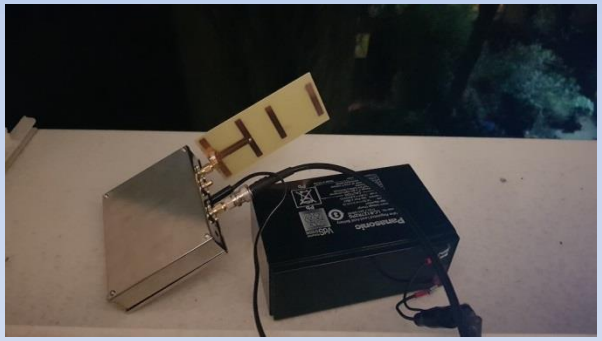


NB operation

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

- PA3WEG
  - 1 watt to a PCB quad patch

- DL7NX
  - 1 watt to 4 ele PCB Yagi.



Oscar 100 Wideband

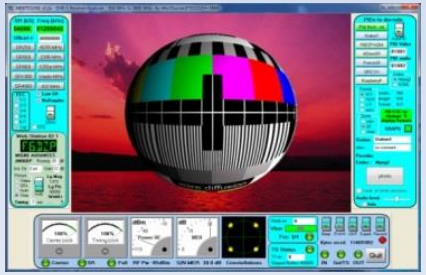
- Oscar 100 wideband is an “8 MHz bent pipe” transponder for wideband digital use
- Occupied bandwidths can be 200 kHz – 8 MHz
- Most signals are <1MHz wide
- Some experiments below 100Khz
- DVB-S2 with H264 / H265 video

