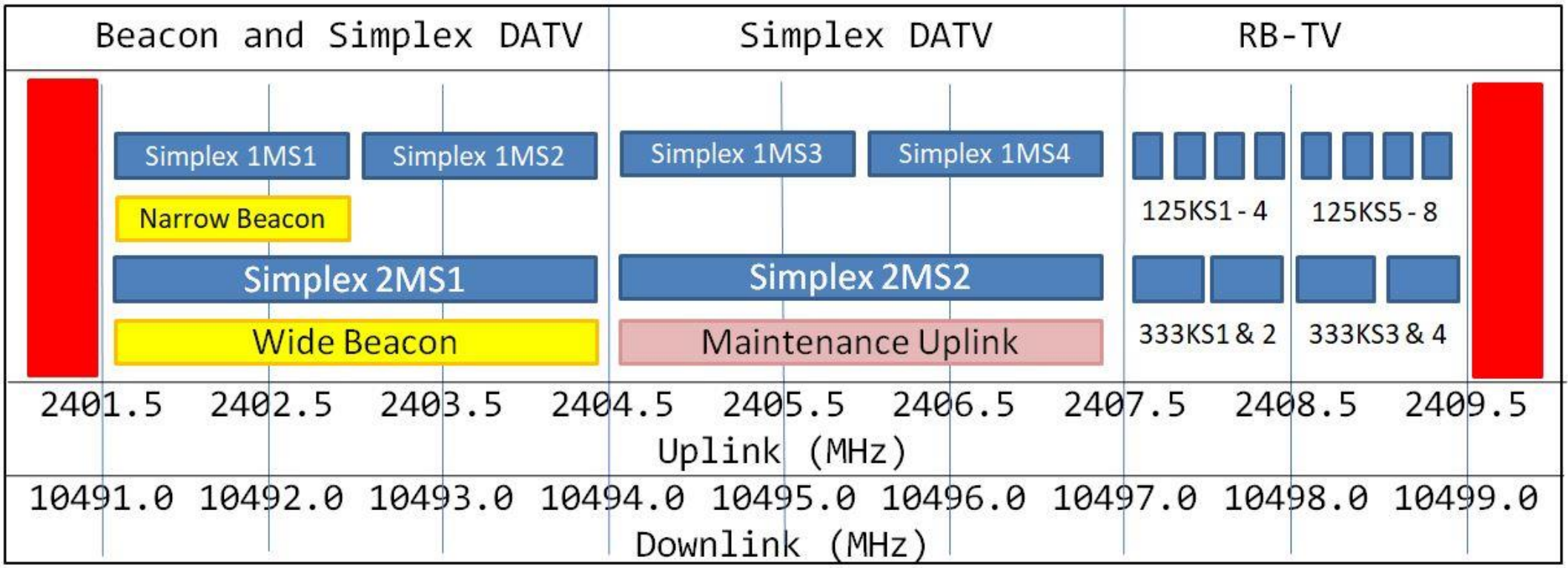
DATV in Space
Oscar 100 Wideband

Noel Matthews G8GTZ

Oscar 100 Wideband

- Oscar 100 wideband is an “8 MHz bent pipe” transponder for wideband digital use
- Currently just DATV use
- Occupied bandwidths can be ~100 kHz – 2 MHz
- Most signals are <1MHz wide
- Some experiments below 100Khz
- DVB-S2 with H264 / H265 video

Band Plan


Beacon and Simplex DATV
Simplex DATV
RB-TV
Simplex 1MS1
Simplex 1MS2
Simplex 1MS3
Simplex 1MS4
Narrow Beacon
125KS1 - 4
125KS5 - 8
Simplex 2MS1
Simplex 2MS2
Wide Beacon
Maintenance Uplink
333KS1 & 2
333KS3 & 4
2401.5 2402.5 2403.5 2404.5 2405.5 2406.5 2407.5 2408.5 2409.5
Uplink (MHz)
10491.0 10492.0 10493.0 10494.0 10495.0 10496.0 10497.0 10498.0 10499.0
Downlink (MHz)

Band Plan

2403.000	433.750	10492.500	742.500	2MS-1
2406.000	438.000	10495.500	745.500	2MS-2
2405.250	437.250	10494.750	744.750	1MS-1
2406.750	438.750	10496.250	746.250	1MS-2
2407.750	439.750	10497.250	747.250	333Ks-1
2408.250	440.250	10497.750	747.750	333ks-2
2408.750	440.750	10498.250	748.250	333Ks-3
2409.250	441.250	10498.750	748.750	333Ks-4
2407.625	439.625	10497.125	747.125	125Ks-1
2407.875	439.875	10497.375	747.375	125Ks -2
2408.125	440.125	10497.625	747.625	125Ks-3
2408.375	440.375	10497.875	747.875	125Ks-4
2408.625	440.625	10498.125	748.125	125Ks-5
2408.875	440.875	10498.375	748.375	125Ks-6
2409.125	441.125	10498.625	748.625	125Ks-7
2409.375	441.375	10498.875	748.875	125Ks-8
2409.875	441.875	10499.375	749.375	Band Edge

