

# Hvězdárna Ďáblice

Vysíláme přes družici QO-100

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Přehled základních  
provozních sestav pro  
komunikaci a provoz

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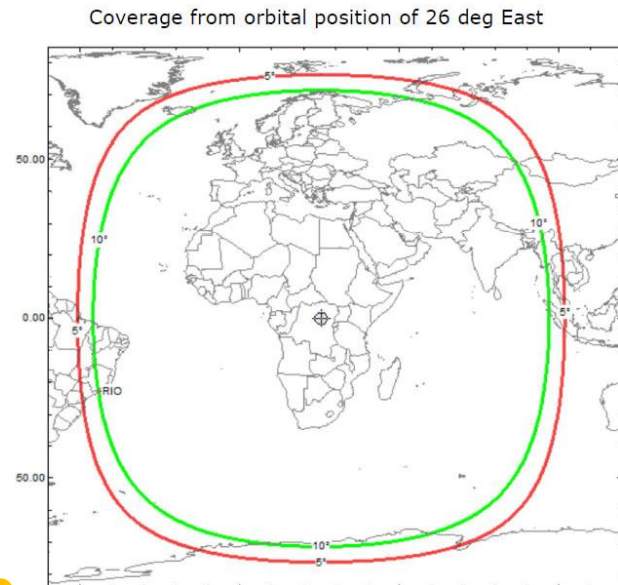
# Agenda

- Základní informace o QO-100
- Základní typy sestav pozemních stanic
- Výběr jednotlivých komponent, čemu se vyhnout
- Dostupné SW vybavení pro SDR
- Používané provozy na QO-100
- Q & A



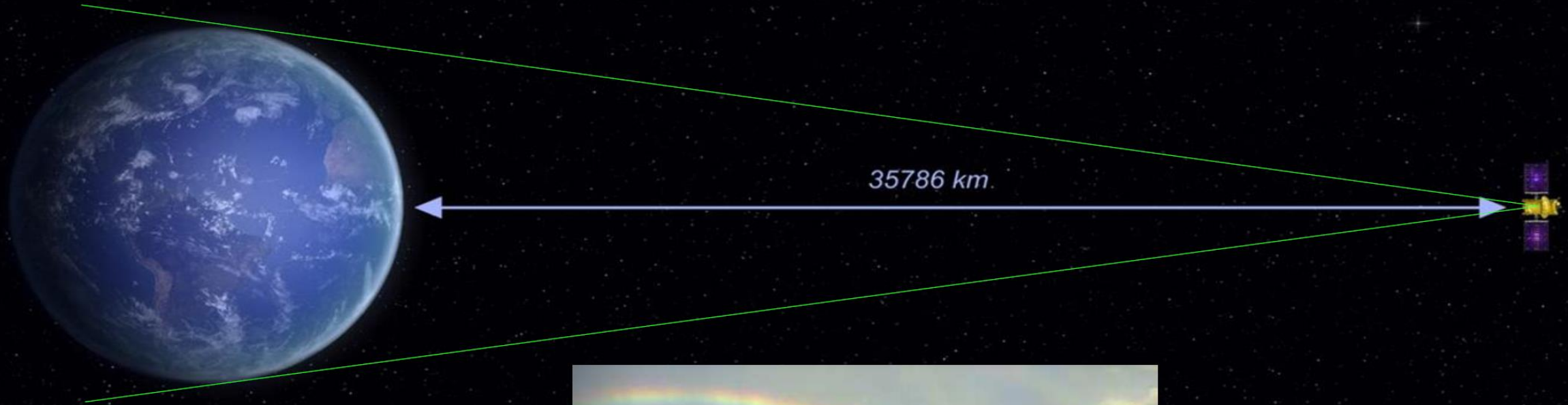
# Základní informace QO-100

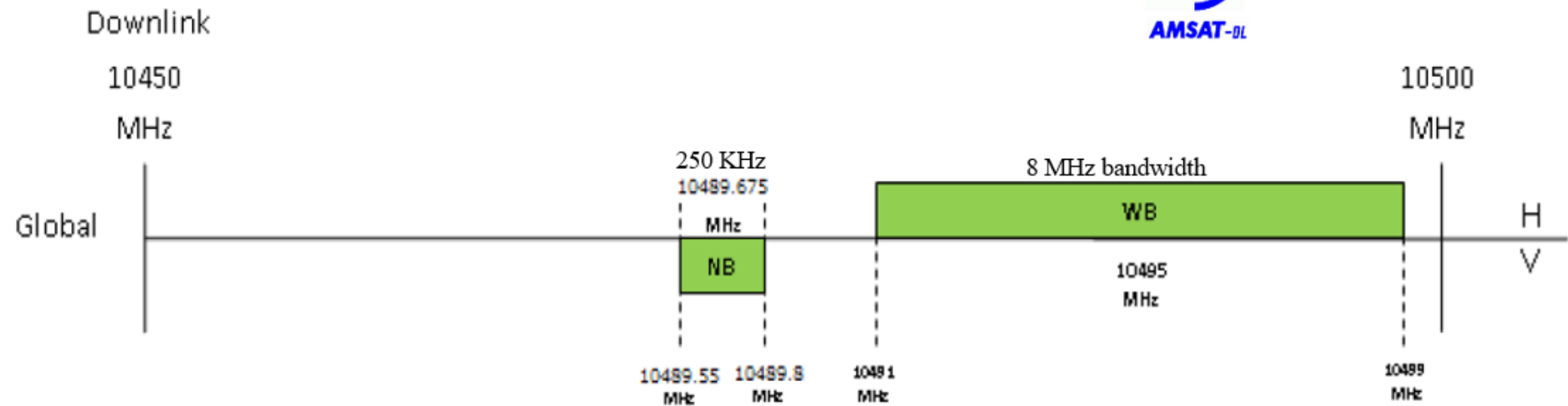
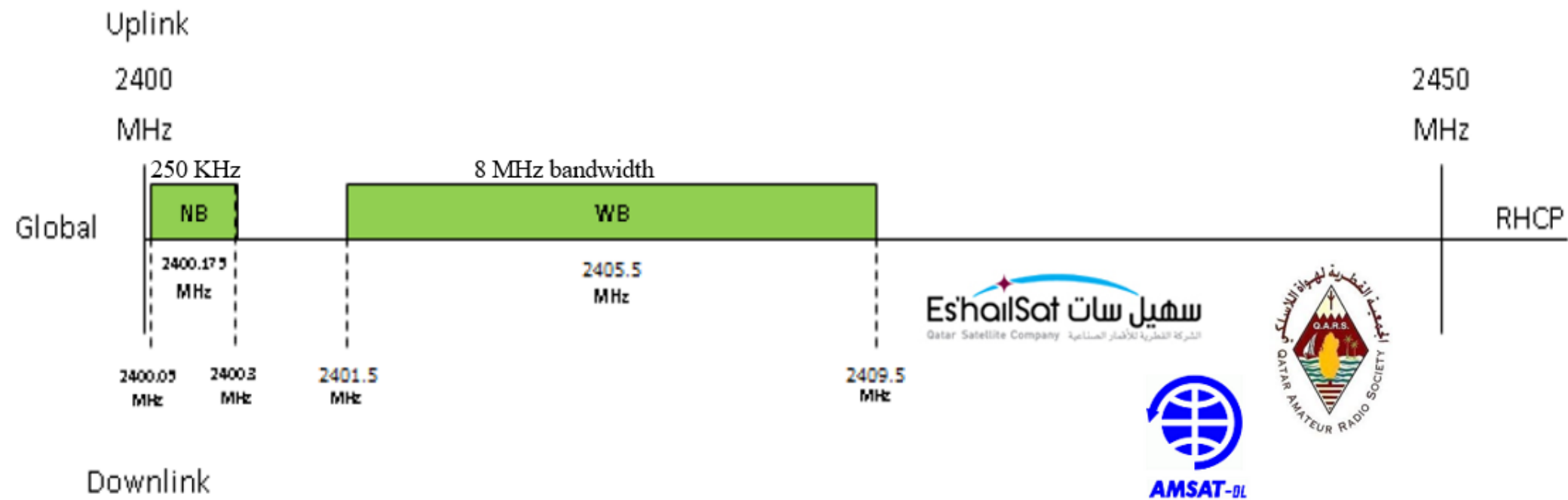
- 15. listopadu 2018 v 20:46 UTC vypuštěn z Kennedyho střediska (rampa LC-39A)
- Od 12.2.2019 je plně aktivní a dostupný uživatelům



- **Pozice 25.5° E**
  - Elevace: 31.6°
  - Azimut: 165.6°
  - LNB Skew: -9.2° (úhel stočení polarizace)

