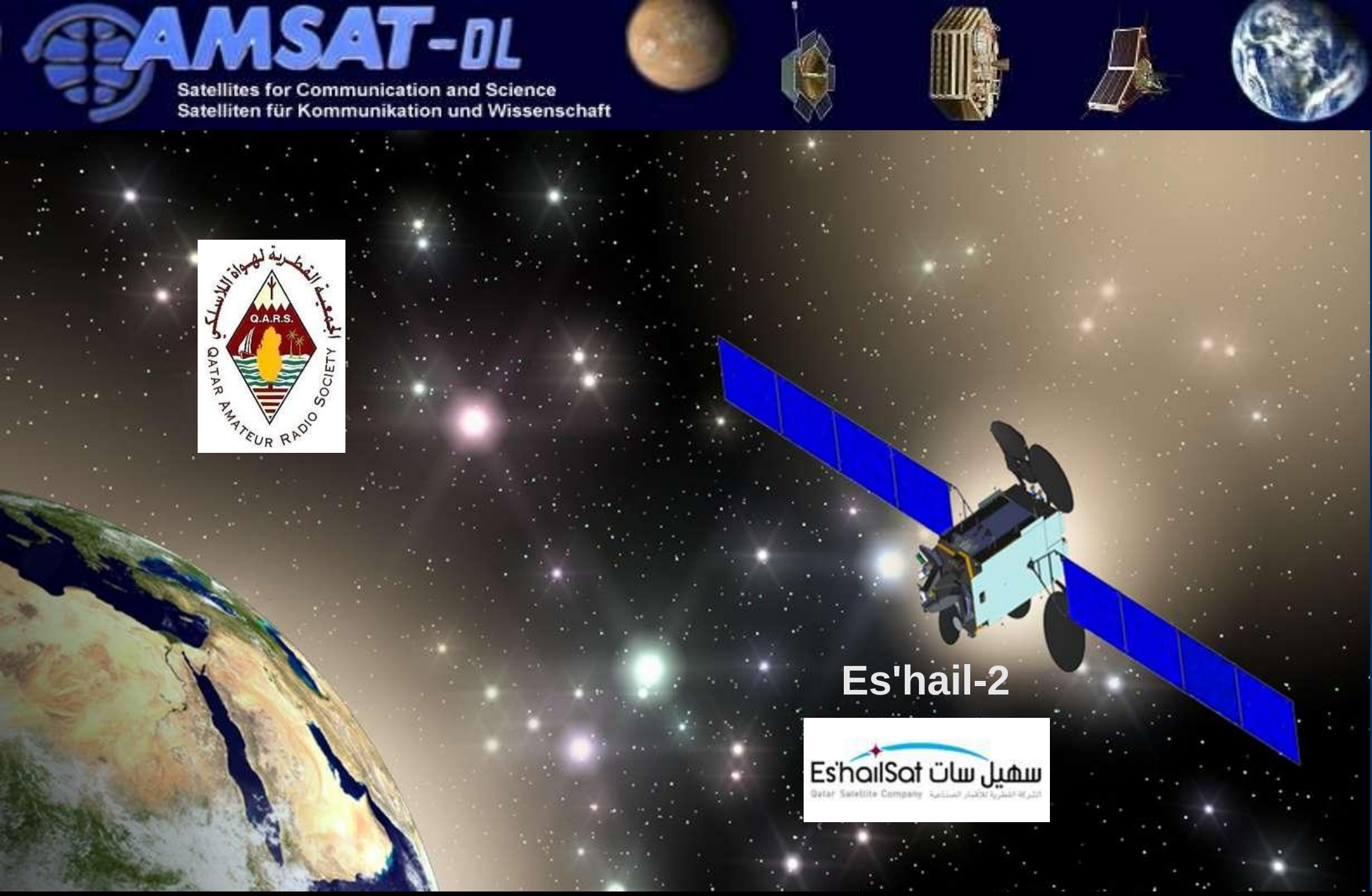
AMSAT-DL

Satellites for Communication and Science
Satelliten für Kommunikation und Wissenschaft