- Bottom 3Mhz of the transponder is 2Ms beacon
- The middle 3MHz can be one 2Ms or two 1Ms
- The top 2Mhz can be four 333ks or eight 125Ks

Rxing DATV

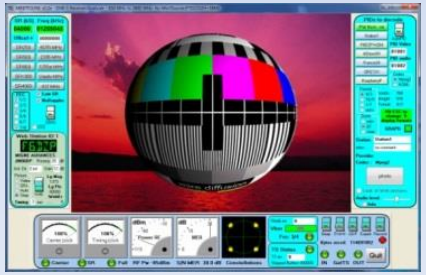
- Downlink frequency is 10,491 – 10,499 MHz and within pass band of standard consumer LNB ☺
- DATV transponder is Horizontal (18v)
- PLL LNBs must be used to give stability for RB-TV below 1 Msymbol/sec
  - Octagon / Goodbay PLL LNB < £25 on ebay
  - Locking can cause phase noise problems
- However 9,750 MHz LO puts IF outside consumer set top box tuning ☹
  - 10,491 MHz – 9,750 MHz = 741 MHz
  - Standard STB range = 950 – 2,150 MHz

Receive Solutions

- Move the local oscillator by using a modified LNB with 9GHz LO
  - Will work but not suitable for RB-TV due to stability of “pulled” DRO oscillator
- Up-convert signal to L Band
  - AMSAT DL have a design in shop
  - Other designs available
- Both solutions enable use of consumer STB
  - Needs to be “Modern”
  - DVB-S and DVB-S2 with MPEG-2 and MPEG-4
  - You will receive the 2Ms beacon
  - But not RB-TV signals below 1 Msymbol / sec ***

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/



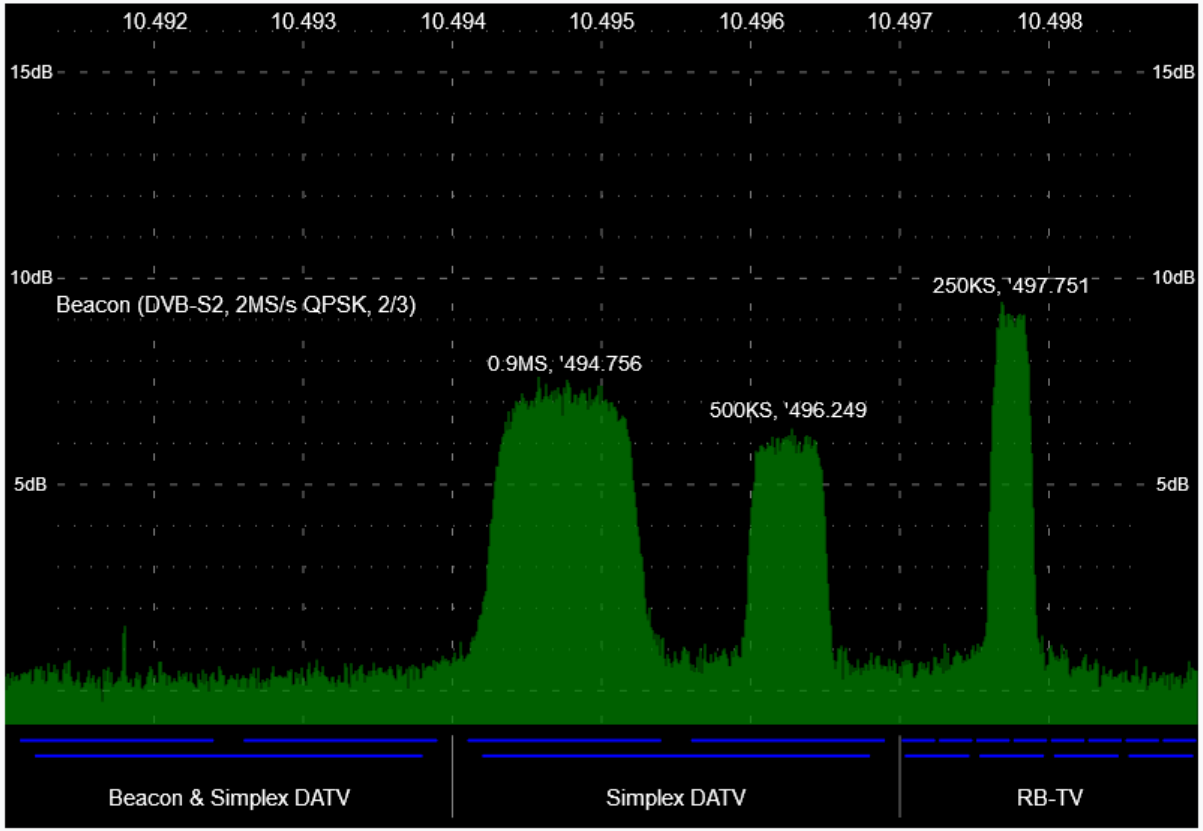
To lock LNB or not?

