

# All-in-One

## A DATV SDR Experimental TX/RX solution

**HAMRADIO 2017**

**HB9DUG Michel**

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# Credits and disclaimers...

The experimental solution described and implemented here is based on the work of

- **Charles G4GUO**, DATV Express software on linux & Windows
- **Ron W6RZ**, gr-dvbs, gr-dvbs2 and gr-dvt2 blocks on GNU Radio
- **Evariste F5OEO**, rpidatv software
- **Pascal F4DAV**, leanDVB - a lightweight software DVB-S demodulator

Without their software, in deep descriptions on the subject, I would not have been successful on this project !

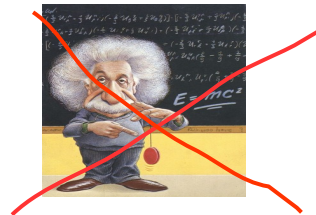
*Please note that the author is not either a Linux, python and script file expert and is therefore asking for your indulgence if the description, python and script files are very basic !*



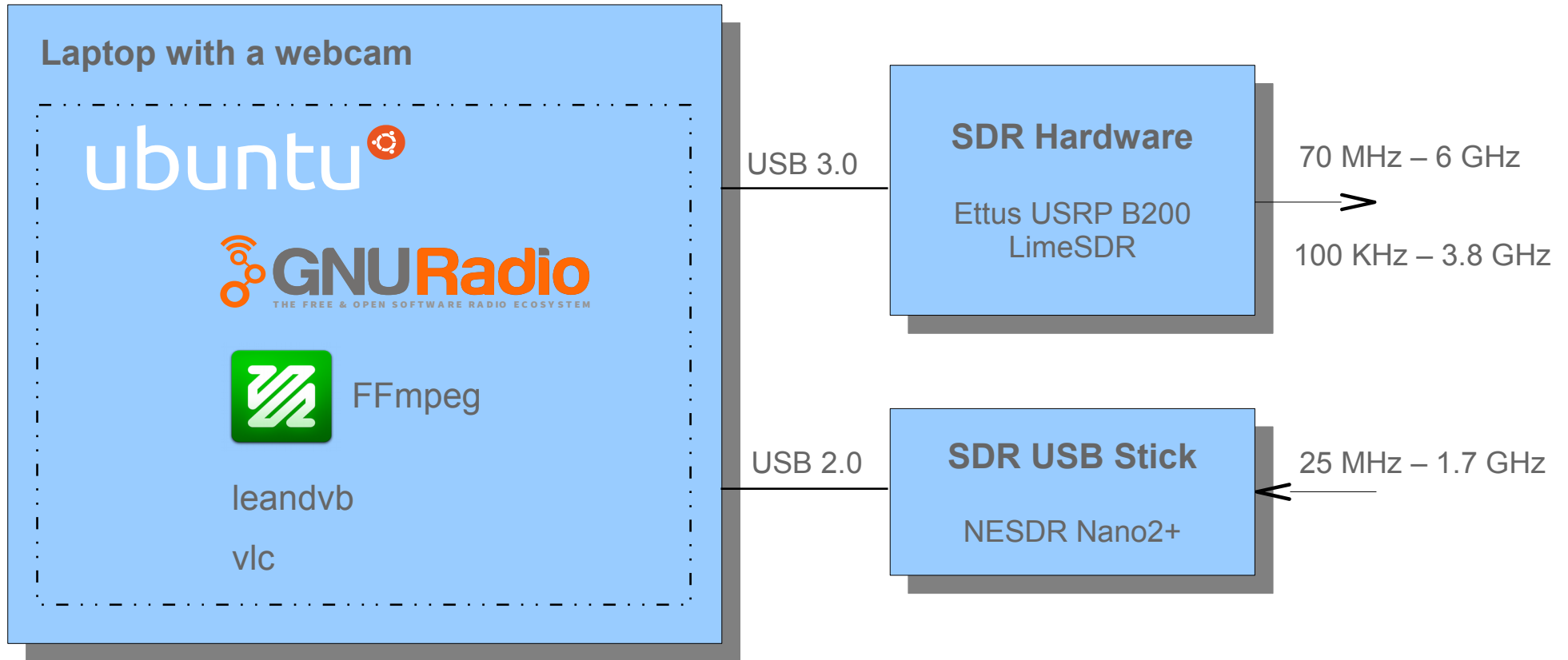
# Project goal

To have a demonstrator of a software defined radio for DATV

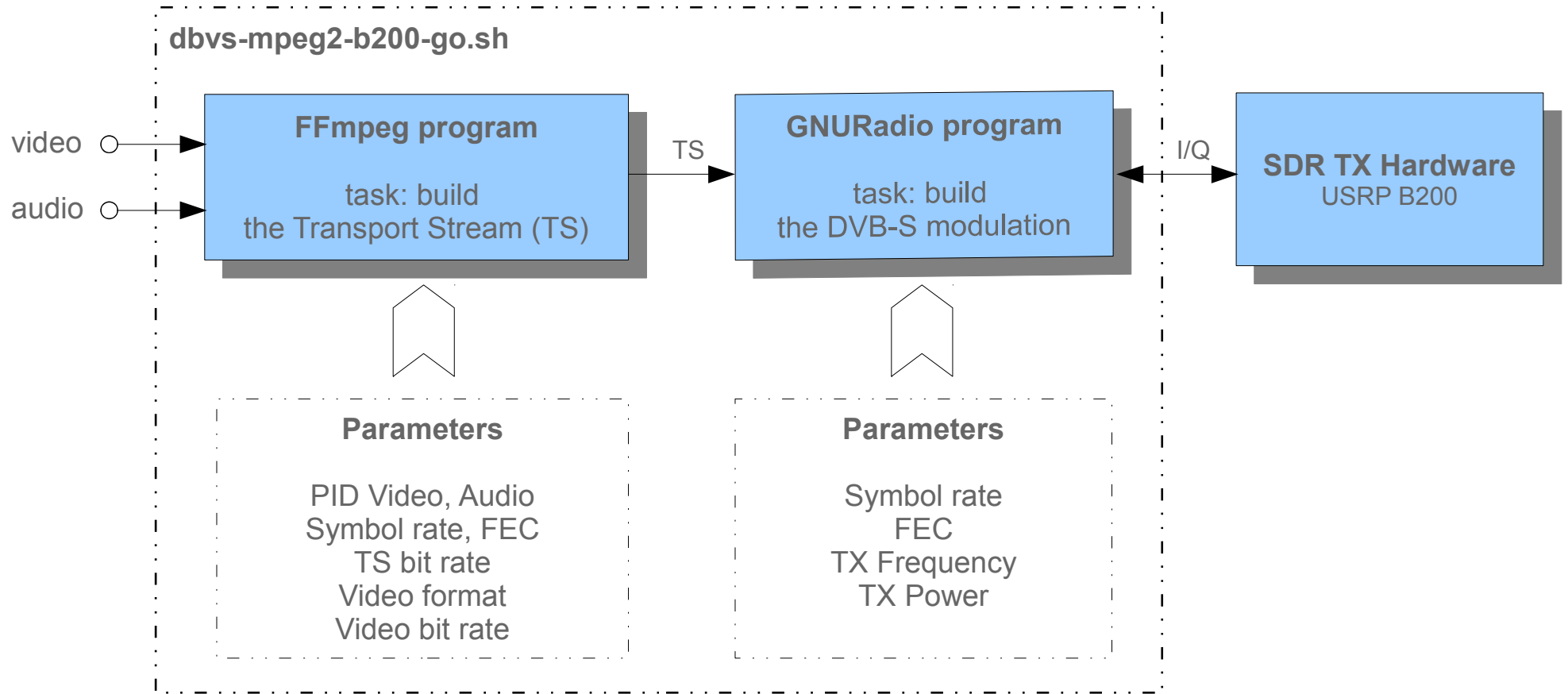
- able to transmit and receive at a minimum, DVB-S standard at low symbol rates
- based on open-source software
- using fully integrated, low-cost, single-board software defined radio
- reproducible by a radio amateur with average knowledge in computer science