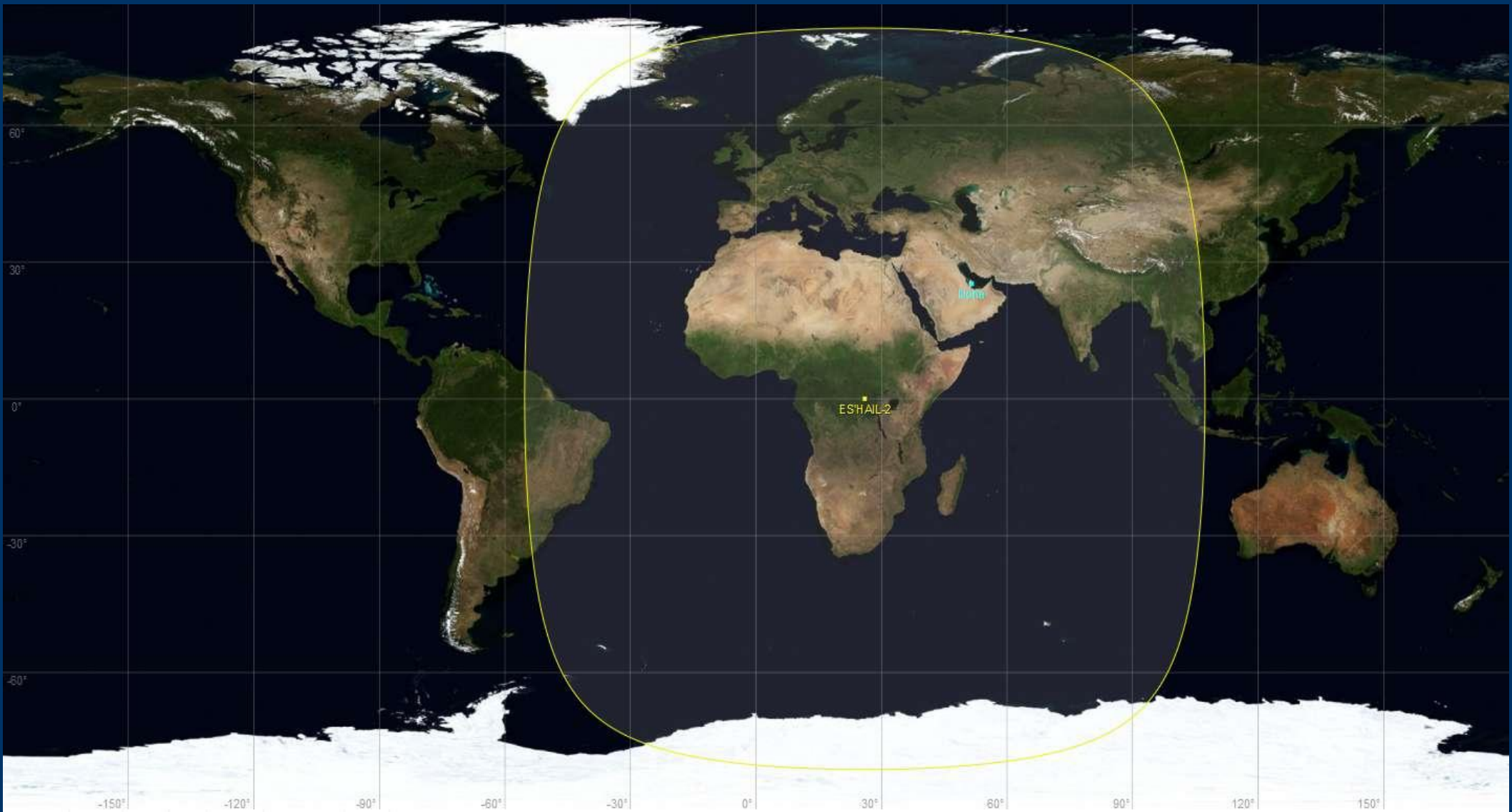
Es'hail-2 (P4-A), the first geostationary OSCAR from Qatar