- Narrow band = Yes
  - Unless you run SDR console
- Wide band = No
- PLL LNBs should be used to give stability for Reduced Bandwidth TV signals
  - But locking can increase phase noise
  - Phase noise is very critical for DVB-S

Choice and Co-ordination

- DATV receivers need to know basic info about the signal they are receiving
  - Modulation, symbol rate and possibly FEC
- With so many modes and bandwidth combinations possible simultaneously we need co-ordination
- BATC has built a Ground station rxr
  - web-based spectrum monitor and analysis tool
  - Real time signal parameter analysis to give approximate SR
- Include a chat window for co-ordination between stations and general information exchange
- An essential tool to enable the Wide Band transponder usage

BATC
Spectrum Monitor



Users: 169 DATV Bandplan Link Open fullscreen

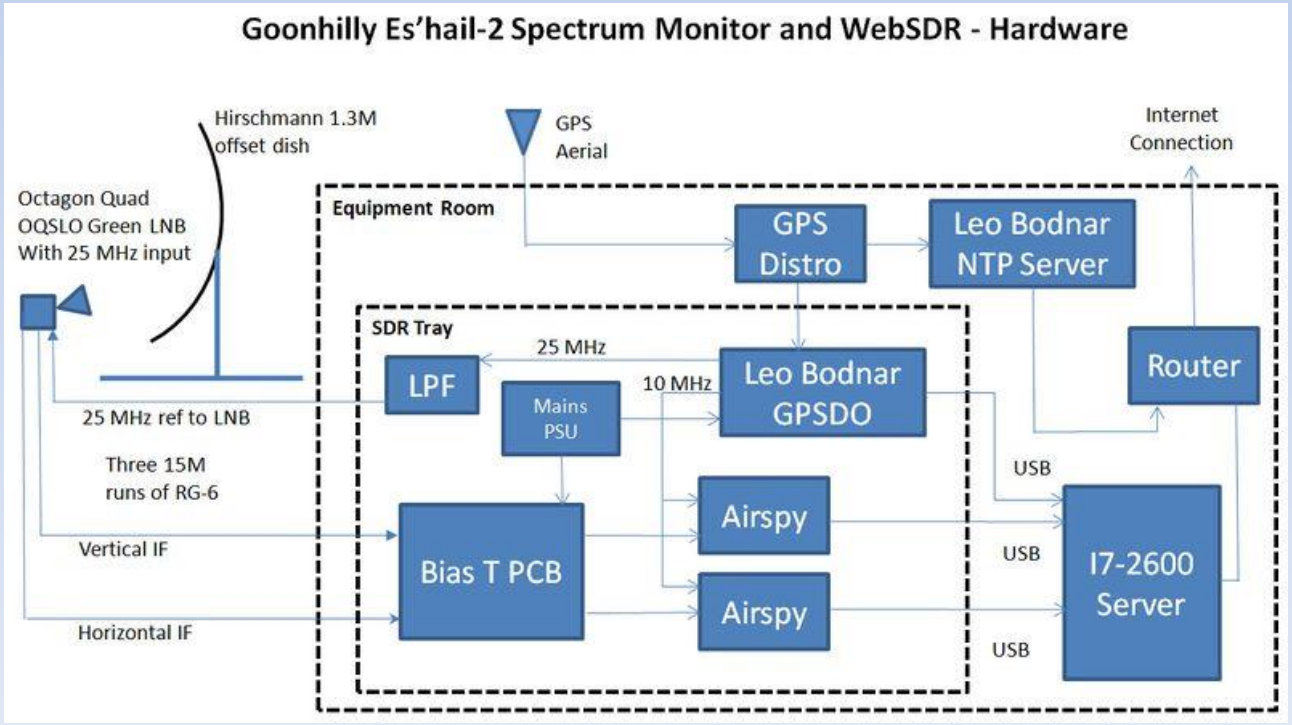
17:07 **i2NDT Claudio** OK DZP...I will wait :-)
17:07 **G7NTG_JIM** haha don't look down the waveguide!
17:07 **F6DZP** thanks JIM
17:08 **G0MJW** I don't like the PTFE lens - its much worse than the recommended polyfeed.
17:09 **G7NTG_JIM** looks like a nice kit - all you need is a blowlamp and solder
17:09 **i2NDT Claudio** by the way Jean Pierre myself and i2CIC are qorking 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 ptfe 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!