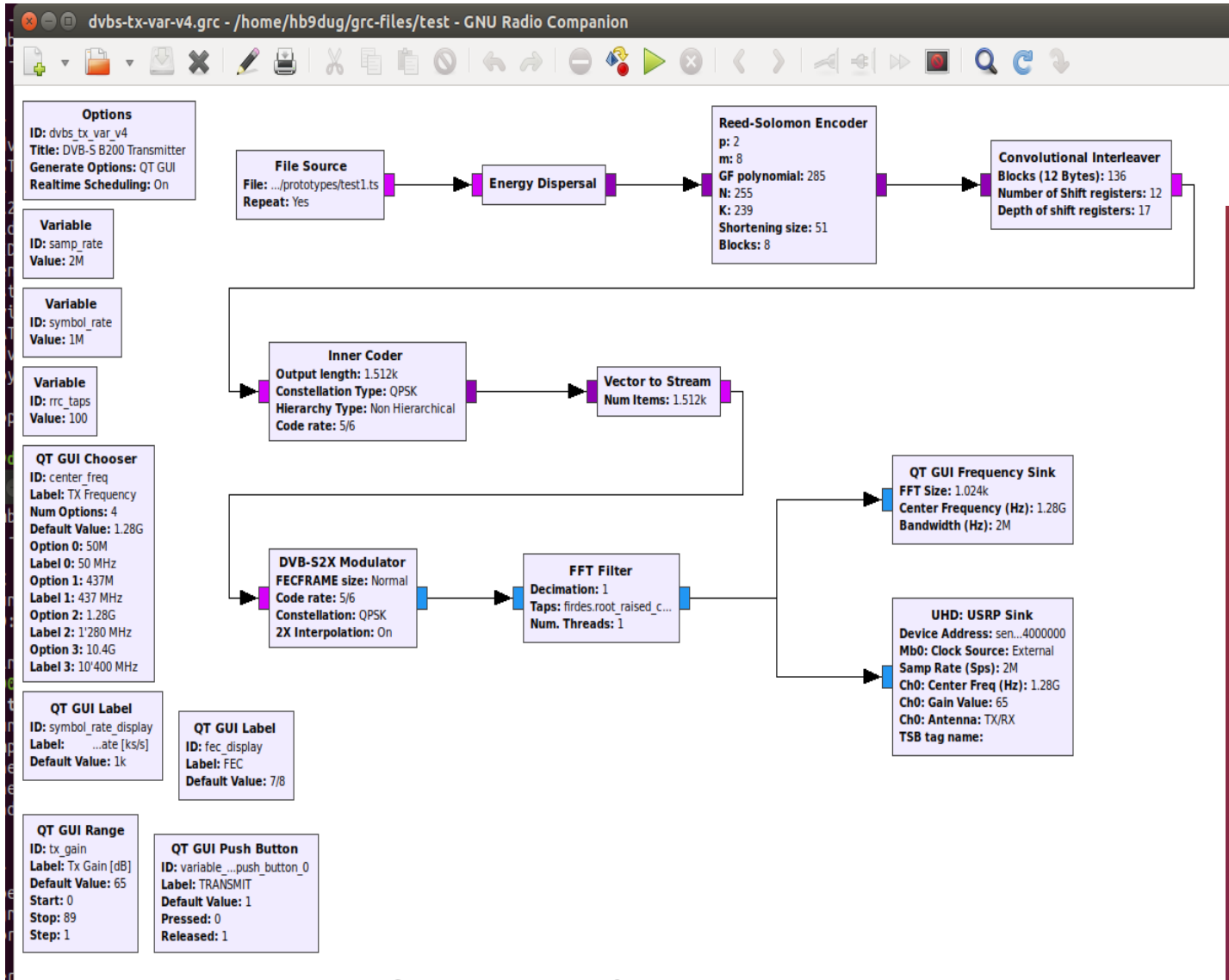
# Project hardware and software



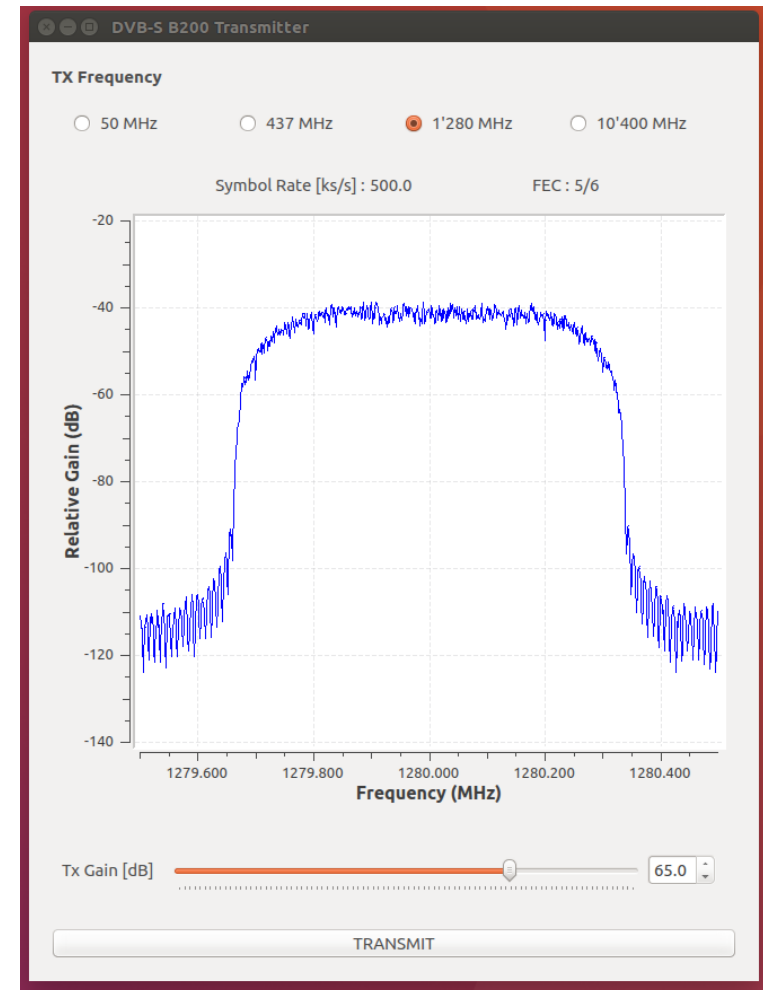
# Software work-flow for the TX side



# GNURadio DVB-S TX



GNURadio-Companion graphic tool



# GNURadio DVB-S TX

```
dvbs_tx_var_v4.py (~/.grc-files) - gedit
Open Save

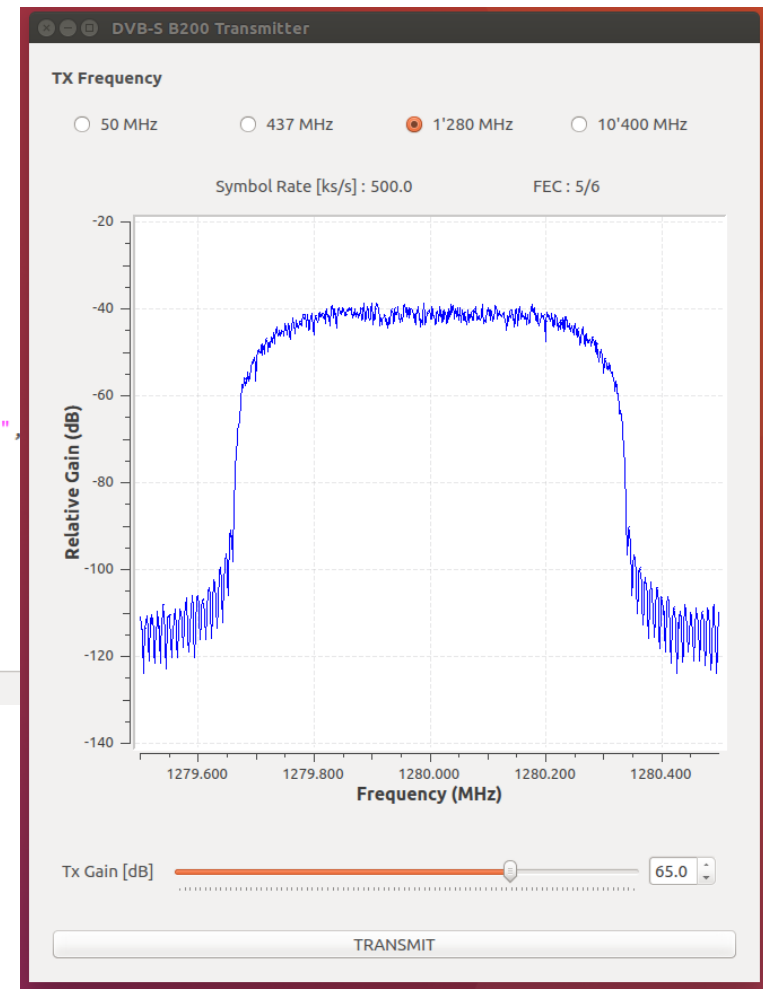
self.top_layout.addLayout(self.top_grid_layout)

self.settings = Qt.QSettings("GNU Radio", "dvbs_tx_var_v4")
self.restoreGeometry(self.settings.value("geometry").toByteArray())

#####
# Variables
#####
self.symbol_rate = symbol_rate = 1000000
self.symbol_rate = symbol_rate
self.variable_qtgui_push_button_0 = variable_qtgui_push_button_0 = 1
self.tx_gain = tx_gain = 45
self.symbol_rate_display = symbol_rate_display = symbol_rate/1000
self.samp_rate = samp_rate = symbol_rate * 2
self.rrc_taps = rrc_taps = 100
self.fec_display = fec_display = "7/8"
self.fec_display = fec_display
self.center_freq = center_freq = 1280e6

#####
# Blocks
#####
self._tx_gain_range = Range(0, 89, 1, 65, 200)
self._tx_gain_win = RangeWidget(self._tx_gain_range, self.set_tx_gain, 'Tx Gain [dB]', "counter_slider",
self._center_freq_options = (50e6, 437e6, 1280e6, 2368.5e6, )
self._center_freq_labels = ('50 MHz', '437 MHz', "1'280 MHz", "10'400 MHz", )
self._center_freq_group_box = Qt.QGroupBox('TX Frequency')
self._center_freq_box = Qt.QHBoxLayout()
class variable_chooser_button_group(Qt.QButtonGroup):
    def __init__(self, parent=None):
        Qt.QButtonGroup.__init__(self, parent)
    @pyqtSlot(int)
    def updateButtonChecked(self, button id):

Python Tab Width: 8 Ln 86, Col 65
```