**-3dB Beamwidth =  $17.4^\circ$   $\rightarrow$   $\sim 20$ dB Antenna Gain !!**





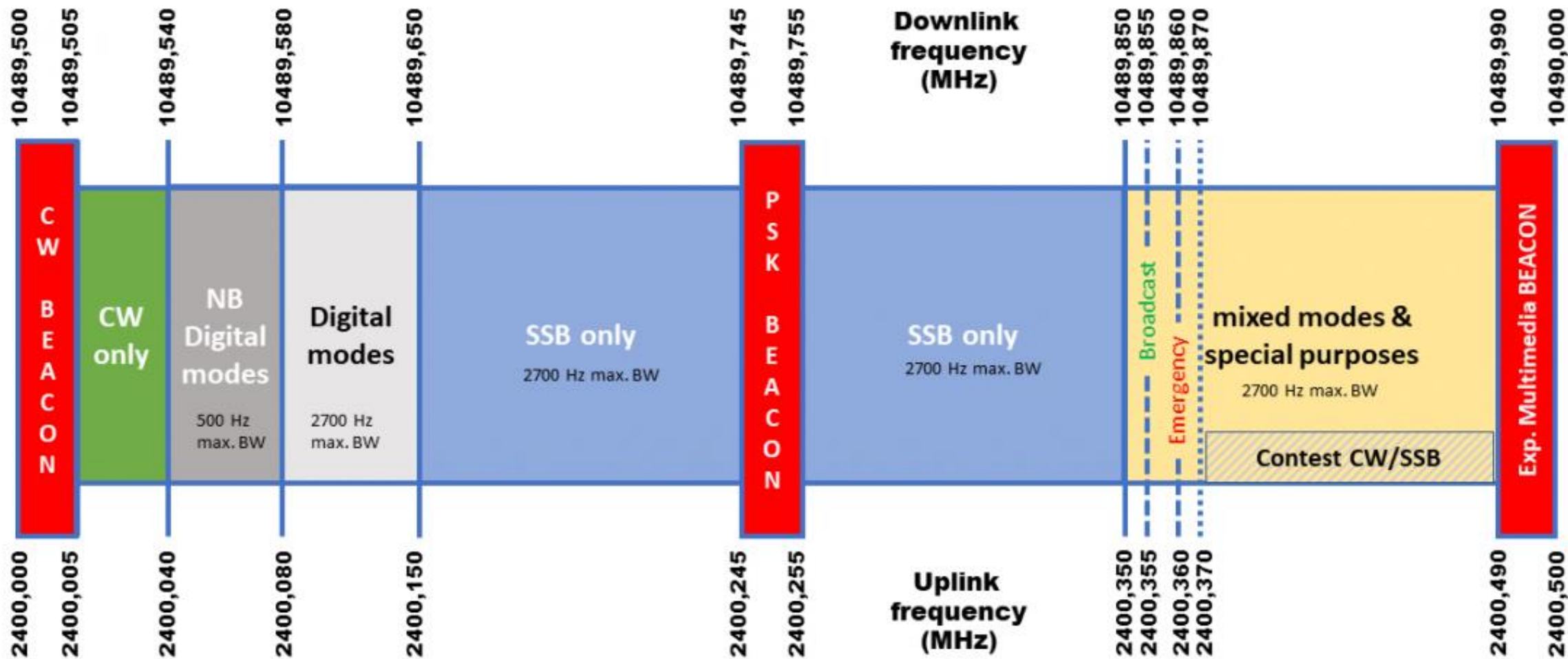
Xpdr	U/L FREQUENCY (MHz)				D/L FREQUENCY (MHz)				LO (MHz)	BW (MHz)
	No	Pol	Begin	Center	End	Pol	Begin	Center		
NB	RHCP	2400.05	2400.175	2400.3	V	10489.55	10489.675	10489.8	8089.5	0.25
WB	RHCP	2401.5	2405.5	2409.5	H	10491	10495	10499	8089.5	8

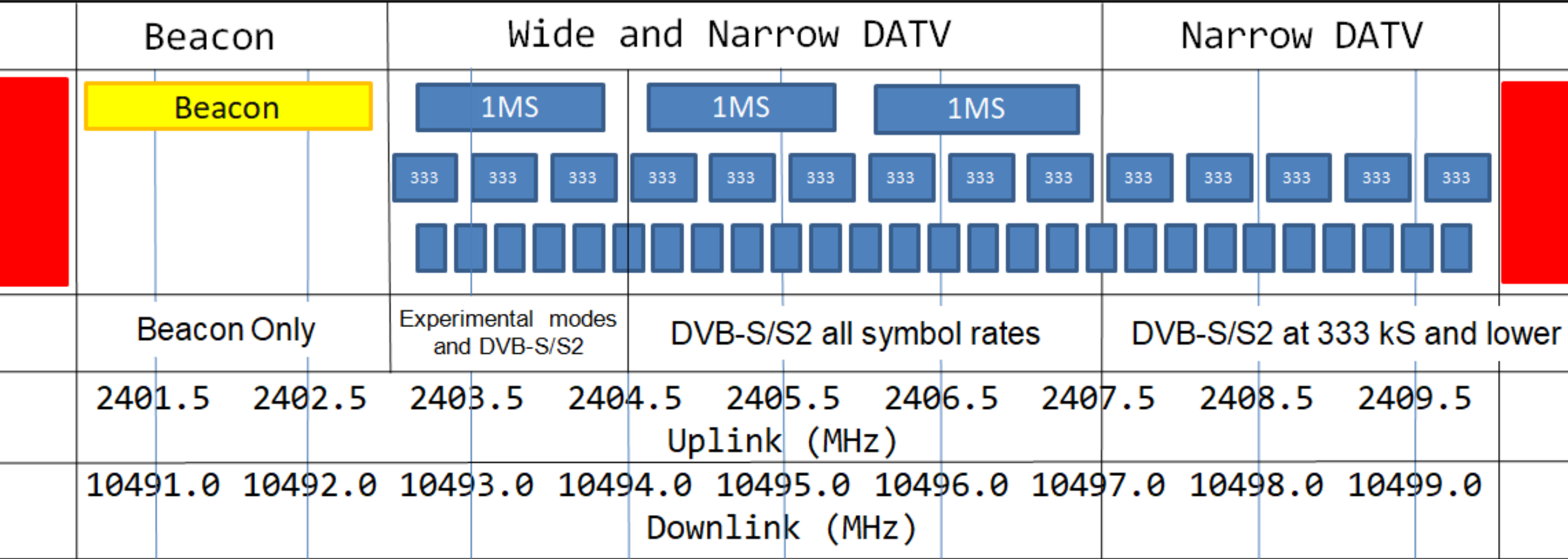
# AMSAT QO-100 / P4A NB Transponder Bandplan



**AMSAT-DL**  
Satelliten für Kommunikation, Wissenschaft und Bildung  
Satellites for Communication, Science and Education

**سهيل سات Es'hailSat**  
شركة قطر للخدمات الفضائية  
Qatar Satellite Company





# Základní typy sestav pozemních stanic

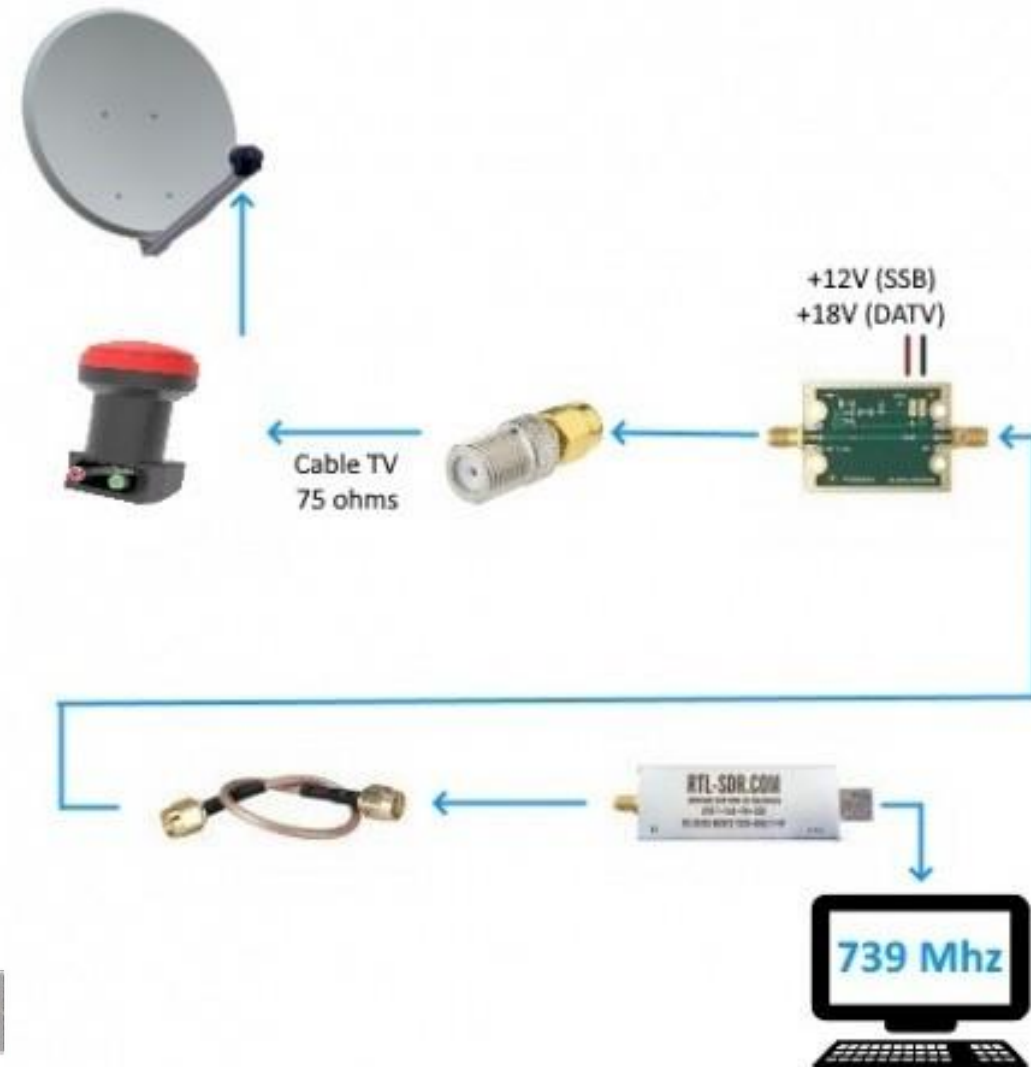
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# NB RX only - (400,- ~ 1000,-kč)

- LNB
- Min. 65cm offset parabola
- SDR + PC



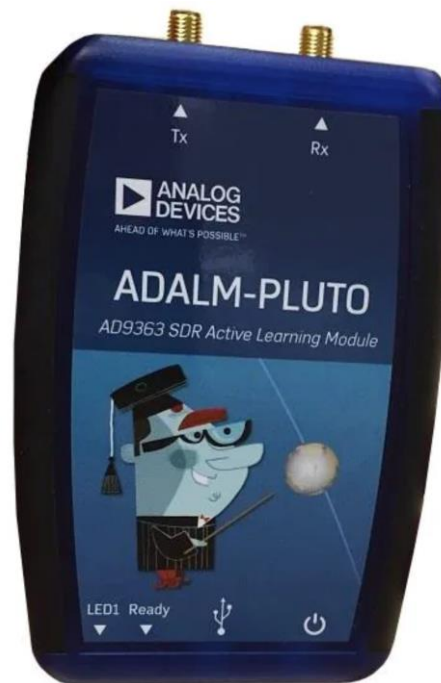
# Sestava pro NB provoz

- **Minimální sestava ~ 7800,-Kč**

- PC / Notebook
- LNB with PLL - (150,-)
- Homemade ozařovač helix
- ADALM Pluto - (6500,-)
- China PA 4W - (1000,-)
- 65cm offset parabola