Presentation Credits: Peter Gülzow, DB2OS AMSAT-DL President, G3VZV and DH2VA

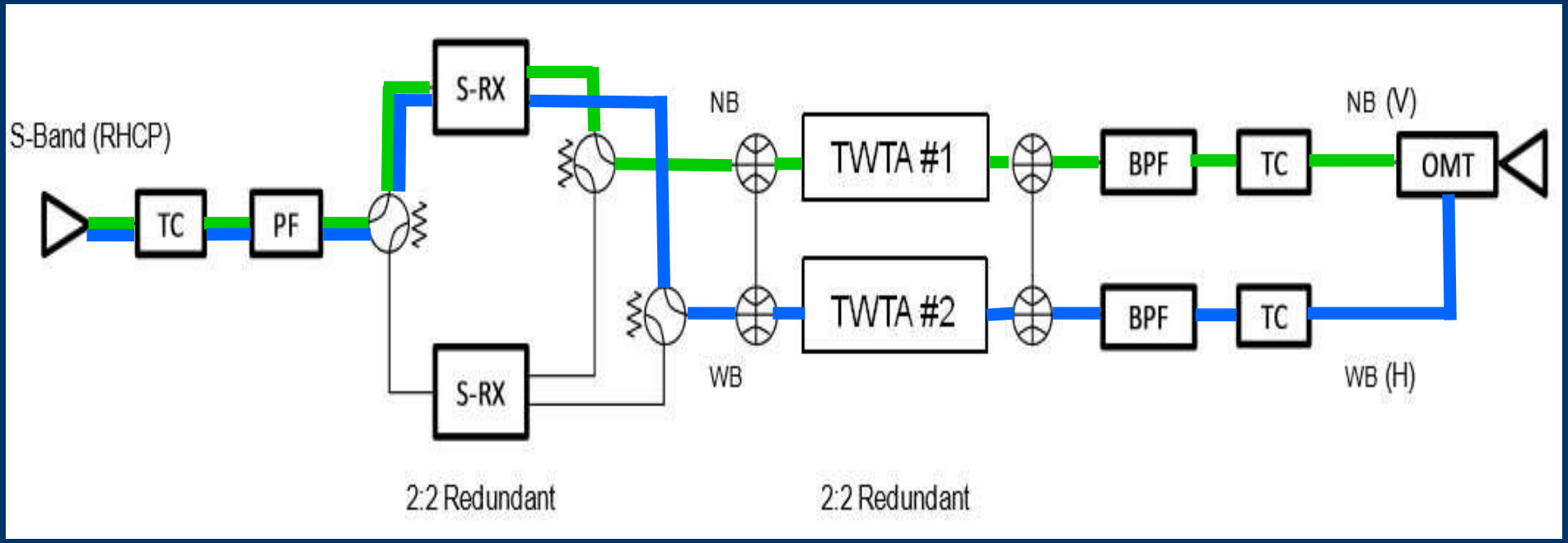
AMSAT-DL

Satellites for Communication and Science
Satelliten für Kommunikation und Wissenschaft

Earth Coverage Es'hail-2



AMSAT Payload Block Diagram



AMSAT-DL
Satellites for Communication and Science
Satelliten für Kommunikation und Wissenschaft

"WB" Transponder (wide band)

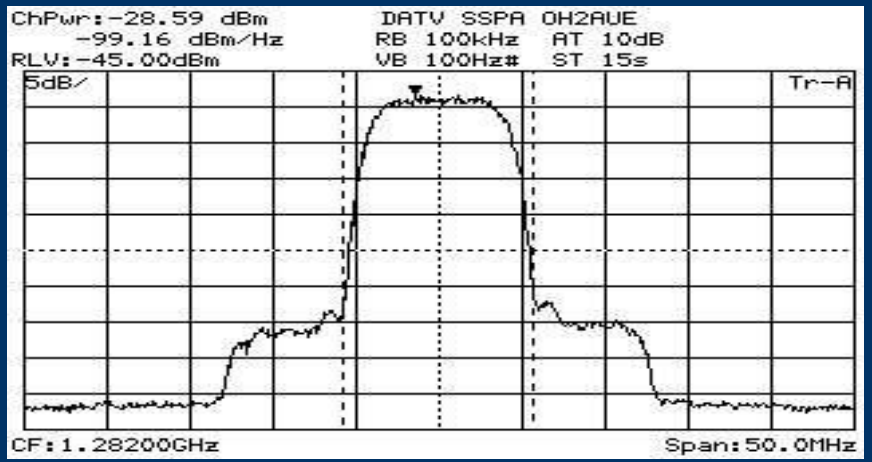
Linear Transponder for Digital Amateur Television (DATV) and other highspeed data transmissions.