IAPC - ATV Technical Group

GNURadio python code

# The TX script file, the glue...

```
*dvbs-mpeg2-b200-go.sh (~/.grc-files) - gedit
Open [+] Save

#!/bin/bash

# Version 1.0 / 2017-05-01
#
# DVB-S B200 Transmitter
# script file to generate a Transport Stream with the internal camera for a given Symbol Rate
# send the SR and FEC parameters to the gnuradio DVB-S Transmitter (dvbs_tx_var_v4.py)

killall -9 ffmpeg >/dev/null 2>/dev/null
killall python2 >/dev/null 2>/dev/null

rm fifo.ts
mkfifo fifo.ts

TYPE="quiet"

PID_VIDEO="33"
PID_AUDIO="49"
PID_PMT="0x0022"
PID_START="0X0121"
ID_TS="1000"
ID_SERVICE="1"
SERVICE_PROVIDER="GNURadio-DVB-S"
SERVICE_NAME="HB9DUG"

FORMAT_VIDEO=""
RATE_VIDEO=""
AUDIO_ON="0"
RATE_AUDIO=""
RATE_MUX=""
GNURADIO_PROG=""

FEC="5/6"

SYMBOL_RATE=""

sh Tab Width: 8 Ln 47, Col 1 INS
```





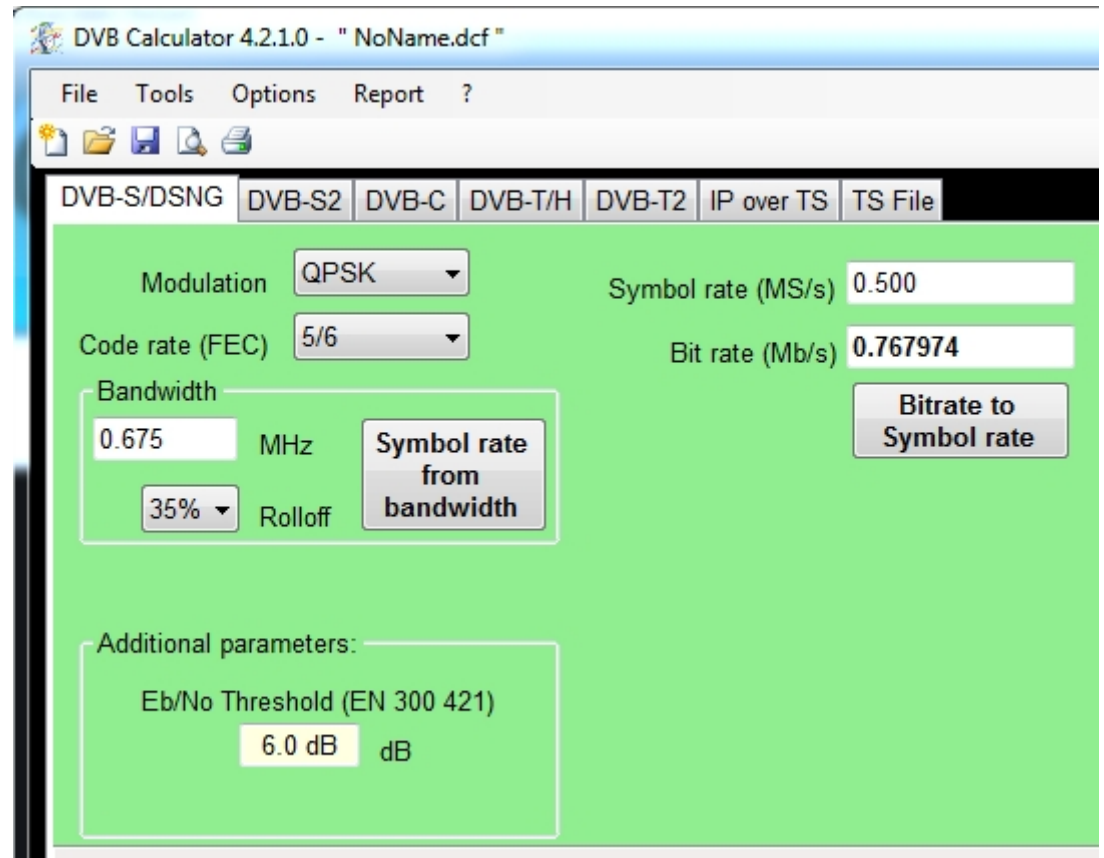
# The TX script file, the glue...

```
*dvbs-mpeg2-b200-go.sh (~/.grc-files) - gedit
Open Save

SYMBOL_RATE="SR"$SYMBOL_RATE_NUM

case "$SYMBOL_RATE" in
  SR125)
    AUDIO_ON="0"
    FORMAT_VIDEO="160x120"
    RATE_VIDEO="0.100M"
    RATE_AUDIO=""
    RATE_MUX="191993"
    ;;
  SR250)
    AUDIO_ON="0"
    FORMAT_VIDEO="320x240"
    RATE_VIDEO="0.320M"
    RATE_AUDIO=""
    RATE_MUX="383987"
    ;;
  SR500)
    AUDIO_ON="1"
    FORMAT_VIDEO="320x240"
    RATE_VIDEO="0.600M"
    RATE_AUDIO=""