G8PEF
PA0BOJ-Jack
PE1BR Marco
G3VZV_Graha
g4bao
G8NOP - Pip
F1TE
GI3VAF_Robe
M1CDQ
GI3VAF_Robe
F6DZP
F6HDW
Simon_G0FCU
G2DD_Lauren
Andy_M0MUX
PE1ASH Renny
GU6EFB Keith
pe2by-boele
2E0XAY
DL0TP

Type a message here and press enter.

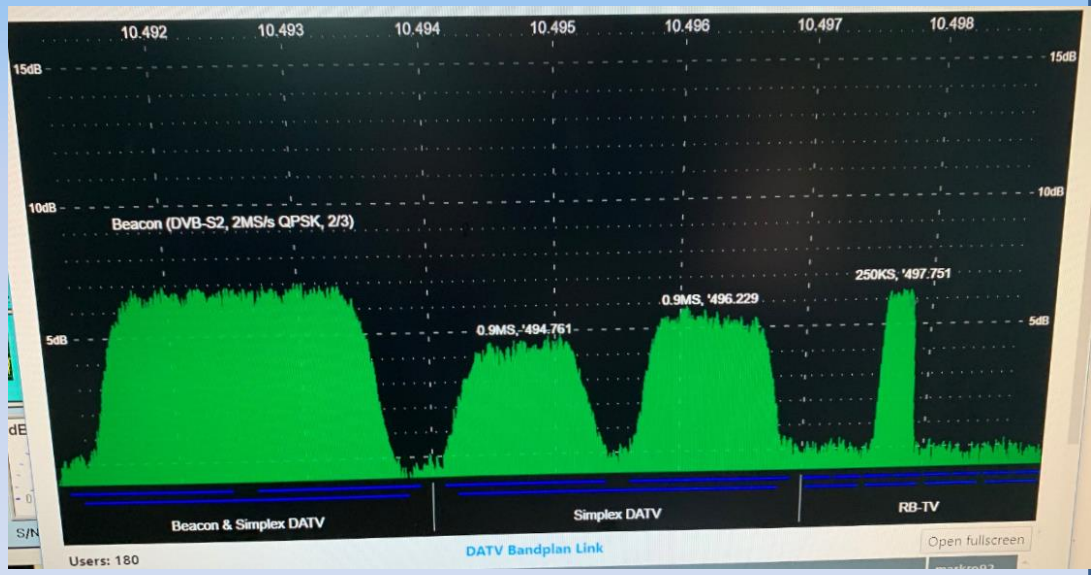
BATC Ground Station

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



So what's on there?

- Normally a 2Ms beacon playing a loop video about Es'hail-2****
- Most signals are less than 1Ms
- 333Ks most common
- Some stations have tried 88Ks or even 32Ks!
- DVB-S2 is preferred
  - 2dB more margin
- G, PA, D, ON, HB, CT, EA, SV, OE,



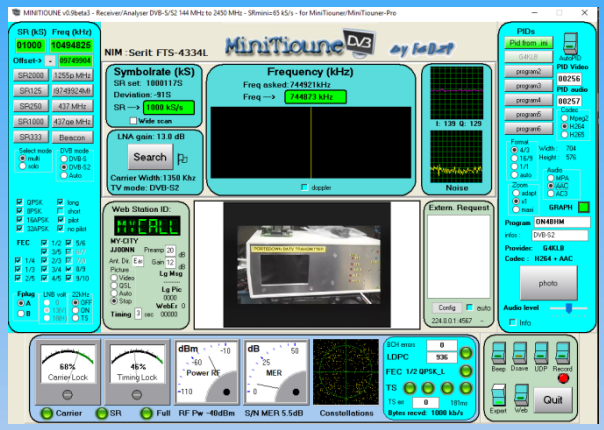
Receiving in practice

- Aim for a 1mt dish
- Check your dish direction using
  - https://www.dishpointer.com/
- Align using BADR-4 TV services
  - 12,597 (or 2246) MHz, 27500Ms, Horiz
  - ~11dB MER
- Check the WB beacon
  - 2Ms DVB-S2