- **First DATV transponder in space!!**

- with 8 MHz bandwidth one or two DVB-S2 carrier in HD quality will be possible
- in SD or lower quality more channels possible

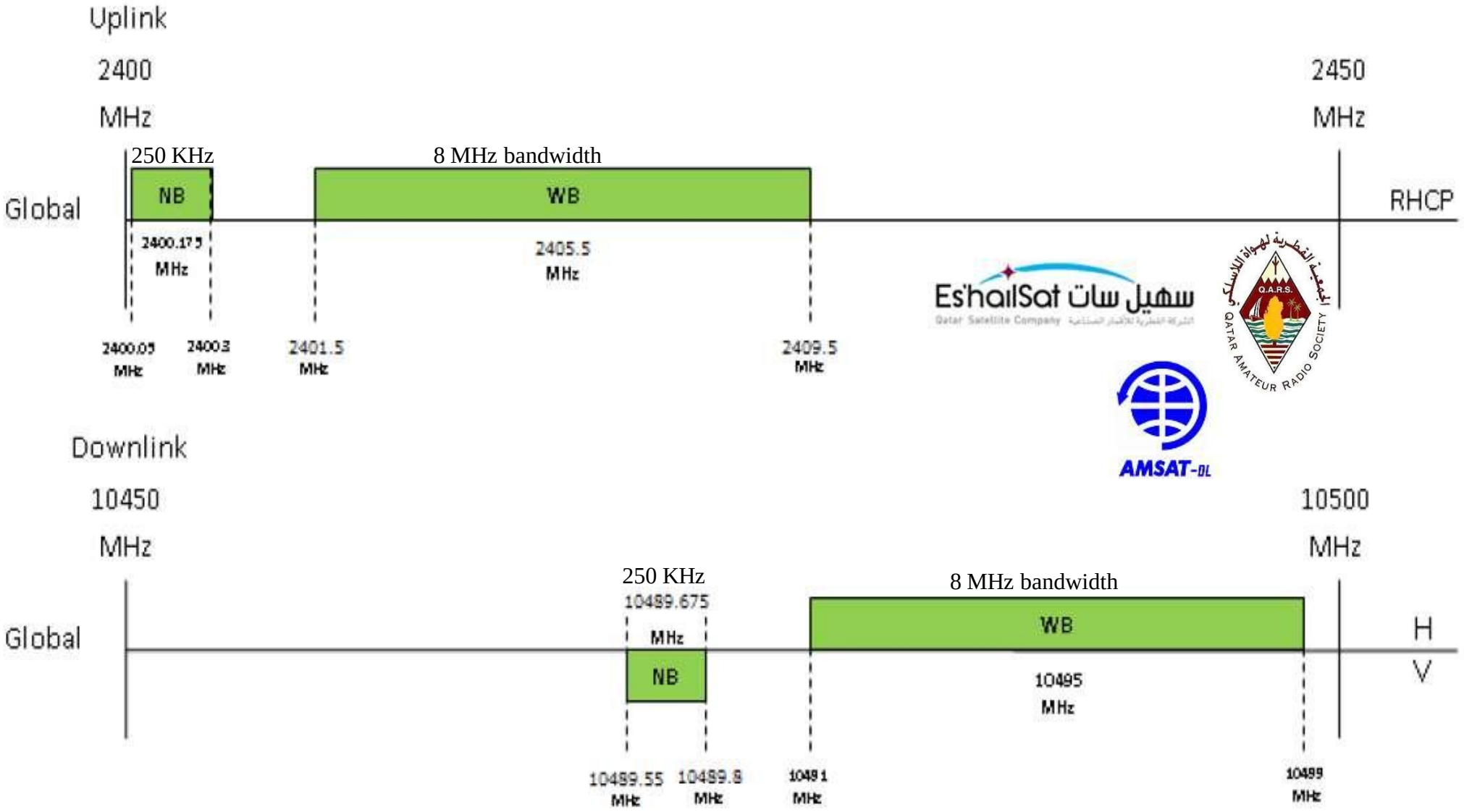
- Assumes S-Band Uplink peak EIRP of 53 dBW (100W PEP into 2.4m dish)