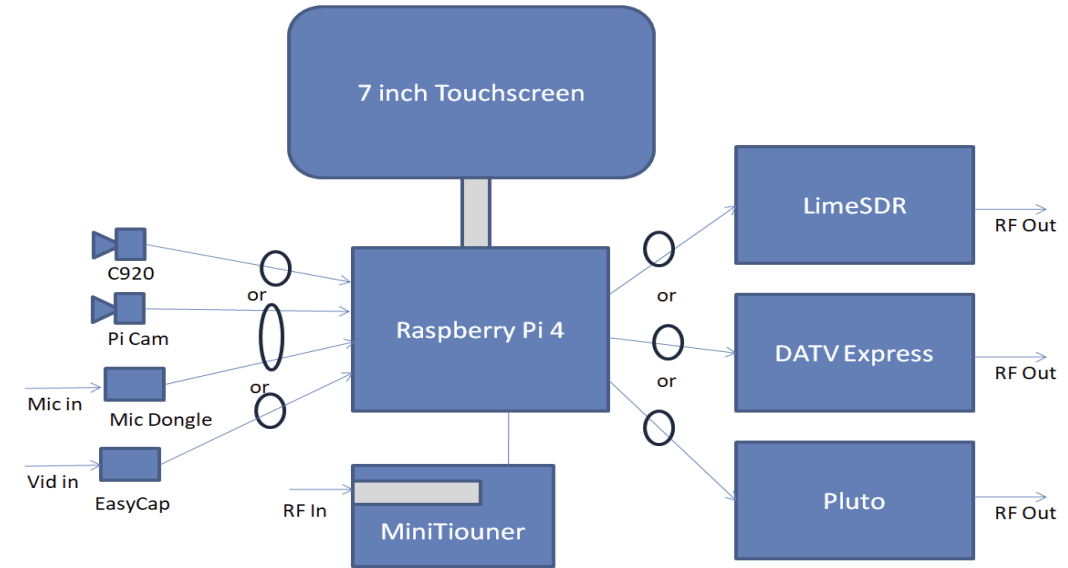
- **Optional**

- GPSDO
  - Leo Bodnar + cca 130,-Eur
  - GPSDO China



# Sestava pro WB / DATV provoz (Portsdown 4)

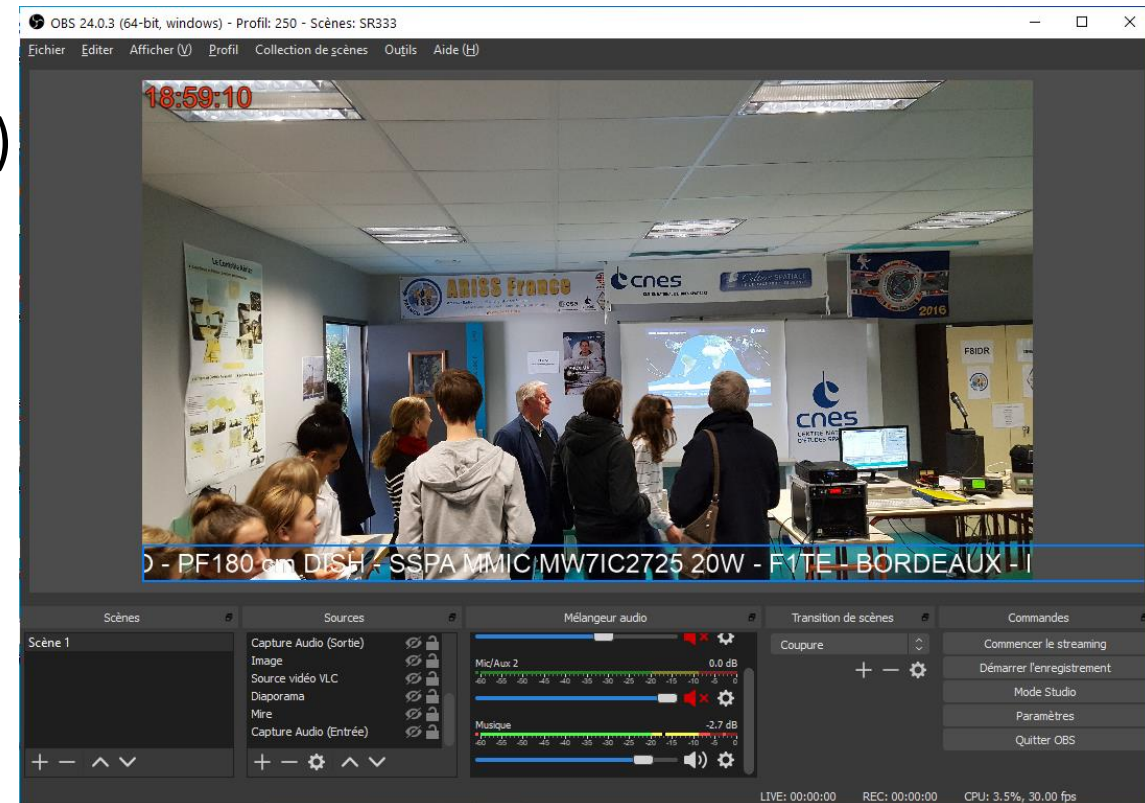
- **Minimální sestava 9500,- ~ 16000,-Kč**
  - PC / Notebook / Portsdown 4 (4000,-)
    - H264
  - LNB with PLL (250,-)
  - ADALM Pluto / Lime SDR (6500,-)
  - WCDMA PA 50W min. (1500,-)
  - 85cm offset parabola 120cm optimal (4000,-)
- **Optional**
  - GPSDO
    - Leo Bodnar ~ 130,-Eur
    - GPSDO China



TX		RX		M2	M3
Modulation	Encoder	Output to	Format	Source	
S2QPSK	H264	Lime Mini	4:3	PiScreen	
Freq	Sym Rate	FEC	Band/Tvtr	Lime Gain	
437 MHz	333	9/10	70_cm	88	
EasyCap	Caption	Audio	Atten	Att Level	
Comp Vid	On	Auto	NONE	-10.00	
Preset 1	Preset 2	Preset 3	Preset 4	Store	
146.5_333	437_Lime	1255_HD	437-Pluto	Preset	

# Sestava pro WB / DATV provoz OBS etc

- **Minimální sestava 9500,- ~ 16000,-Kč**
  - PC / Notebook with streaming SW
  - H265 encoder
  - LNB with PLL (250,-)
  - ADALM Pluto / Lime SDR (6500,-)
  - WCDMA PA 50W min. (1500,-)
  - 85cm offset parabola 120cm optimal (4000,-)
- **Optional**
  - GPSDO
    - Leo Bodnar ~ 130,-Eur
    - GPSDO China

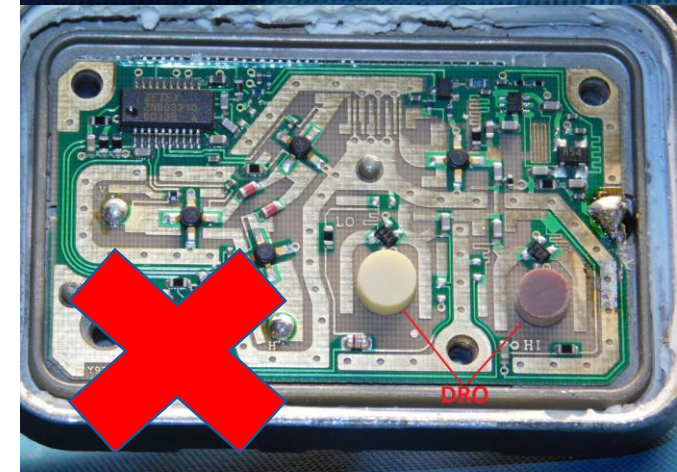
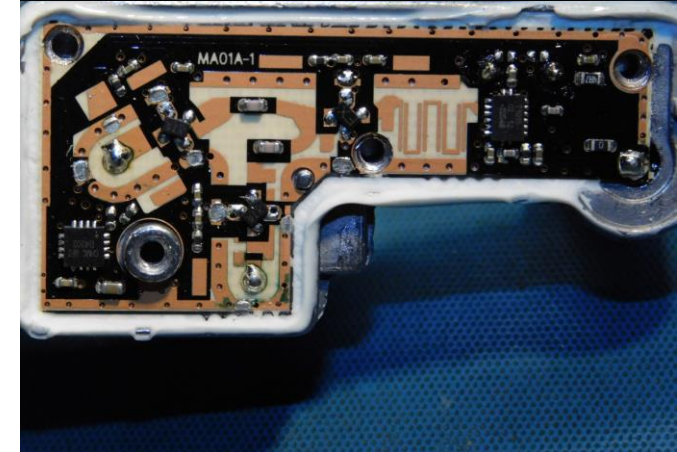
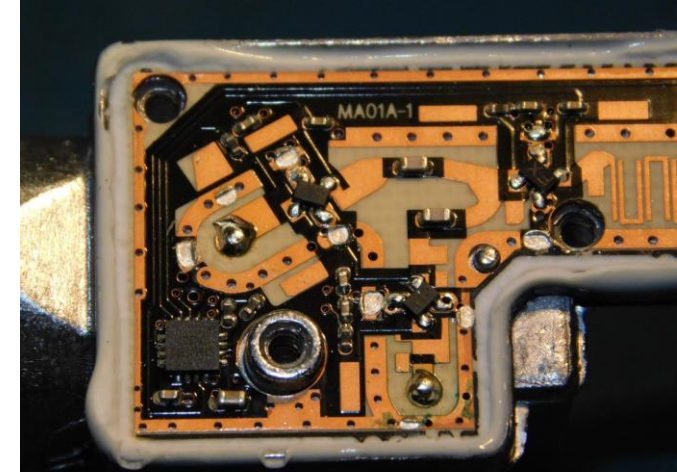