- More details: https://wiki.batc.org.uk/Receiving_Oscar_100_DATV_signals

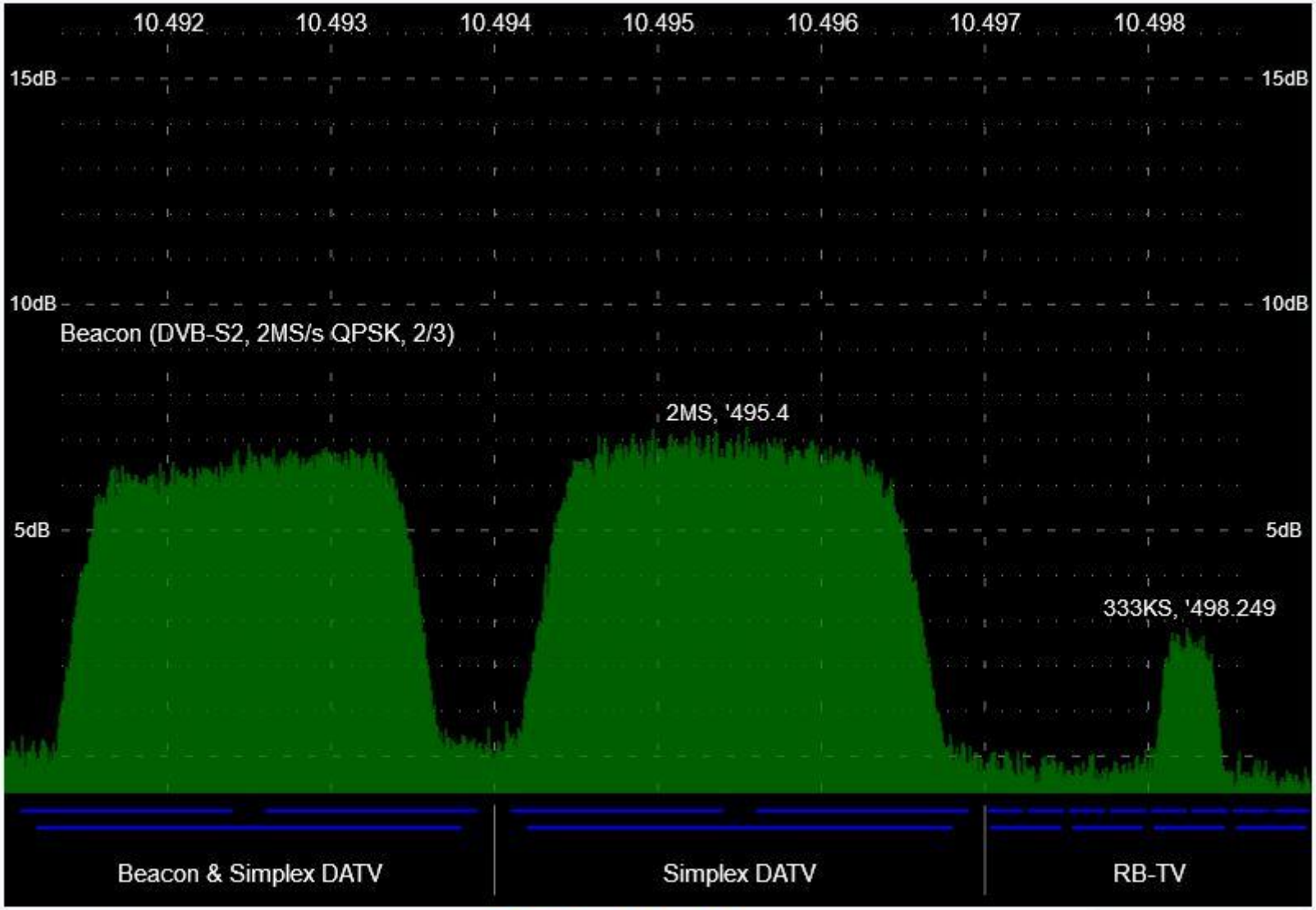
Dish size	Recieved MER
1.8m	10dB
1.2m	8dB
1m	6dB
80cm	5dB