- X-Band Downlink (SAT-TV dish):
  - 90 cm dishes in rainy areas at EOC like Brazil or Thailand
  - 60 cm around around coverage peak
  - 75 cm dishes at peak -2dB



- Uplink Polarisation on S-Band is RHCP
- Downlink Polarisation on X-Band is Horizontal !

- DVB-S2 "beacon" from Qatar is planned with Live WebCam and promotional videos for Ham radio activities.



Xpdr	U/L FREQUENCY (MHz)				D/L FREQUENCY (MHz)				LO	BW
No	Pol	Begin	Center	End	Pol	Begin	Center	End	(MHz)	(MHz)
NB	RHCP	2400.05	2400.175	2400.3	V	10489.55	10489.675	10489.8	8089.5	0.25
WB	RHCP	2401.5	2405.5	2409.5	H	10491	10495	10499	8089.5	8

Partners

Es'hailSat سهيل سات
Qatar Satellite Company الشركة القطرية للأقمار الصناعية

AMSAT-DL

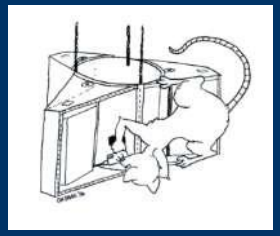
Q.A.R.S.
QATAR AMATEUR RADIO SOCIETY
الجمعية القطرية للهواة اللاسلكي