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

MiniTiouner 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/



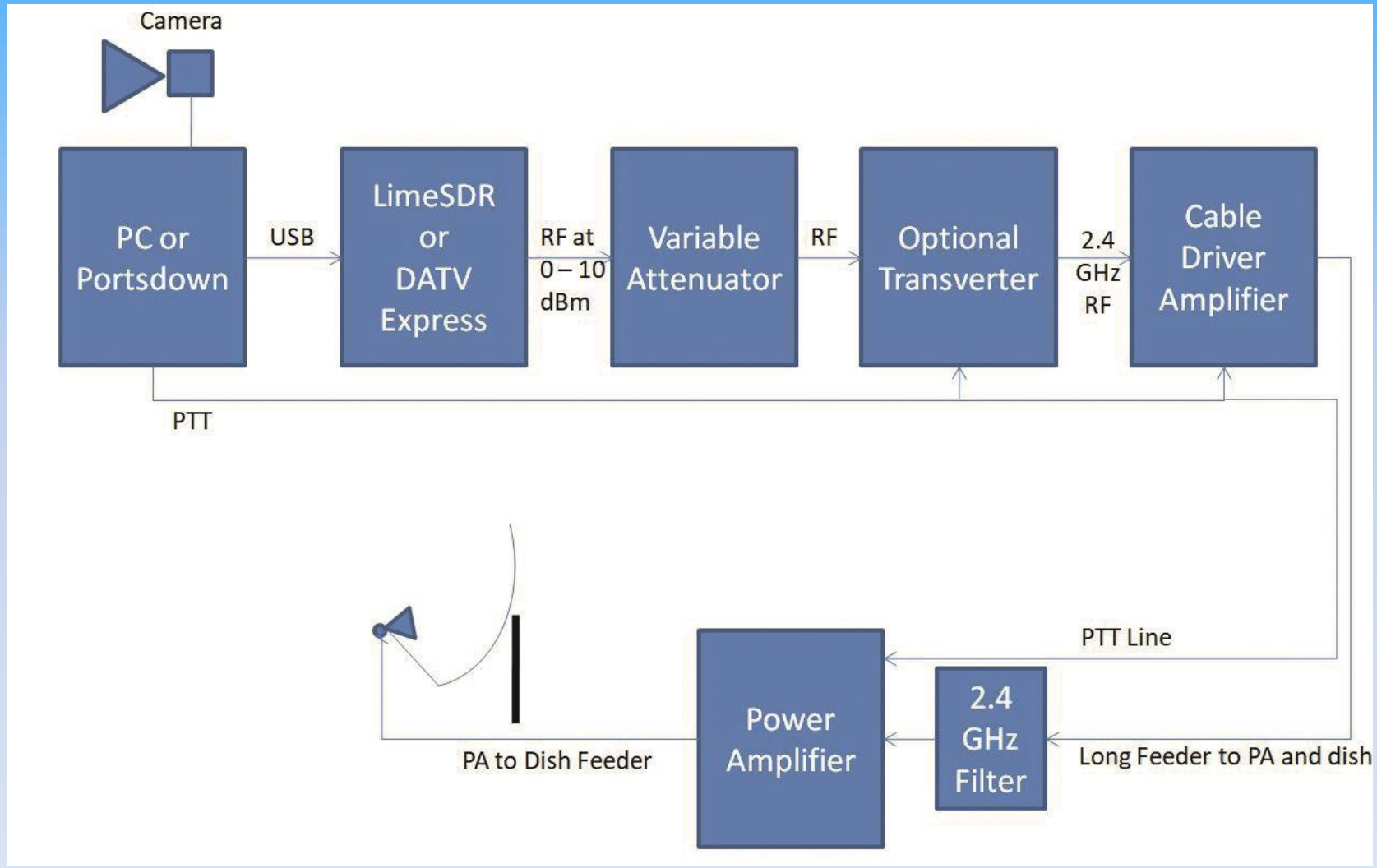
Receiving DATV

- 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

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

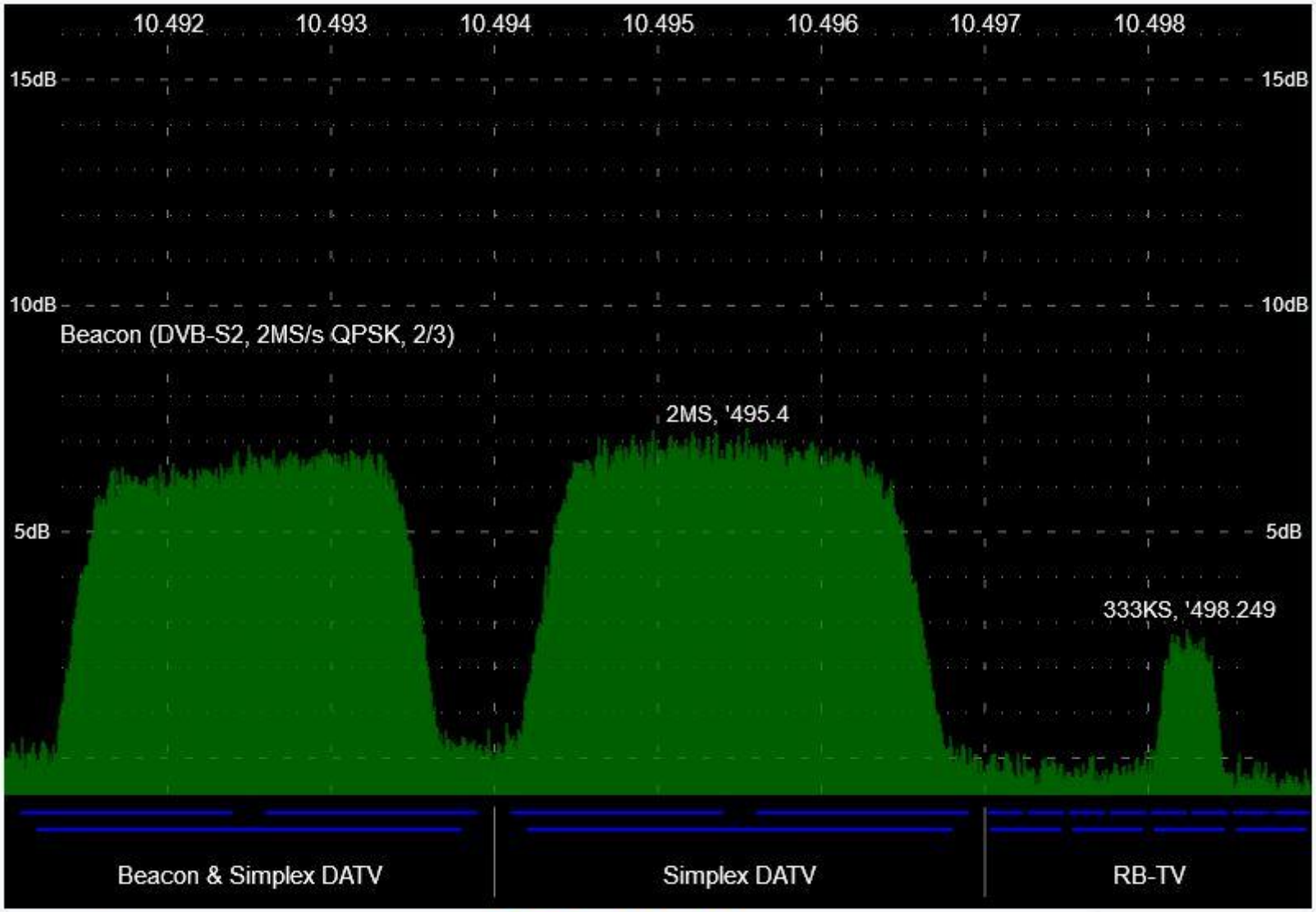