Receiving RB-TV



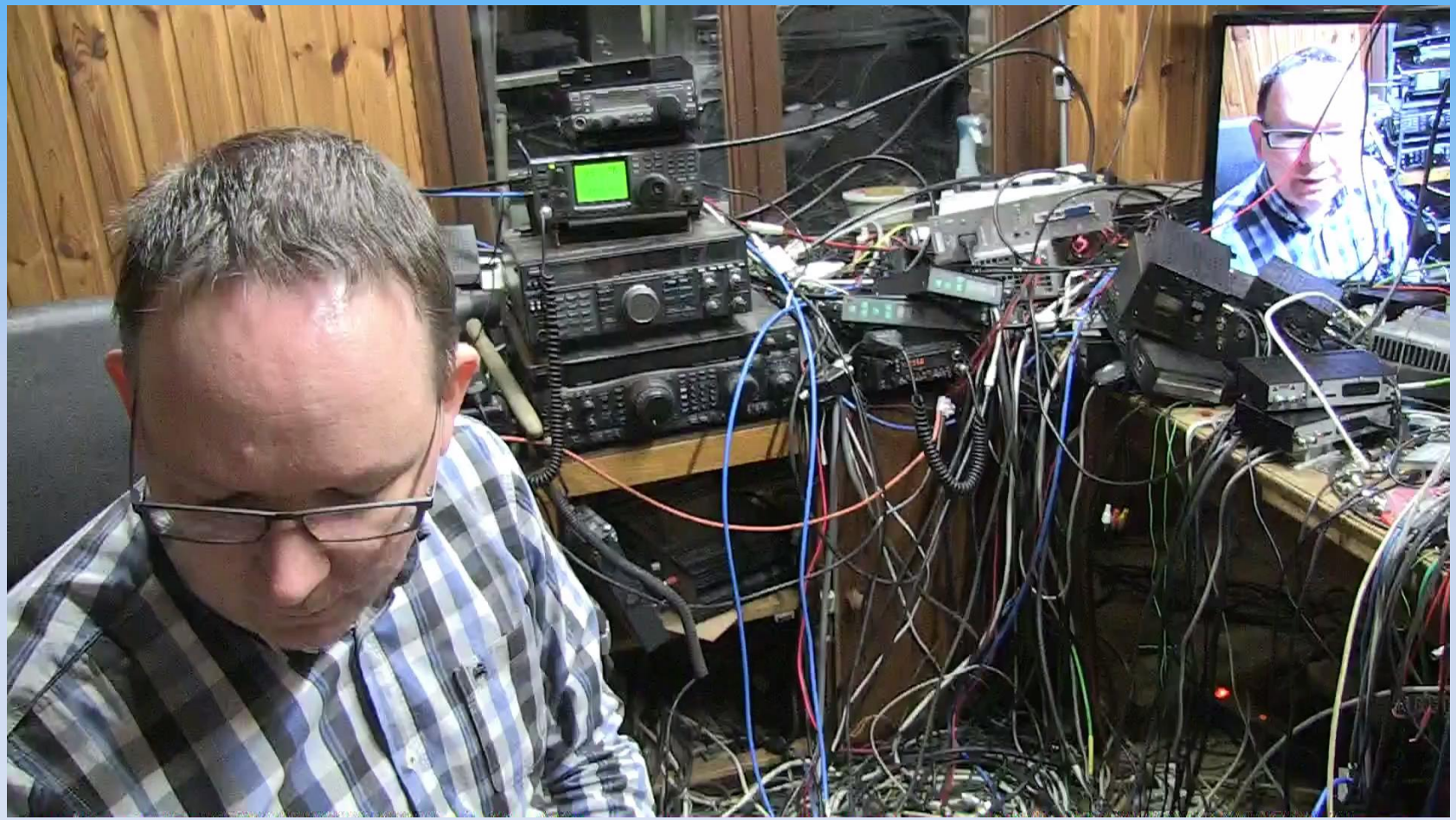
- 80% of signals on Oscar 100 are >1Ms
- Most are 125 – 500Ks
- Some are 66Ks and 88Ks
- To receive really narrow RB-TV you need to check your LNB frequency
- Latest version of MiniTiuner allows you to “adapt” your offset
- Tune to the beacon – press “adapt offset” – tick “keep”
- This will change the offset value in your ini file.

3 signals


10.492
10.493
10.494
10.495
10.496
10.497
10.498
15dB
15dB
10dB
10dB
Beacon (DVB-S2, 2MS/s QPSK, 2/3)
2MS, '495.4
5dB
5dB
333KS, '498.249
Beacon & Simplex DATV
Simplex DATV
RB-TV
Users: 149
DATV Bandplan Link
Open fullscreen