Výběr  
jednotlivých  
komponent,  
čemu se  
vyhnout



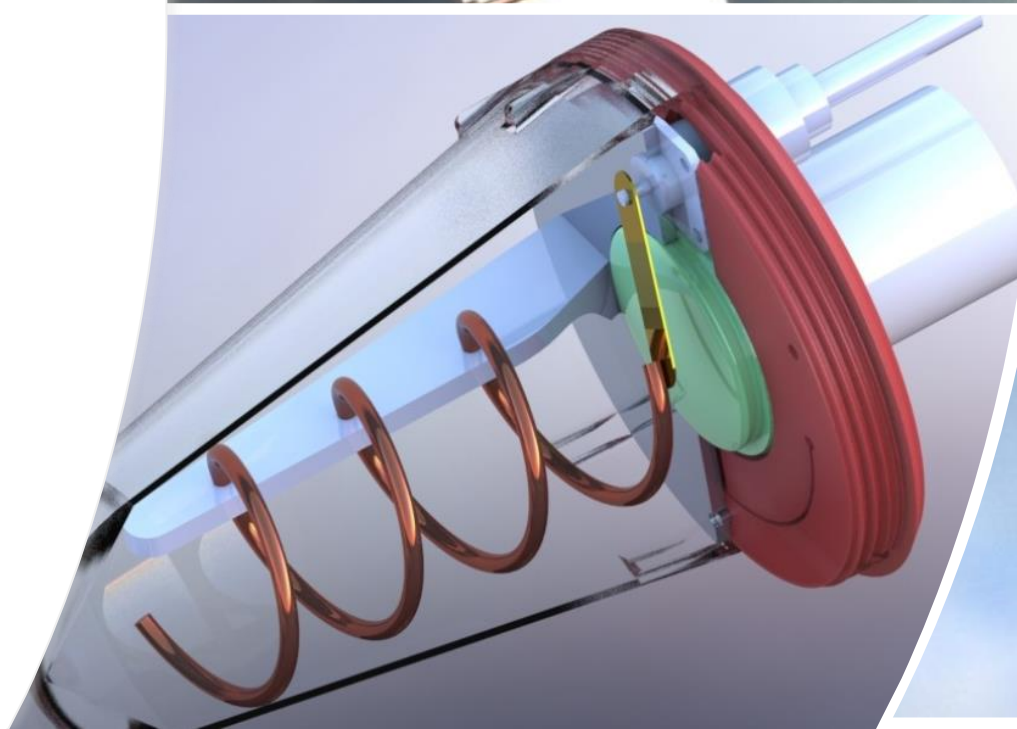
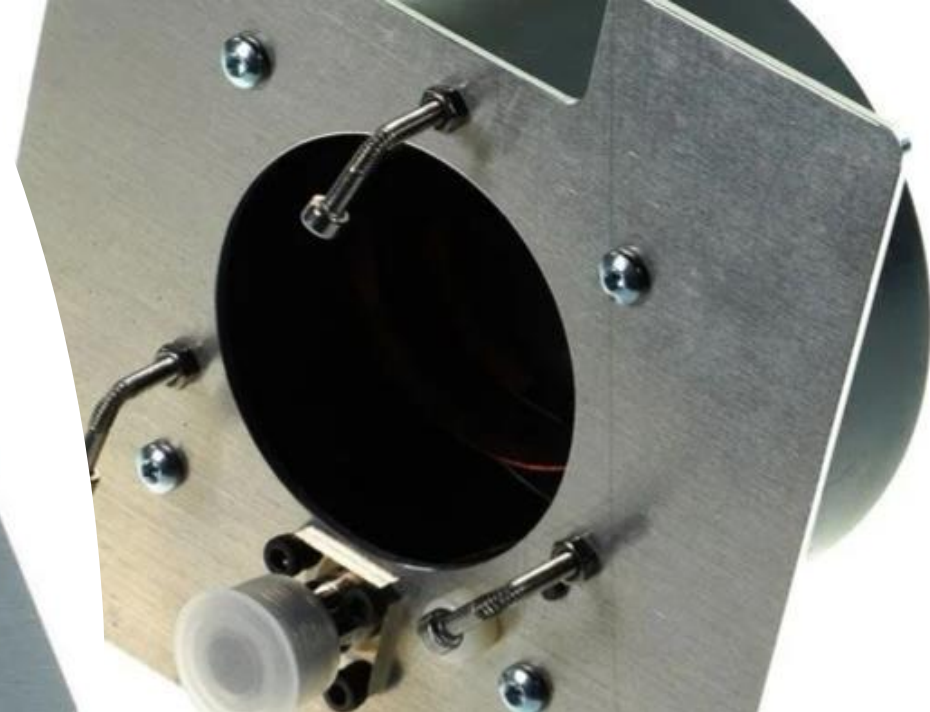
# LNB – Low Noise Block

- LNB – alespoň s PLL **ne dielektrický rezonátor**
  - 4K Ultra HD
- XO 25MHz x 390 = LO 9750MHz
- IF ~ 740MHz
- Změnou na 24MHz => IF 1129MHz (LO 9360MHz)
  - Značné zlepšení parametrů LNB
- Vyzkoušené LNB (s XO 20PPM)
  - Amiko L-107
  - Mascom MCT01, MCS02HD
  - Tesla TL-200, TL-100
  - Bullseye
    - TCXO 2PPM
    - ~ 30,-Eur



# Ozařovače

- Dxpatrol Helix Antenne
  - ~ 89,-Eur
- DG7GP – bamatech.net
  - ~ 92,-Eur
- IceCone
  - ~ 10,-Eur



# Antény

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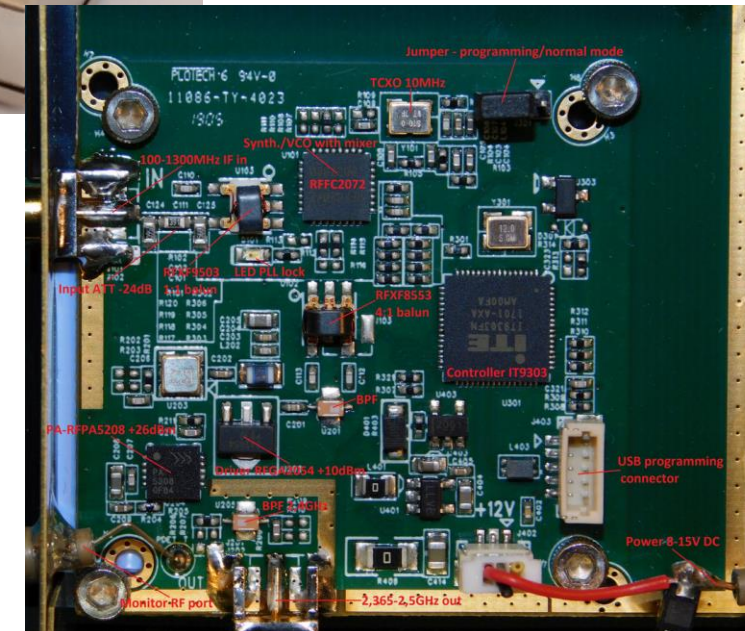
- Offset / Gregorian parabola 65~150cm
  - 20,-Eur ~ 400,- Eur
  - NB min 65cm
  - WB min. 85cm (125cm optimal)
- Wi-Fi „síto“
  - Lineární polarizace vs. RHCP -3dB





# Transvertory

- BU-500 de OE7DBH
  - IF 100 ~ 1300MHz
  - RF 0,5W out
  - 2 PPM
  - ~ 135,- Eur
- SG Labotary
  - IF 432MHz
  - RF 2W out
  - ~ 210,-Eur
- DX Patrol
  - IF 28 / 50 / 70 / 144 / 432 / 1296MHz
  - GPS reference
  - RF 10W out
  - ~ 1000,- Eur



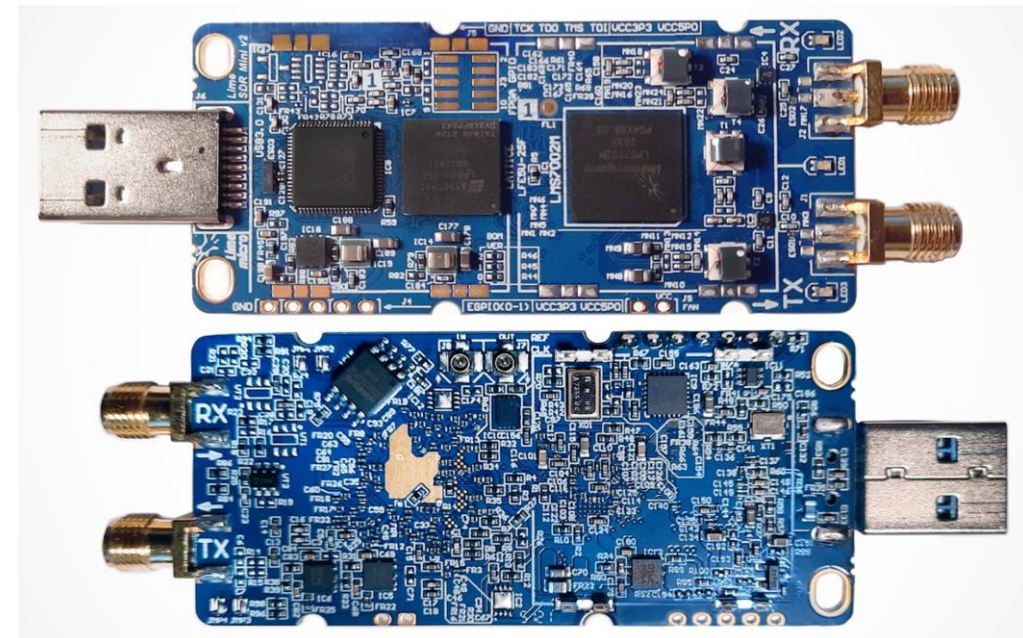
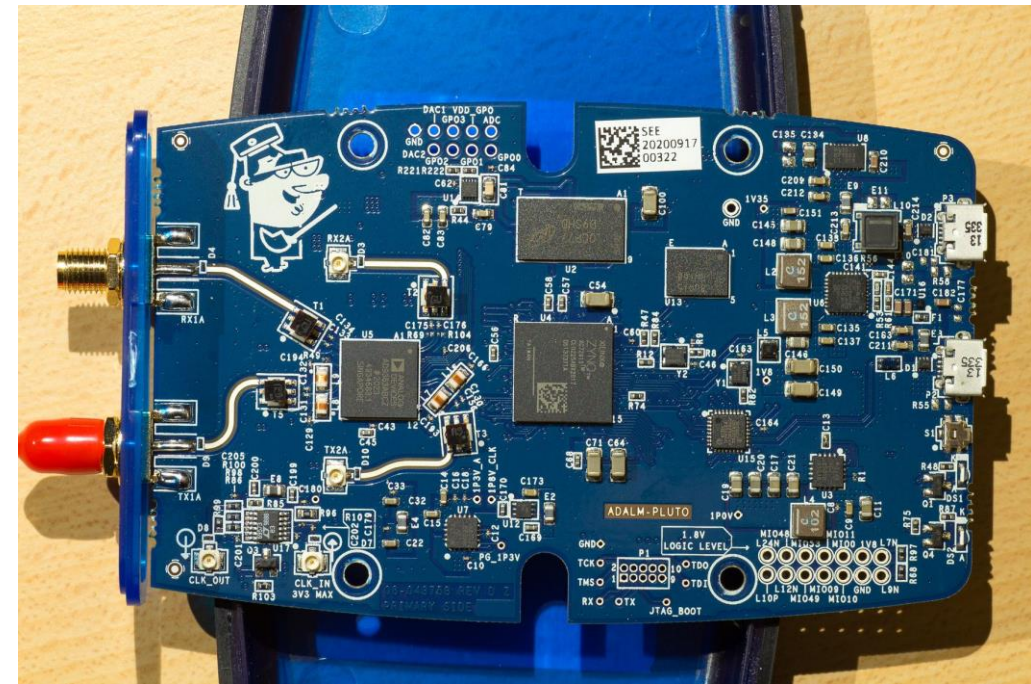
# SDR