DATV transmit system



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

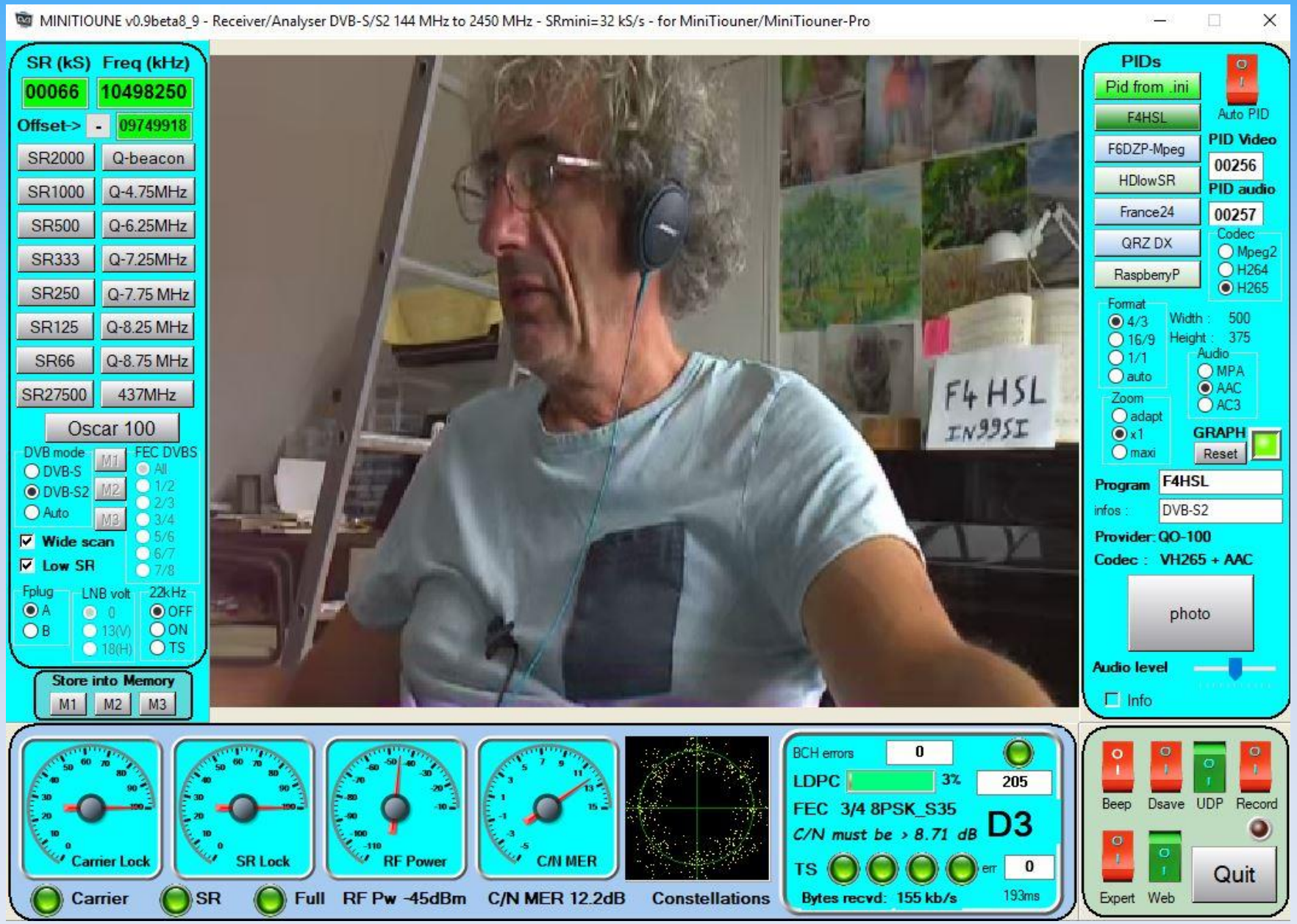


Users: 149

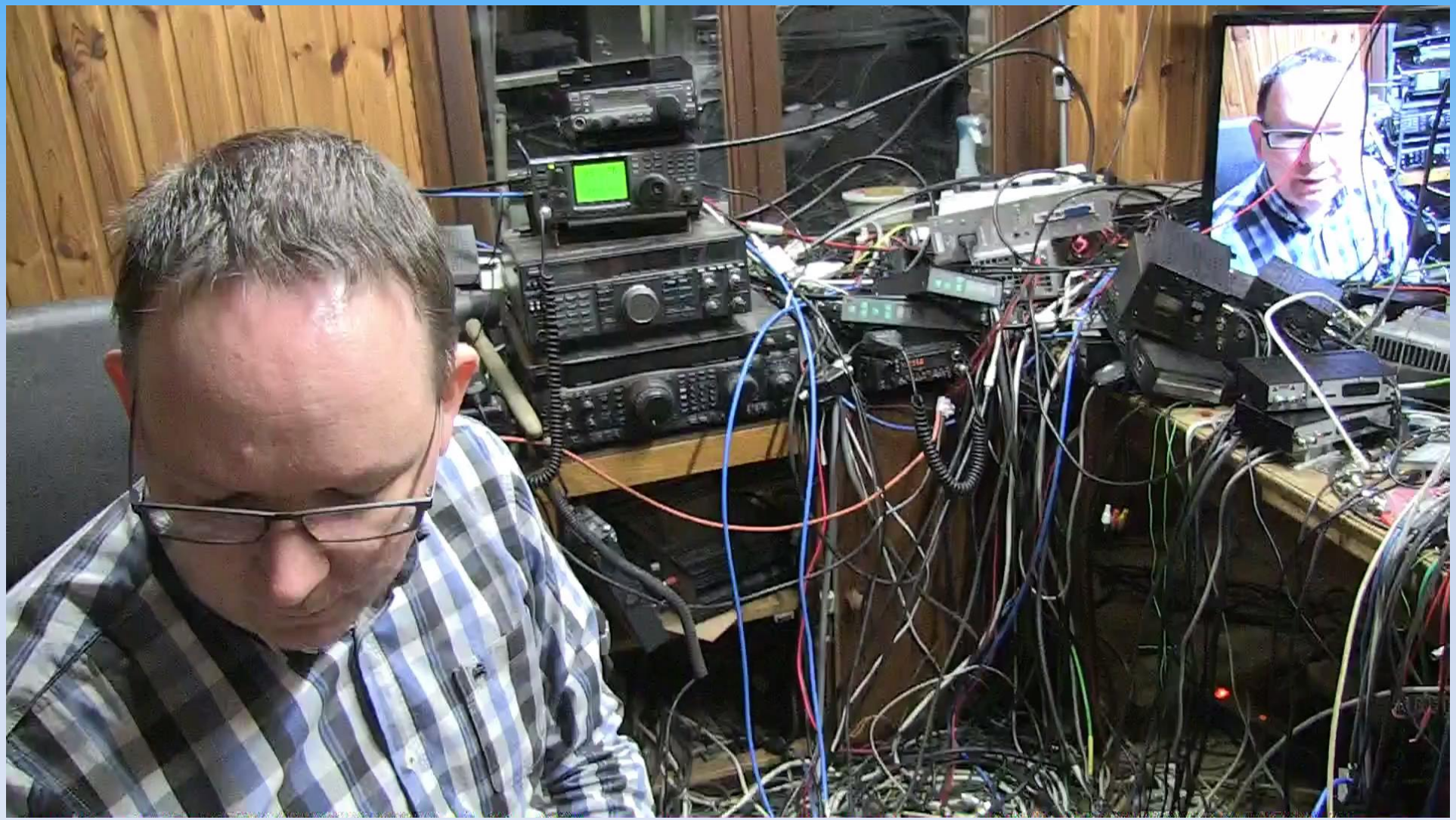
DATV Bandplan Link

Open fullscreen

F4HSL ~ 80KHz!

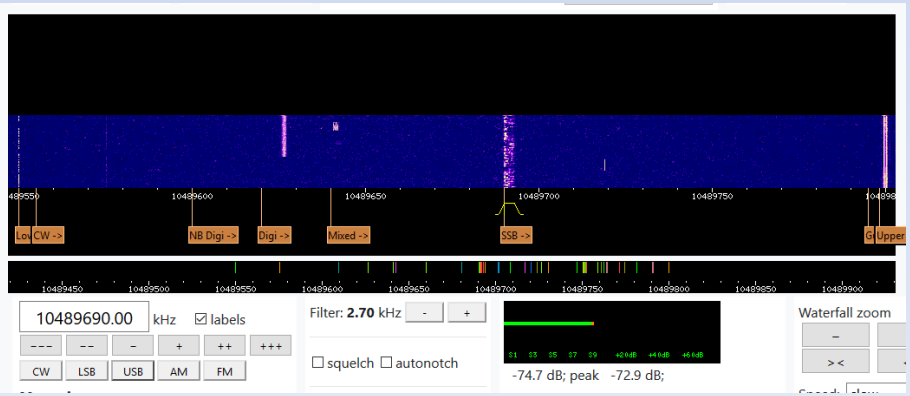

MINITIOUNE v0.9beta8_9 - Receiver/Analyser DVB-S/S2 144 MHz to 2450 MHz - SRmini=32 kS/s - for MiniTiouner/MiniTiouner-Pro
SR (kS) Freq (kHz)
00066
10498250
Offset->
09749918
SR2000
Q-beacon
SR1000
Q-4.75MHz
SR500
Q-6.25MHz
SR333
Q-7.25MHz
SR250
Q-7.75 MHz
SR125
Q-8.25 MHz
SR66
Q-8.75 MHz
SR27500
437MHz
Oscar 100
DVB mode
DVB-S
DVB-S2
Auto
M1
M2
M3
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
F4 HSL
IN99SI
PIDs
Pid from .ini
F4HSL
F6DZP-Mpeg
HDlowSR
France24
QRZ DX
RaspberryP
Auto PID
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: QO-100
Codec : VH265 + AAC
photo
Audio level
Info
Carrier Lock
SR Lock
RF Power
C/N MER
Carrier
SR
Full
RF Pw -45dBm
C/N MER 12.2dB
Constellations
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
Expert
Web
Quit