    RATE_MUX="767974"
    ;;
  SR1000)
    AUDIO_ON="1"
    FORMAT_VIDEO="640x480"
    RATE_VIDEO="1.250M"
    RATE_AUDIO=""
    RATE_MUX="1535948"
    ;;
  SR2000)
    AUDIO_ON="1"
    FORMAT_VIDEO="640x480"
    RATE_VIDEO="2.7M"
    RATE_AUDIO=""
    RATE_MUX="3071895"

```



# The TX script file, the glue...

```
*dvbs-mpeg2-b200-go.sh (~/.grc-files) - gedit
Open Save

else

# ***** MPEG-2 VIDEO WITHOUT AUDIO *****
ffmpeg -loglevel $TYPE -analyzeduration 0 -probesize 2048 -thread_queue_size 512 \
-r 15 -f v4l2 -s $FORMAT_VIDEO -i /dev/video0 -fflags nobuffer -pix_fmt yuv420p -c:v mpeg2video \
-b:v $RATE_VIDEO -minrate $RATE_VIDEO -maxrate $RATE_VIDEO -bufsize $RATE_VIDEO \
-f mpegts -blocksize 1880 -strict experimental \
-mpegts_transport_stream_id $ID_TS \
-mpegts_pmt_start_pid $PID_PMT \
-mpegts_start_pid $PID_START \
-streamid 0:$PID_VIDEO \
-streamid 1:$PID_AUDIO \
-metadata service_provider=$SERVICE_PROVIDER \
-metadata service_name=$SERVICE_NAME \
-muxrate $RATE_MUX \
-y fifo.ts &
#*****
fi

sleep 1

./dvbs_tx_var_v4.py -sr $SYMBOL_RATE_NUM -vr $FEC >/dev/null 2>/dev/null &

sleep 1
echo ""
echo ""
echo -n "*** Press enter to stop transmitting at any time ***"
read var_n

killall -9 ffmpeg >/dev/null 2>/dev/null
killall python2 >/dev/null 2>/dev/null

sleep 1

echo ""
echo "Stopped encoding."
echo ""

sh Tab Width: 8 Ln 47, Col 1 INS
```