- ADALM Pluto

- Nestabilní LO lokální oscilátor (20PPM) - který je třeba vyměnit.
- USB 2.0 (Přenášené hodnoty jsou 2x Float32)
- „20MHz“ šířka pásma (6MSps)
- Podporuje přímé ovládání ze “studiových” programů pro zpracování videa a lze jej ovládat přímo z PC jako streamovací zařízení.
- S upraveným FW lze Pluto používat jako SNA analyzátor
- Výkon cca 0dBm / 2400MHz
- Cena ~ 225,-Eur

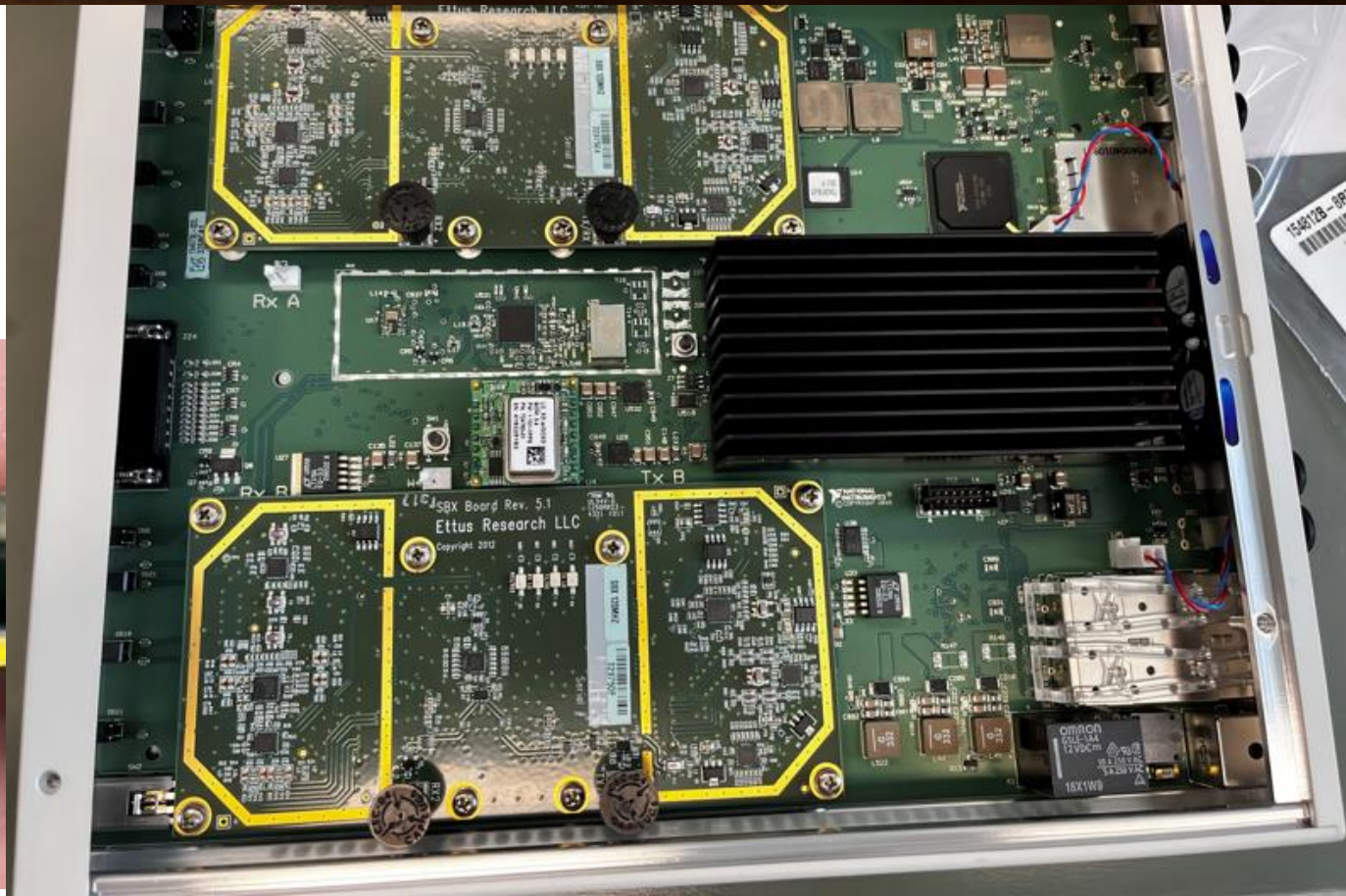
- LimeSDR Mini

- Stabilní TCXO Rakon RTX5032A @40.00MHz / 1ppm
- USB 3.0
- 30,72MHz šířka pásma
- Možnost dalších experimentů (FakeGPS, NMT, LTE vysílače)
- Výkon cca +8dBm / 2400MHz
- Pouze ve verzi 2.0 za ~400,-Eur



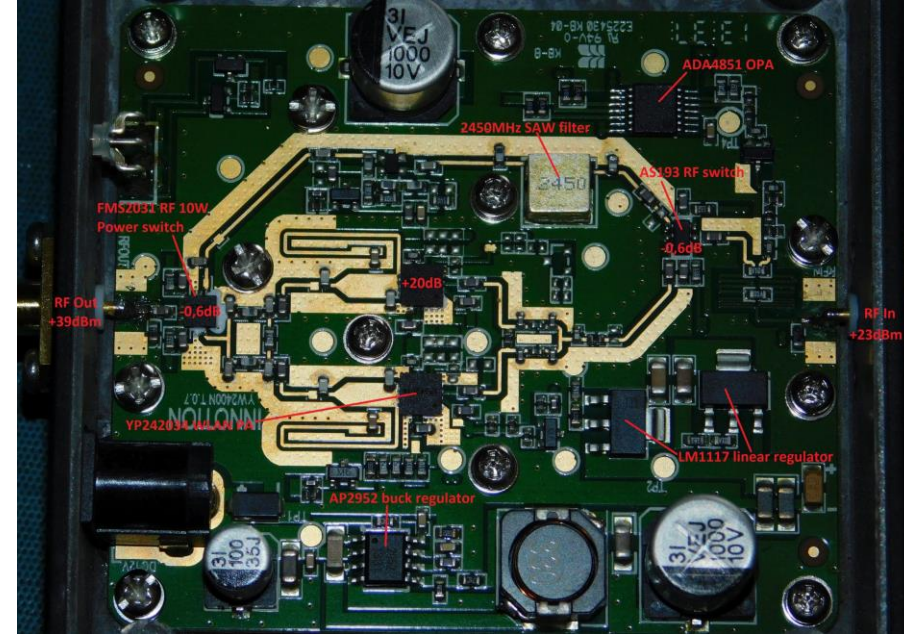
# SDR – High end

- USRP B-200
  - 25.000,-kč
- USRP B-310
  - 350.000,-kč



# PA

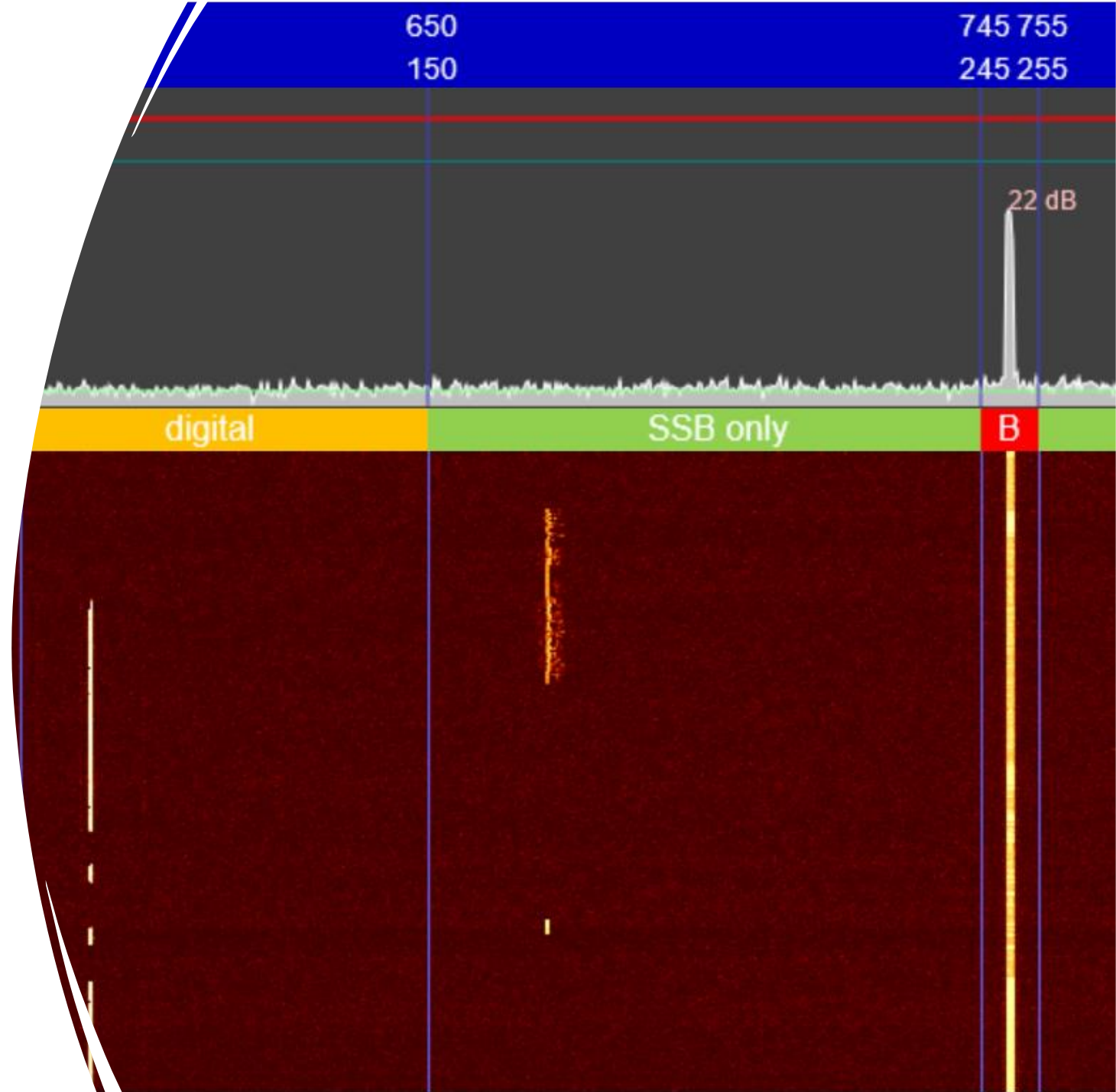
- Wi-Fi booster china s YP242034
  - **RF 2/4W out**
  - 800,- / 1600,-kč
- WCDMA PA s vyzařených sítí
  - Ruzné typy
  - **RF 60W -200W out**
  - 1500,- ~ 3000,-kč