KENWOOD

JAMSAT

AMSAT-UK

BATC



AMSAT-OH

maintech GmbH

SR-Systems

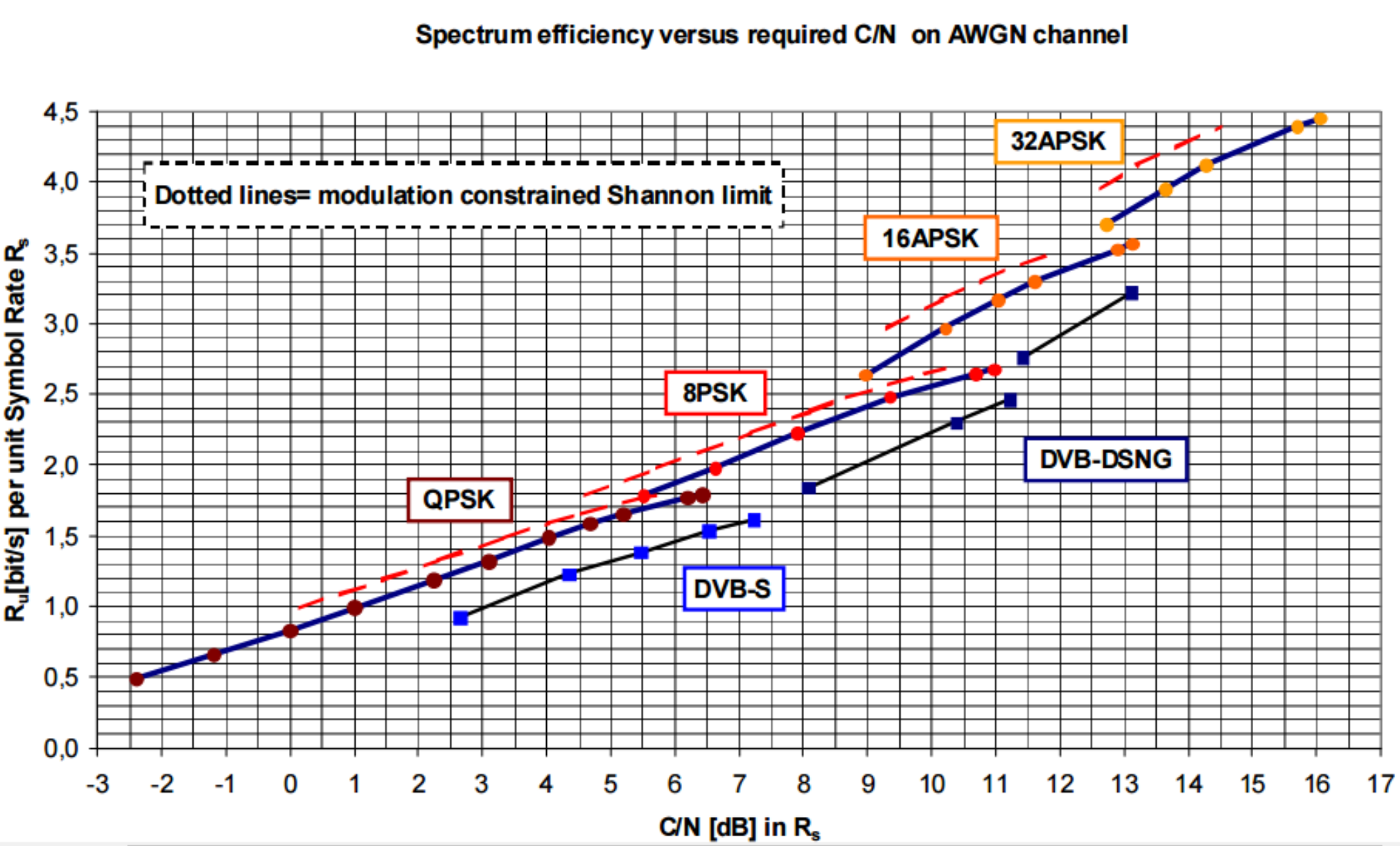
BATC Involvement

- AMSAT-DL requested BATC help to manage and develop WB transponder use
- Hub of experimental DATV experience seems to centre on UK

Es'Hail-2 P4A WB

- Es'Hail-2 wideband is an “ 8 MHz bent pipe” transponder
- There are many potential modes and uses by the amateur TV community
  - Two standards: DVB-S and DVB-S2
  - Four Modulations: QPSK, 8PSK, 16APSK and 32APSK
  - Eleven error corrections (eg 1/2 7/8)
  - Variable Symbol Rate
  - Three video encoders: MPEG-2, H264 and H265
  - 2-way QSOs or broadcasts
- Occupied bandwidths can be 200 KHz – 8 MHz

What Mode?