G4EML – 250Ks

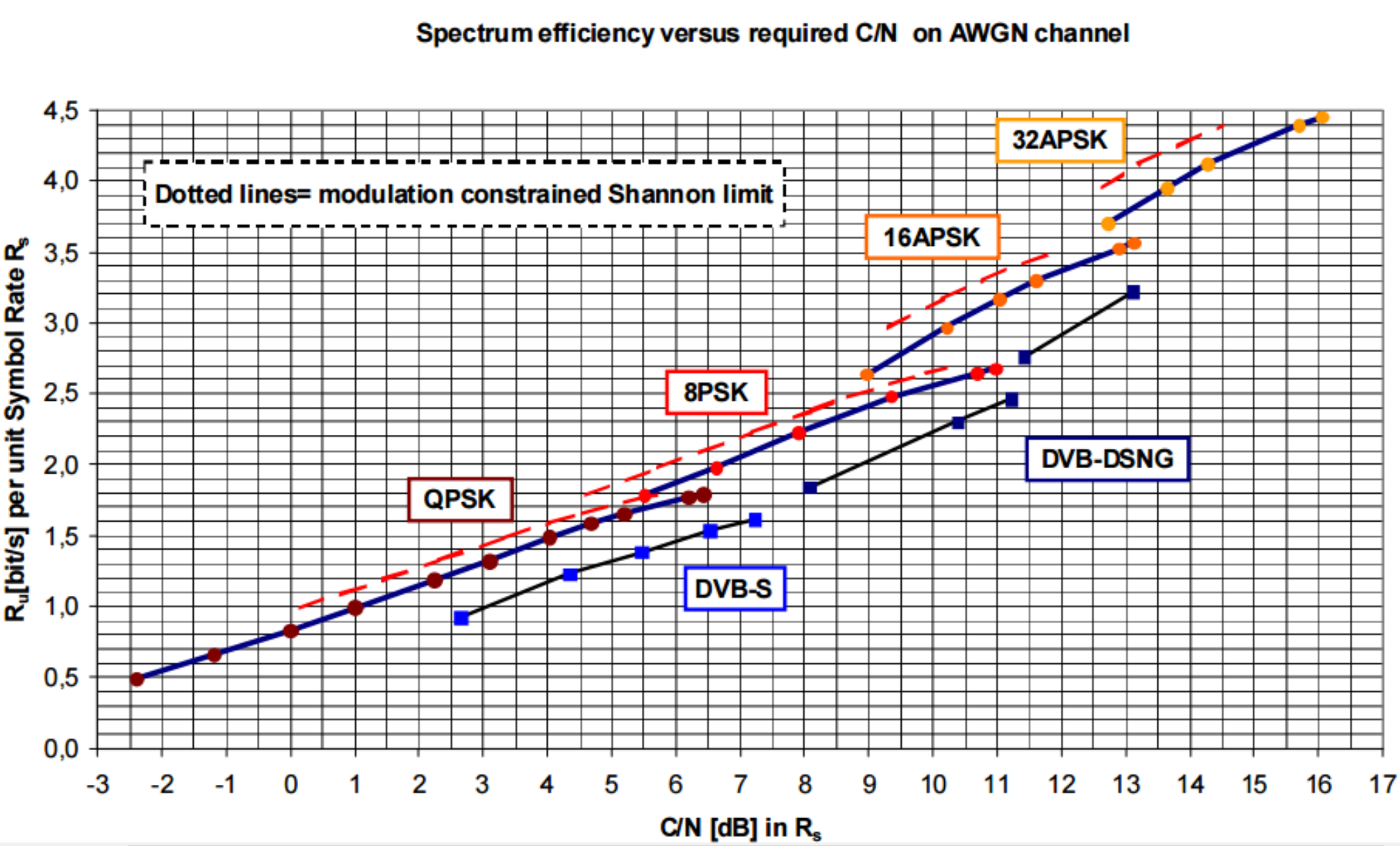
ON4BHM – 2Ms



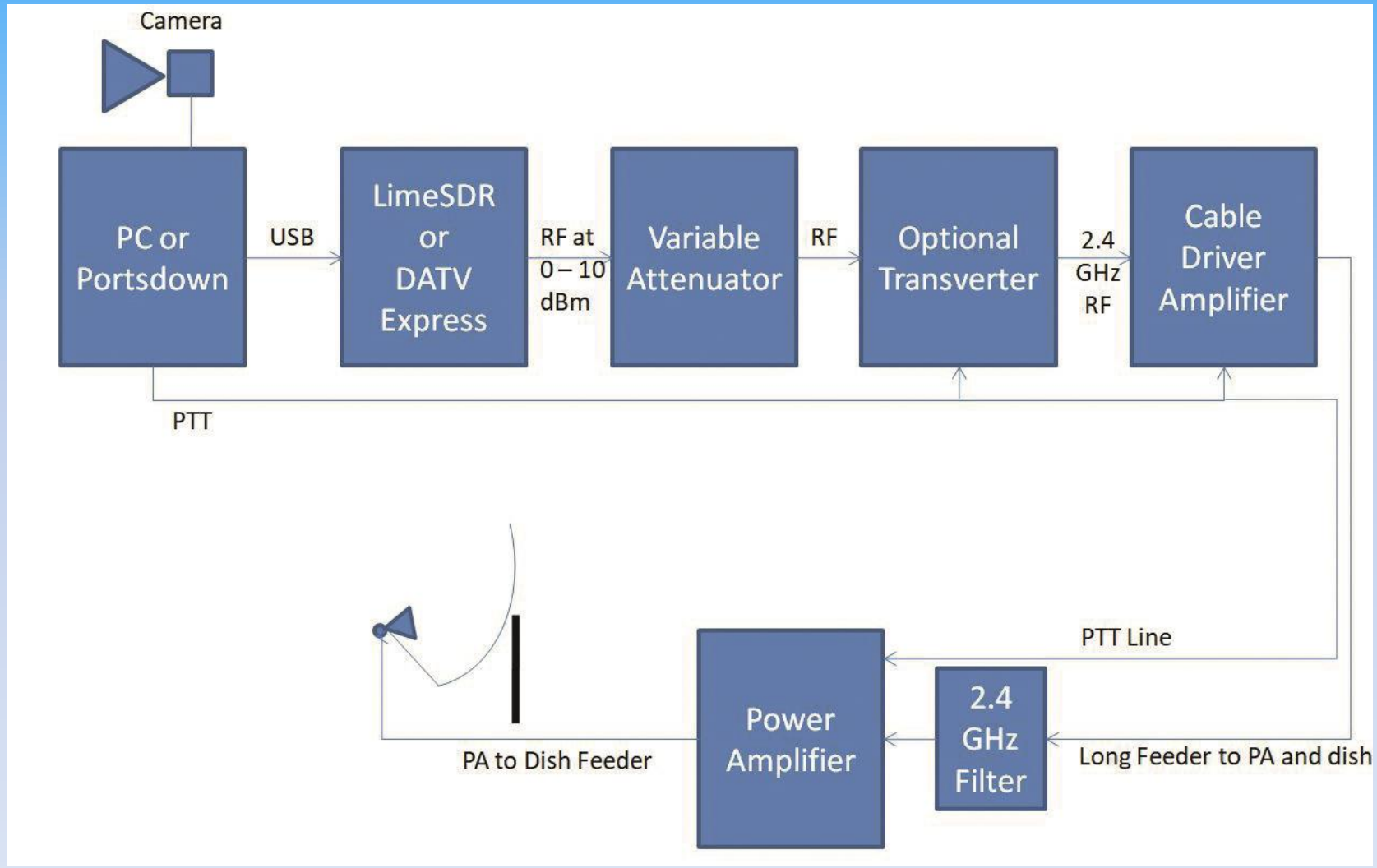
Transmit / Uplink

- Uplink band is 2,401.5 – 2,409.5 MHz = Secondary allocation = WiFi Channel 1(2412)
- Duplex is easy!
- ~30 watts in to a 1.2mt dish
- PA at dish and VERY short feeder
  - Offset dish is easier to manage
- DVB-S2 is preferred as it gives an extra 2 dB

Why DVB-S2?


Spectrum efficiency versus required C/N on AWGN channel
Dotted lines= modulation constrained Shannon limit
32APSK
16APSK
8PSK
QPSK
DVB-DSNG
DVB-S
R_u[bit/s] per unit Symbol Rate R_s
C/N [dB] in R_s
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
-3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Typical tx system



TX Option 1: Up-convert

- Generate DATV signal at lower frequency and up convert - possibly from 437 MHz?
  - Use standard encoder/modulator Portsdown 2018, DTX1, SR systems or ex-broadcast
  - There will work but due to tight uplink margins it really needs to be H264 and DVB-S2 capable
  - But give it a go!

- Up-converter options:
  - Use narrow-band 13cms up-converter
    - 80 MHz away from 13cms terrestrial NB section
  - Kuhne KU UP 2325 A up-converter
  - DU700

TX -generate at 2400

- Portsdown 2019
  - All you need is a Rpi, touch screen and LimeSDR Mini
- DATV Express s/w
  - Will drive Pluto, Lime and DATVexpress card
- All solutions are low power and will require amplification and filtering