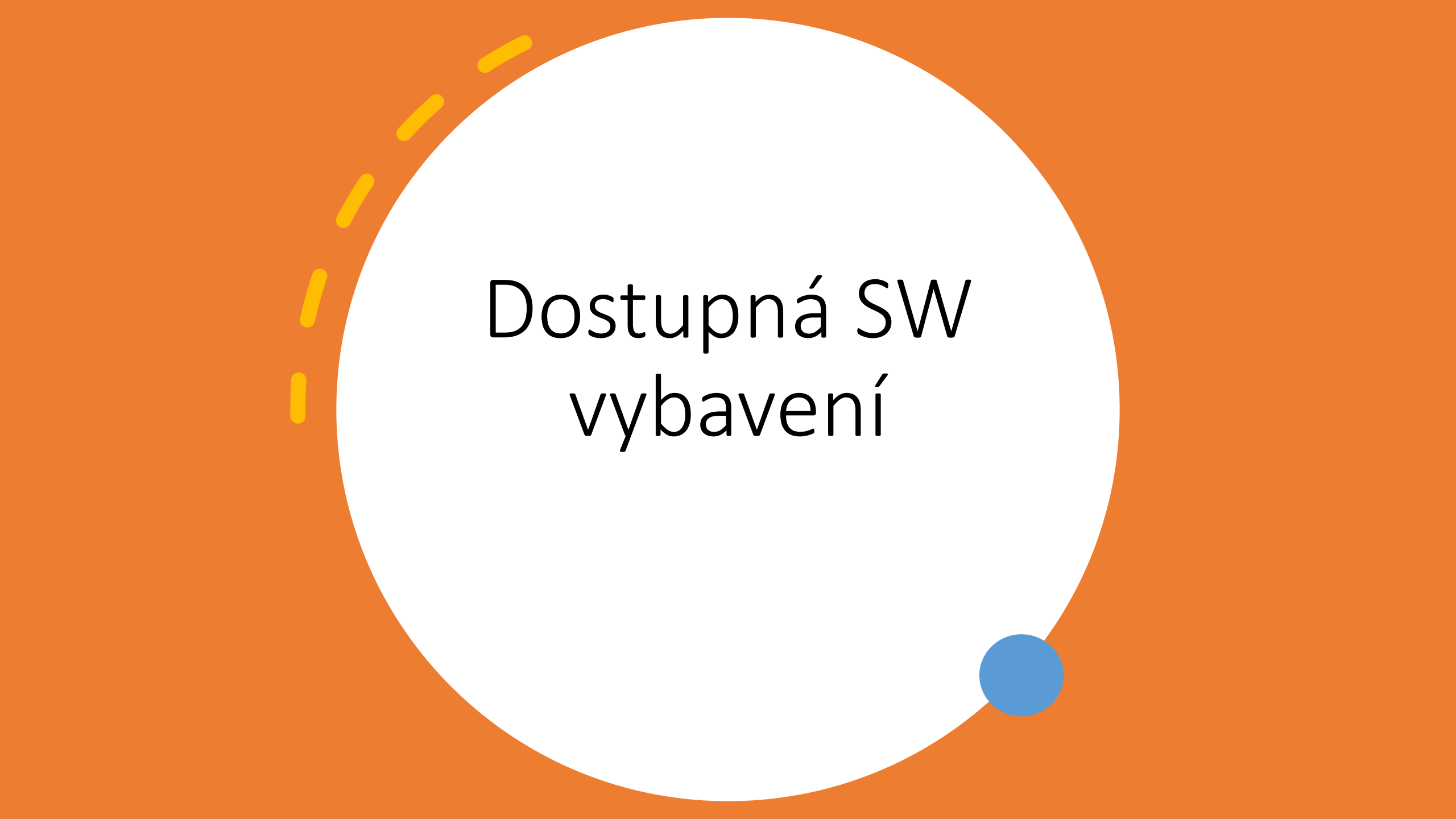


# Web SDR

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- <http://db0hal.dyndns.org>
- <https://eshail.batc.org.uk/nb/>
- <https://www.twitch.tv/pa3fbx>