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

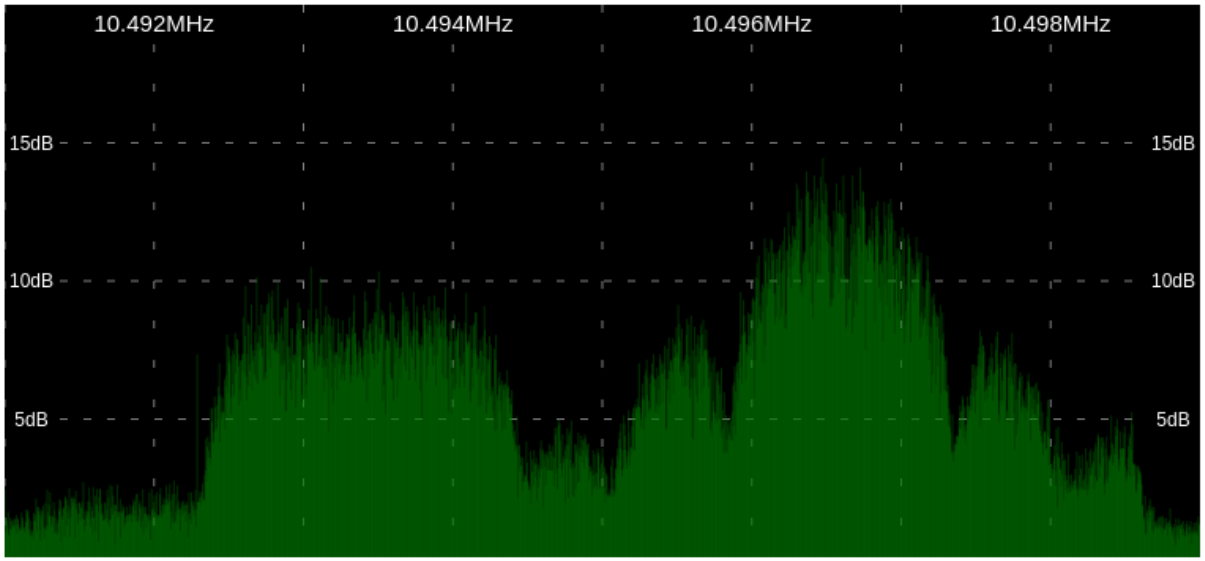
Choice and Co-ordination

- Easiest mode to start with is “standard” DVB-S QPSK DATV at 2 or 4 Msymbols/Sec 1/2 FEC
- But we should encourage and allow experimentation as well as the standard QSO operation
- 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 is working with AMSAT-DL to produce a web-based monitor and analysis tool
  - Without it, it just won’t work!
  - Will include a chat window for questions

Proposed Web-based Spectrum Monitor

file:///home/phil/Projects/websocket-fft/index.html

Es'hailSat Spectrum Monitor



Users currently monitoring the spectrum: 1

23/07/2016

19:05 **Phil_M0DNY**
Hello!

19:05 **Phil_M0DNY**
*World!

Type '/nick your_name' and press enter to join.