- Approximately 30 watts in to a 1.2mt dish to transmit 250Ks
- Equipment in the shack and PA at the dish

How much power?

Dish Diameter	Power Required for 250Ks
2.4m	7.5W
2.0m	11W
1.8m	13W
1.5m	19W
1.2m	30W
1m	43W
90cm	53W
80cm	67W
60cm	120W

Power required to achieve same MER as the beacon at a receiving station – eg 8dB MER on 1.2mt dish

SR	Factor
66 KS	0.26
125 KS	0.5
250 KS	1.0
333 KS	1.33
500 KS	2.0
1000 KS	4.0
1500 KS	6.0

125Ks = 15 watts with 1.2mt dish for 8db MER

Relative Power	Received MER
100%	8 dB
80%	7 dB
63%	6 dB
50%	5 dB
40%	4 dB
31%	3 dB
25%	2 dB
20%	1 dB
16%	0 dB
13%	-1 dB
10%	-2 dB

7.5 watts, 1.2mt dish = 125Ks at 5dB MER

PA options

- Buy new from DB6NT etc
- Buy ex commercial UMTS units.
  - Most units are designed for 2.1GHz
  - It must cover 2.4GHz
- Best option is Spectrian PCBs from ebay seller “Pyrojoseph” at £70
  - Can run up to 50watts at 28v
- But remember all Pas must be backed off from their rated output!

Dish feed - POTY

- Only 1 show in town!
- Mike, GOMJW, has designed a RHC 2.4Ghz patch with a hole in the middle!
- 22m copper pipe acts as wave guide to feed the LNB
- Enables 2.4GHz Tx on the patch and Rx at 10.5GHz
- Look through and full duplex QSOs are possible – with a delay!

Conclusions

- Es'Hail-2 is a fantastic opportunity for amateur experimentation
- Receive is easy!
- A good transmit capability is more of a challenge but not impossible!!
- For more details see CQ-TV 263
- Start simple
  - Get a receiver working!