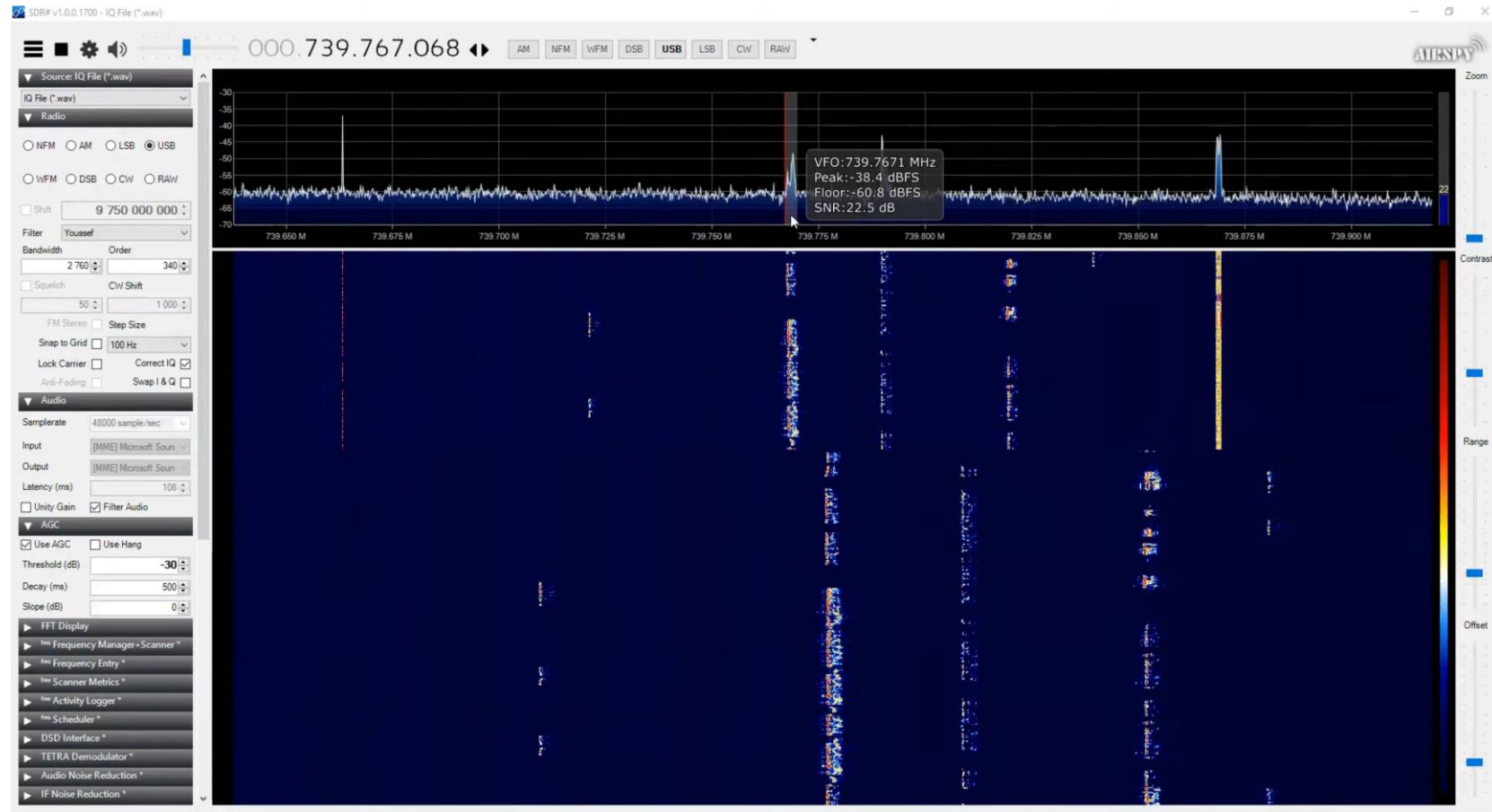




Dostupná SW  
vybavení

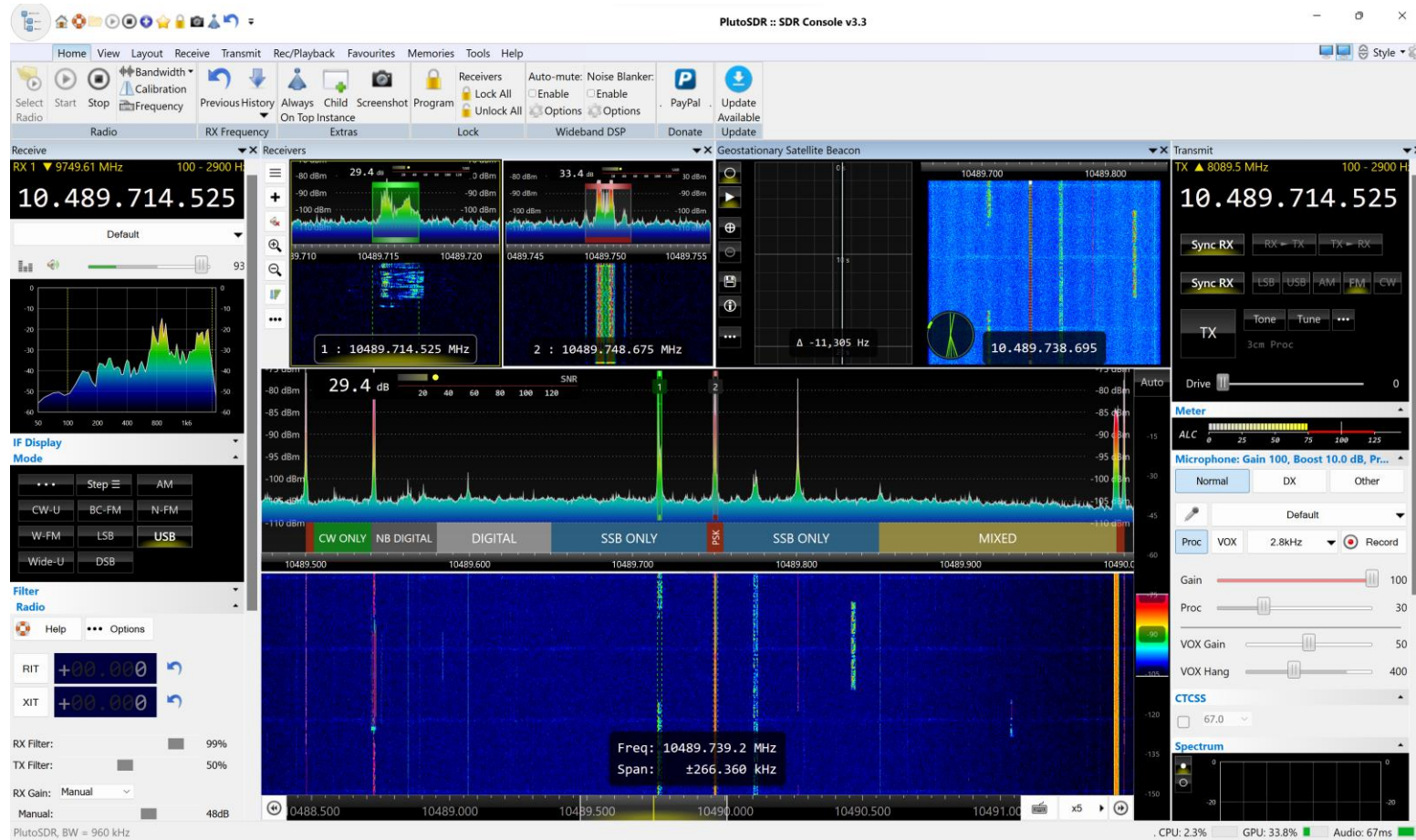
# SDR Sharp

- Pouze RX
- Jednoduchý
- Zásuvné moduly pro dekódování dig. provozů



# SDR console

- Full transceiver
  - Nejen na QO-100
- Široká podpora HW
  - LimeSDR, ADALM pluto, AirSpy, USRP
- Synchronizace na datový maják





# SDR Angel

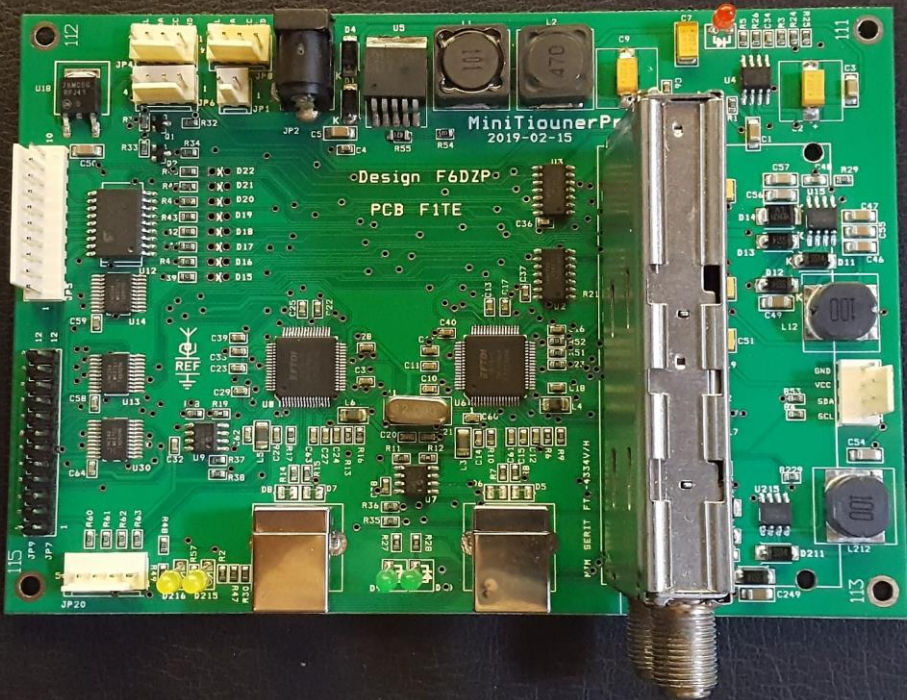
- Linux SW
- Podpora DATV

The image displays the SDR Angel software interface, which is used for software-defined radio (SDR) operations. The interface is divided into several panels:

- Top Panel:** Shows the main SDR Angel window with a menu bar (File, View, Workspaces, Preferences, Help) and a toolbar. The main display area shows a spectrum plot for "Airspsy[0]" with a center frequency of 0,745,000 kHz. The plot shows a signal between 740.0 and 750.0 kHz, with a vertical axis from 0 to -100 dB.
- Bottom-Left Panel:** Shows the "DATV Demodulator" settings. The "RF Settings" section displays a frequency of +02,393,728 Hz and a bandwidth of 01,712,000 Hz. The "DATV Settings" section includes options for DVB-S2, MCOD, QPSK, Sym/s (1500000), 4/5, Notch filter (0), FAST LOCK, ALLOW DRIFT, HARD METRIC, VITERBI, SOFT LDPC, MAX BFL (0), and FIR NEARE. The "Data" section shows 0B and "Speed: 0b/s". The "Video" section is checked, and the "Buffer" is at 0%. The "MER" and "CNR" meters are visible, with MER at 0.0 and CNR at 30.9. The "UDP" section shows an address of 127.0.0.1 and a port of 8882.
- Bottom-Right Panel:** Shows the "DATV" video stream output. The video displays a satellite in space with the text "P4-A / Es'hail-2 00-100 Qatar-OSCAR 100". The "VIDEO Stream" section shows the PID (257), Width (1280), and Height (720). The "service\_name" is A71A, the "service\_provider" is QARS, and the "Codec" is H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10. The "Data" section is checked, and the "Transport" and "Video" sections are also checked. The "Decoding" section is checked, and the "0" button is visible.

# MiniTiouner

- Single RX
- Detailnější rozbor signálu
- Dedikovaný HW



MINITIOUNE v1.0.1.0r - Receiver/Analyser DVB-S/S2 144 MHz to 2450 MHz - SRmini=25 kS/s - for MiniTiouner/MiniTiouner-Pro

MiniTiounerPro V2  
NIM : Serit FTS-4334L  
ppm calibr 23,00 (i)

SR (kS) Freq (kHz)  
01500 10491525

OSCAR-100

SR	Freq
1500	1 000
1000	2 125
500	3 250
333	4 375
250	5 500
125	6 625
66	7 750
35	8 875
25	9 000

DEROTATOR  
Symbolrate mode: fixed  
SR set: 1499965S  
Deviation: 89S  
SR → 1500 kS/s

Frequency  
Freq asked: 10491525kHz  
Freq → 10491865 kHz  
IF 741525kHz

TS from:  
16USB  
8USB  
2USB  
Demod

2980 max  
2380 min  
2 373,976kb/s  
Bitrate expected: 2 380,794kb/s  
reset TS

Noise  
I: 143 Q: 145

TS bitrate

PIDs  
A71A Auto PID  
F6DZP-Mpeg VIDEO  
HDlowSR PID 00257  
France24 V\_H264  
QRZ DX PID 00258  
RaspberryP MPA

Program A71A  
Provider QARS

Renderer  
Graph  
VLCdll

TS IP: 230.0.0.10:10000  
Width: 1280  
Height: 720  
photo

A\_decoder: LAV Audio Decoder  
V\_decoder: Microsoft DTV-DVD

Format: 4/3  
16/9  
1/1  
auto  
Zoom: adapt  
x1  
maxi  
Format: 16/9

Info  
Audio level mute

Beep Dsave UDP Record  
Quit

LNA gain: 13,0dB

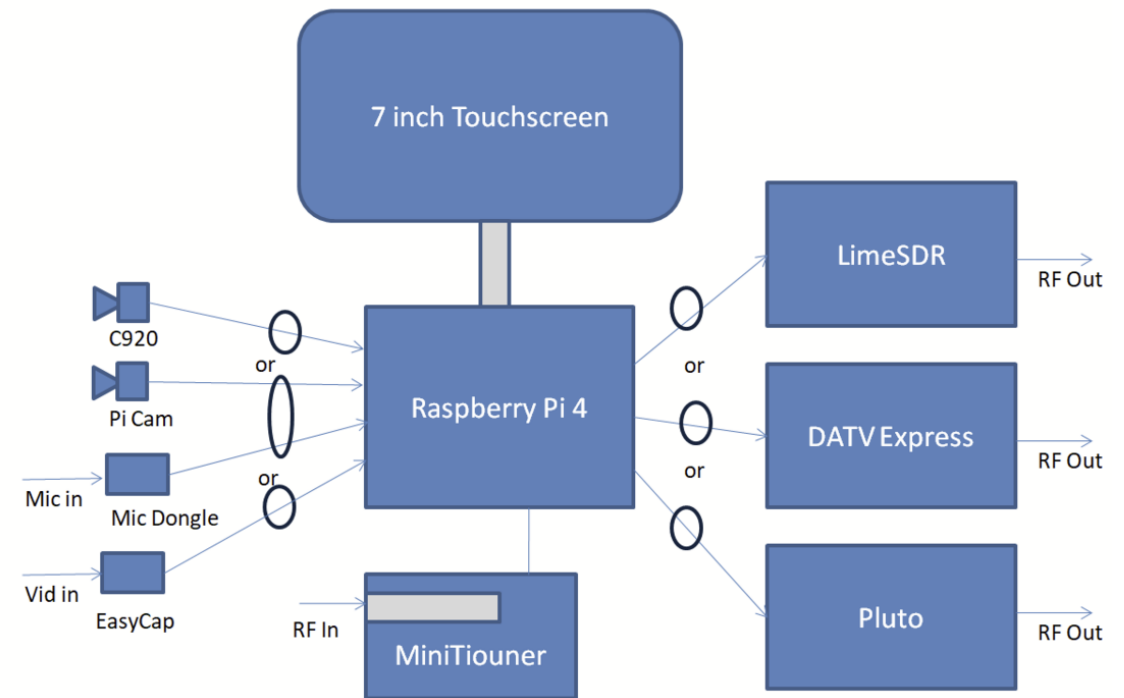
Carrier Lock  
SR Lock  
RF Pw -35dBm  
C/N MER 9,6dB  
Constellations