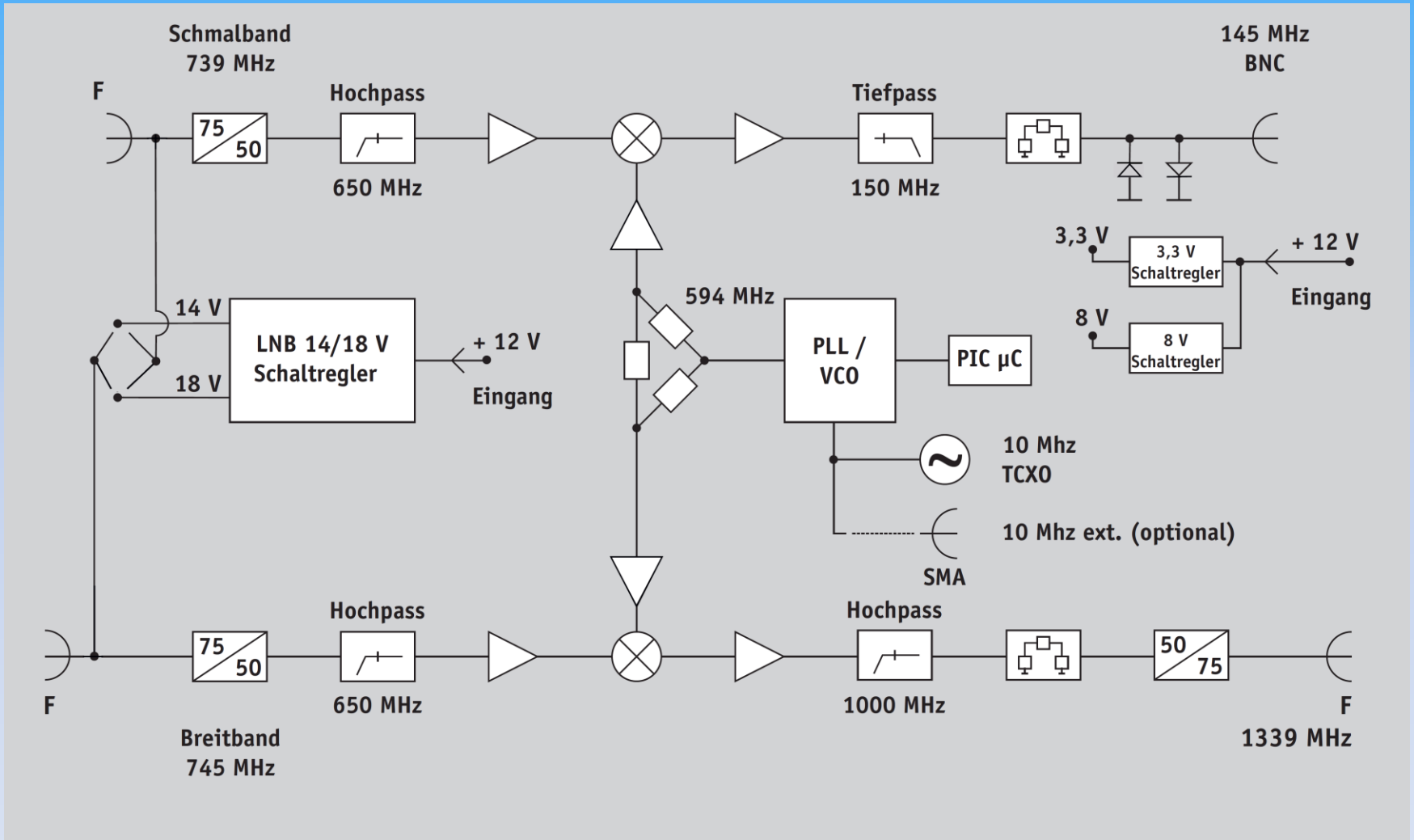
Reception

- Downlink power levels should enable use of fixed 80cm dish in most areas ☺
- Downlink frequency is 10,491 – 10,499 MHz and within pass band of standard consumer LNB ☺
- PLL LNBs must be used to give stability for RB-TV below 1 Msymbol/sec
  - Octagon PLL LNB = £25 on ebay
- However 9,750 MHz LO puts IF outside consumer set top box tuning ☹
  - Standard STB range = 950 – 2,150 MHz
  - 10,491 MHz – 9,750 MHz = 741 MHz

Receiver – 3 Possible Solutions

- Move the local oscillator by using a modified LNB with 9GHz LO
  - Used to be available from Germany?
  - Will work but not suitable for RB-TV due to stability of “pulled” DRO oscillator
- BATC USB Minitiouner card with Sharp or Serit tuner covers 741 MHz
  - Gives totally flexible receive system
  - HD-TV, DATV and RB-TV
- Up-convert: SUP-2400, GOMRF Converter, AMSAT-DL Converter?

AMSAT-DL Up-Converter



Design by Achim, DH2VA. May be available ready-built for €130 - €150 if sufficient demand

Uplink issues

- Uplink band is 2,401.5 – 2,409.5 MHz = Secondary allocation = WiFi Channel 1(2412)
- Uplink must not cause interference to other users, both in-band and on adjacent bands
- Spectral re-growth – adjacent channel interference will be a real issue

TX Option 1: Up-convert

- Generate DATV signal at lower frequency and up convert - possibly from 437 MHz?
  - Use standard encoder/modulator
  - DTX1, DigiLite, DATV-Express or Portsdown
- Up-converter options:
  - Use narrow-band 13cms up-converter
    - 80 MHz away from 13cms terrestrial NB section
  - Kuhne KU UP 2325 A up-converter?
    - Eur500

TX Option 2: Generate at 2400

- DATV Express
  - Very flexible but requires PC etc
- Portsdown
- Modified DTX1
  - Standalone system

- All solutions are low power (0 – 10 dBm) and will require extensive amplification and filtering

Uplink Power Budget

- Starting point is that an 8 MHz of DVB-S2 transmission will require 100W into a 2.4m dish

Power Budget (Watts)					
	8 MHz	4 MHz	2 MHz	1 MHz	0.5MHz
2.4m	100	50	25	12.5	6.25
1.7m	200	100	50	25	12.5
1.2m	400	200	100	50	25
0.85m	800	400	200	100	50

Credit M0DTS

Conclusions

- Es'Hail-2 is a fantastic opportunity for amateur experimentation
- It will need flexible ground station solutions
- A good transmit capability will be a challenge!
- Amateur service coordination is essential if we are to maximise the benefit
- Start simple
  - Get a receiver working!
- Launch in 2018?