ON4BHM ~ 2MHz



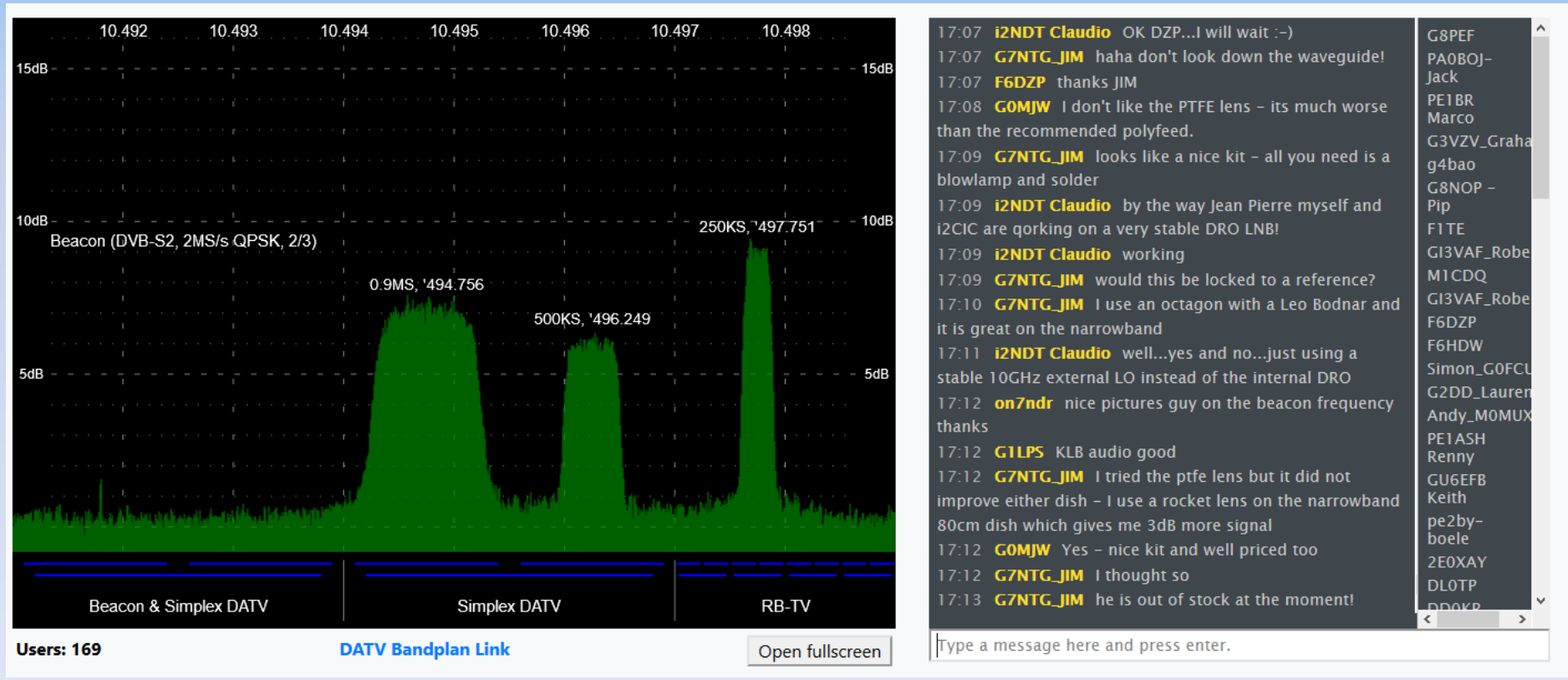
The WebSDR

- 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



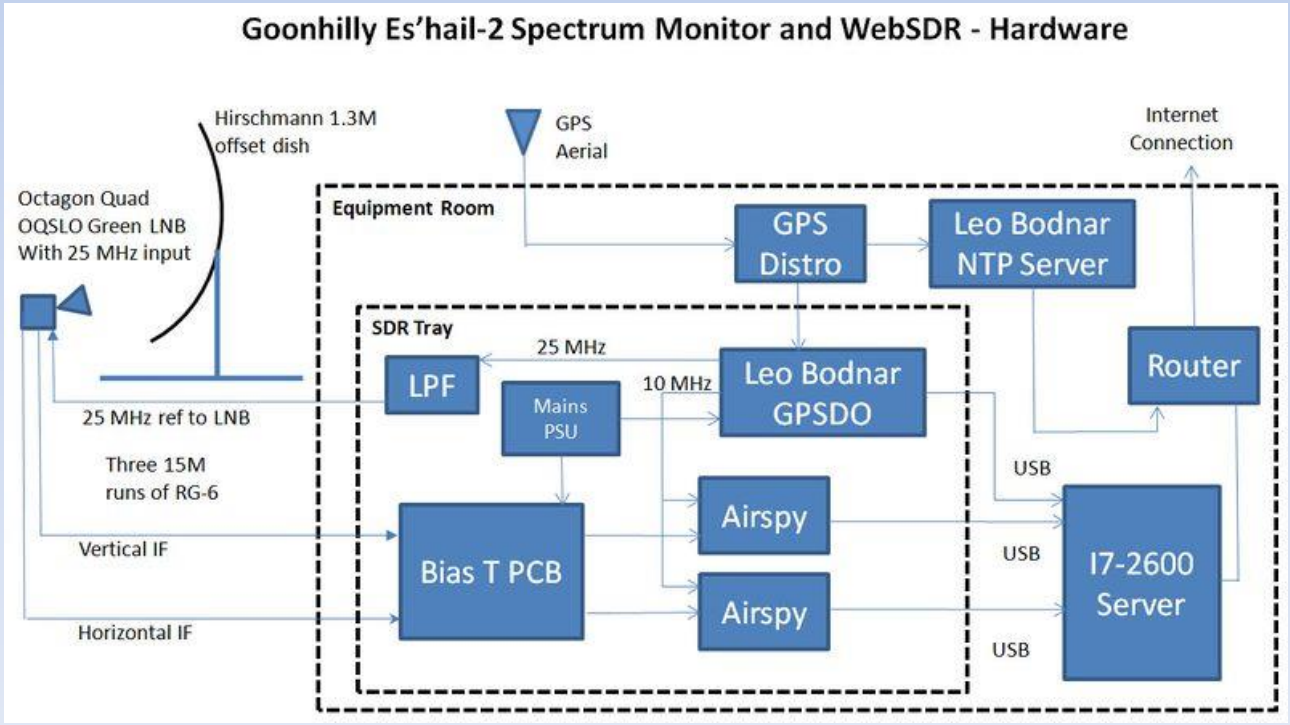
Spectrum Monitor

- An essential tool to enable the Wide Band transponder usage



BATC + AMSAT-UK SDR

- Located at Goonhilly Earth Station
  - Quiet secure location (IO70JB)
  - Excellent network connectivity