BCH errors 0  
LDPC 1% 98  
FEC QPSK 4/5\_L20  
C/N needed: 4,7 dB  
D5  
TS lock time: 2 402 ms refresh: 284ms

TS stat  
Null Packets: 2,5%  
Video: 2105kb/s 88,5%  
Audio: 125kb/s 5,3%  
data rcvd: 2 374,527kb/s  
TS bitrate: 2 379,686kb/s

# Portsdown 4

- Standalone řešení DATV
  - Běží na RPi 3/4
- Podpora LimeSDR + ADALM Pluto
  - DVB-T, DVB-S, DVB-S2
  - QPSK, 8PSK, 16APSK
  - 66kS ~ 4MS
- Sada podpůrných tools
  - BandViewer, Noise meter, Power meter
  - Signal generator, Meteor viewer (need SDR Play)
  - Langstone TRVCR



BATC Portsdown 4 DATV System Main Menu

TX		RX		M2	M3
Modulation	Encoder	Output to	Format	Source	
S2QPSK	H264	Lime Mini	4:3	PiScreen	
Freq	Sym Rate	FEC	Band/Tvtr	Lime Gain	
437 MHz	333	9/10	70_cm	88	
EasyCap	Caption	Audio	Atten	Att Level	
Comp Vid	On	Auto	NONE	-10.00	
Preset 1	Preset 2	Preset 3	Preset 4	Store	
146.5_333	437_Lime	1255_HD	437-Pluto	Preset	

# Open Tuner by [ZR6TG](https://github.com/ZR6TG)

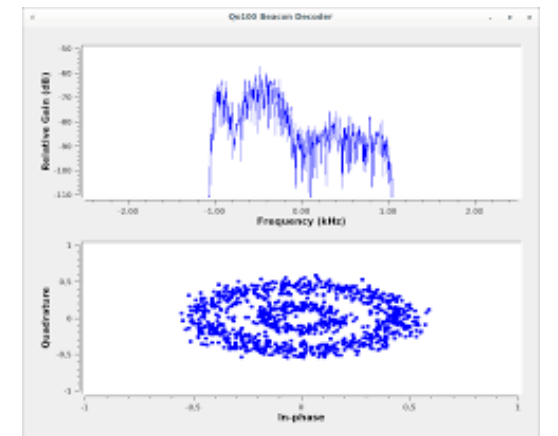
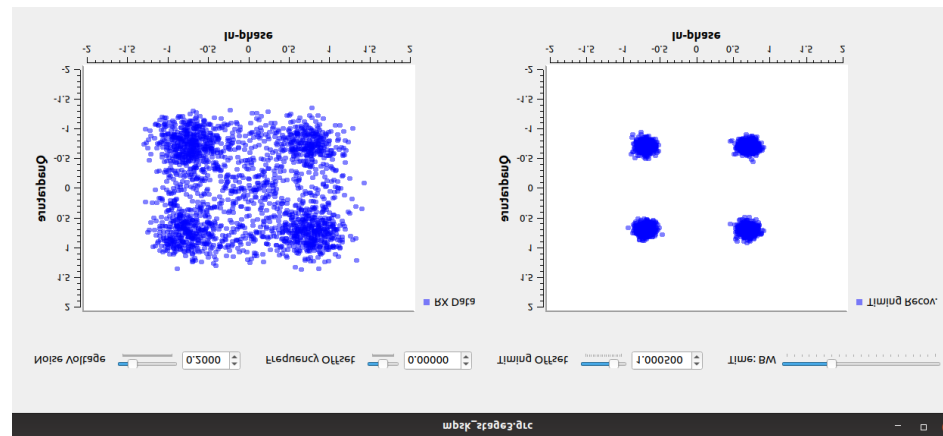
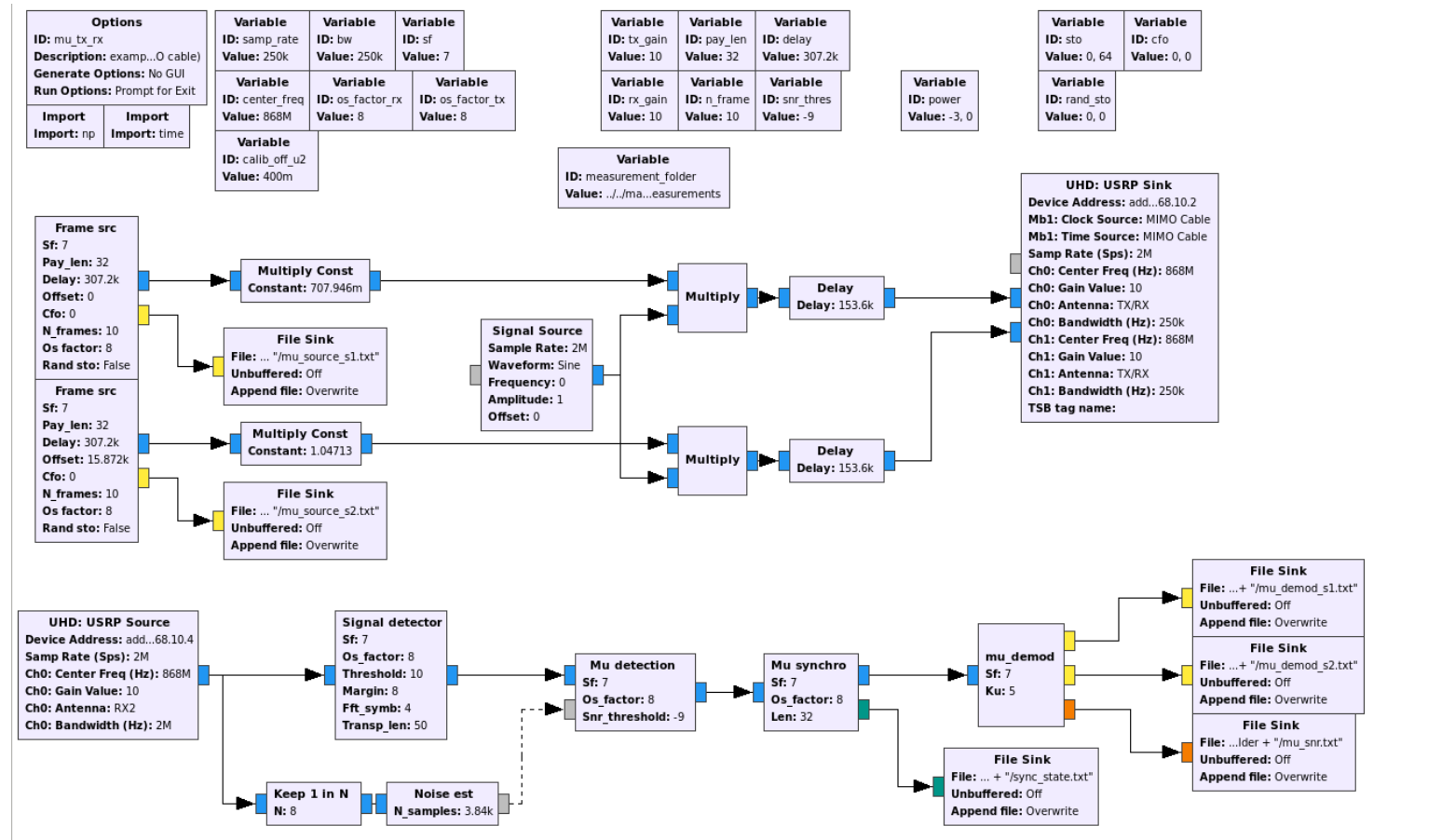
- Dual RX
- Spektrogram
- Wideband chat
- Potřeba Minitiouner HW

The screenshot displays the Open Tuner software interface, which is divided into several sections:

- Top Panel:** Shows a video feed of a rocket launch (ES'HAIL-2) with a telemetry overlay. The telemetry includes: T+ 00:01:21, STAGE 2, SPEED 02007 km/h, and ALTITUDE 16.0 km. A progress bar at the bottom of the video feed indicates stages: LIFTOFF, SES-1, ENTRY BURN, LANDING BURN, LANDING, SES-2, PAYLOAD DEPLOY, and SES-3.
- Left Panel (Tuner 1 - VLC):** Shows the configuration for the first tuner. It is locked to DVB-S2 D4,0. Key parameters include: Mer: 8,7 dB, RF Input Level: -37 dB A, Requested Freq: 10 491 530 (741 530), LNA Gain: 0, Symbol Rate: 1499, Modcod: QPSK 4/5, Ber: 1234, Freq Carrier Offset (Hz): 353914, Stream Format: Transport, Service Name: A71A, Service Name Provider: QARS, Null Packets: 3%, Video Codec: H264 - MPEG-4 AVC (part 10), Video Resolution: 1280 x 720, Audio Codec: MPEG Audio layer 1/2, Audio Rate: 48000 Hz, 2 channels. Volume is set to 0%.
- Left Panel (Tuner 2 - VLC):** Shows the configuration for the second tuner. It is locked to DVB-S2 D1,5. Key parameters include: Mer: 2,5 dB, RF Input Level: -37 dB A, Requested Freq: 10 496 254 (741 530), LNA Gain: 0, Symbol Rate: 999, Modcod: QPSK 1/2, Ber: 1137, Freq Carrier Offset (Hz): 384049, Stream Format: Transport, Service Name: OK2HAZ, Service Name Provider: FIRM2101RC, Null Packets: 30%, Video Codec: H264 - MPEG-4 AVC (part 10), Video Resolution: 1024 x 576, Audio Codec: MPEG AAC Audio, Audio Rate: 48000 Hz, 2 channels. Volume is set to 0%. There is a checkbox for "Disable TS/Video".
- Bottom Panel:** A spectrum analyzer showing the frequency spectrum. It displays several peaks with their corresponding frequencies and rates: A71A at 10491,52 (1500Ks), OK2HAZ at 10496,26 (1000Ks), and other channels at 10494,72 (500Ks), 10497,26 (333Ks), 10498,23 (333Ks), and 10499,25 (333Ks). The display also shows Dn: 10496,75 SR: 125/66/33 and Up: 2407,25.

# GNU Radio

- Extrémí škálovatelnost
- Lze implementovat prakticky jakýkoliv provoz
- Složitější na ovládání



# Používané provozy na QO-100

- CW
- SSB (FM je zakázána)
- SSTV (analog + digital DRM)
- FSK (telemetrický + multimediální maják)
- Digital voice (FreeDV)
- FT8 ~~FT8~~
- DATV
  - DVB-S, DVB-S2
    - H.265 / H.265 / H.266



Q & A

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OK2HAZ

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Michal Grygárek

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ok2haz@seznam.cz