  - Scaled for 500+ users

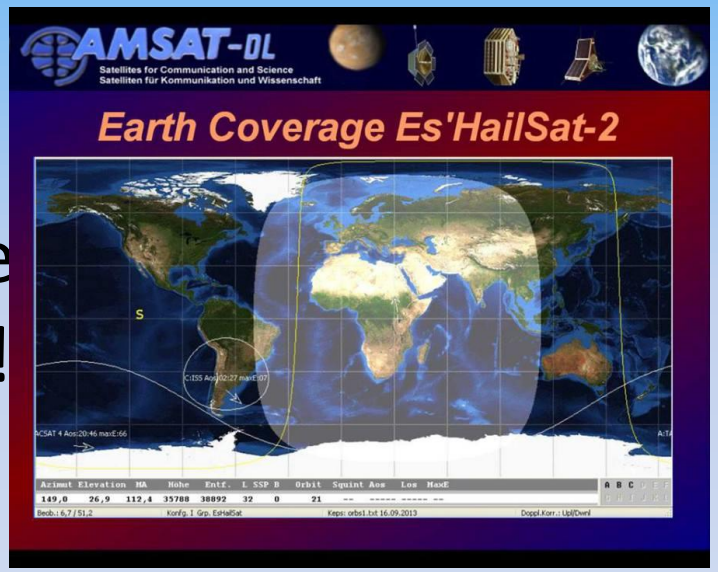


Is it really amateur radio?

- 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 1/3rd 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
  - More than 150 systems around the world
- https://eshail.batc.org.uk/nb/
- Wideband spectrum monitor
  - https://eshail.batc.org.uk/wb/