# To check the transmission...

TS Analyzer - HB9TV-2 11463 H - TechnoTrend BDA/DVB-S Tuner (1)

SI Tree Entries: 384

- Transponder
  - Network = HB9TV-2
  - Frequency = 11463 MHz
  - Polarisation = H
  - Symbolrate = 12000
  - FEC = 3/4
  - PAT PID = 0
    - TransportStreamID = 2000
    - NIT PID = 16
    - ServiceID = 6000 - Mire HB9T
    - ServiceID = 4000 - HB9TV-1 A
    - ServiceID = 4500 - HB9TV-1 C
    - ServiceID = 5000 - HB9TV-3 D
  - NIT PID = 16 - Actual Network
    - NetworkID = 2000 - RESEAU H
    - Descriptor = 0x40 - Network I
    - TransportStreamID = 2000 - 1
  - SDT PID = 17 - Actual TS
    - OriginalNetworkID = 2000 - R
    - TransportStreamID = 2000 - 1
    - ServiceID = 6000 - Mire HB9T
    - ServiceID = 4000 - HB9TV-1 A
    - ServiceID = 4500 - HB9TV-1 C
    - ServiceID = 5000 - HB9TV-3 D
  - EIT PID = 18 - Actual TS, Present
    - OriginalNetworkID = 1000
    - TransportStreamID = 5000
    - ServiceID = 3000
    - ServiceID = 6000 - Mire HB9T
    - ServiceID = 16
    - ServiceID = 1000
    - ServiceID = 2000
    - ServiceID = 17
    - ServiceID = 4000 - HB9TV-1 A
    - ServiceID = 4500 - HB9TV-1 C
    - ServiceID = 5000 - HB9TV-3 D

PIDs: 25

PID	Stream Type	Packets	Missing	Data Rate	Percent	Service	
18	0x0012	EIT	705	3830	25.84 kbps	0.13%	
100	0x0064	?	41	0	1.50 kbps	0.01%	
110	0x006E	MPEG2 Video	105059	0	3.85 Mbps	19.88%	HB9TV-1 ANALOG
120	0x0078	MPEG Audio	7860	0	288.13 kbps	1.49%	HB9TV-1 ANALOG
200	0x00C8	?	41	0	1.50 kbps	0.01%	
300	0x012C	?	41	0	1.50 kbps	0.01%	
310	0x0136	Video	30318	0	1.11 Mbps	5.74%	
330	0x014A	Teletext	5682	0	208.29 kbps	1.08%	
610	0x0262	MPEG2 Video	30412	0	1.11 Mbps	5.76%	Mire HB9TV-2
620	0x026C	Teletext	5670	0	207.85 kbps	1.07%	Mire HB9TV-2
1042	0x0412	?	467	0	17.12 kbps	0.09%	
1057	0x0421	MPEG2 Video	96866	0	3.55 Mbps	18.33%	HB9TV-3 DIGITAL
1073	0x0431	MPEG Audio	5488	0	201.18 kbps	1.04%	HB9TV-3 DIGITAL
1225	0x04C9	Video	31261	17	1.15 Mbps	5.92%	
1324	0x052C	Teletext	5610	0	205.65 kbps	1.06%	
8191	0x1FFF	Null Packets	202494	0	7.42 Mbps	38.32%	
0	0x0000	PAT	41	0	1.50 kbps	0.01%	
16	0x0010	NIT	41	0	1.50 kbps	0.01%	
17	0x0011	SDT	41	0	1.50 kbps	0.01%	
194	0x00C2	PMT	41	0	1.50 kbps	0.01%	HB9TV-1 DIGITAL
400	0x0190	PMT	41	0	1.50 kbps	0.01%	HB9TV-1 ANALOG
600	0x0258	PMT	41	0	1.50 kbps	0.01%	Mire HB9TV-2
1124	0x0464	?	41	0	1.50 kbps	0.01%	
1224	0x04C8	?	41	0	1.50 kbps	0.01%	
1524	0x05F4	PMT	41	0	1.50 kbps	0.01%	HB9TV-3 DIGITAL

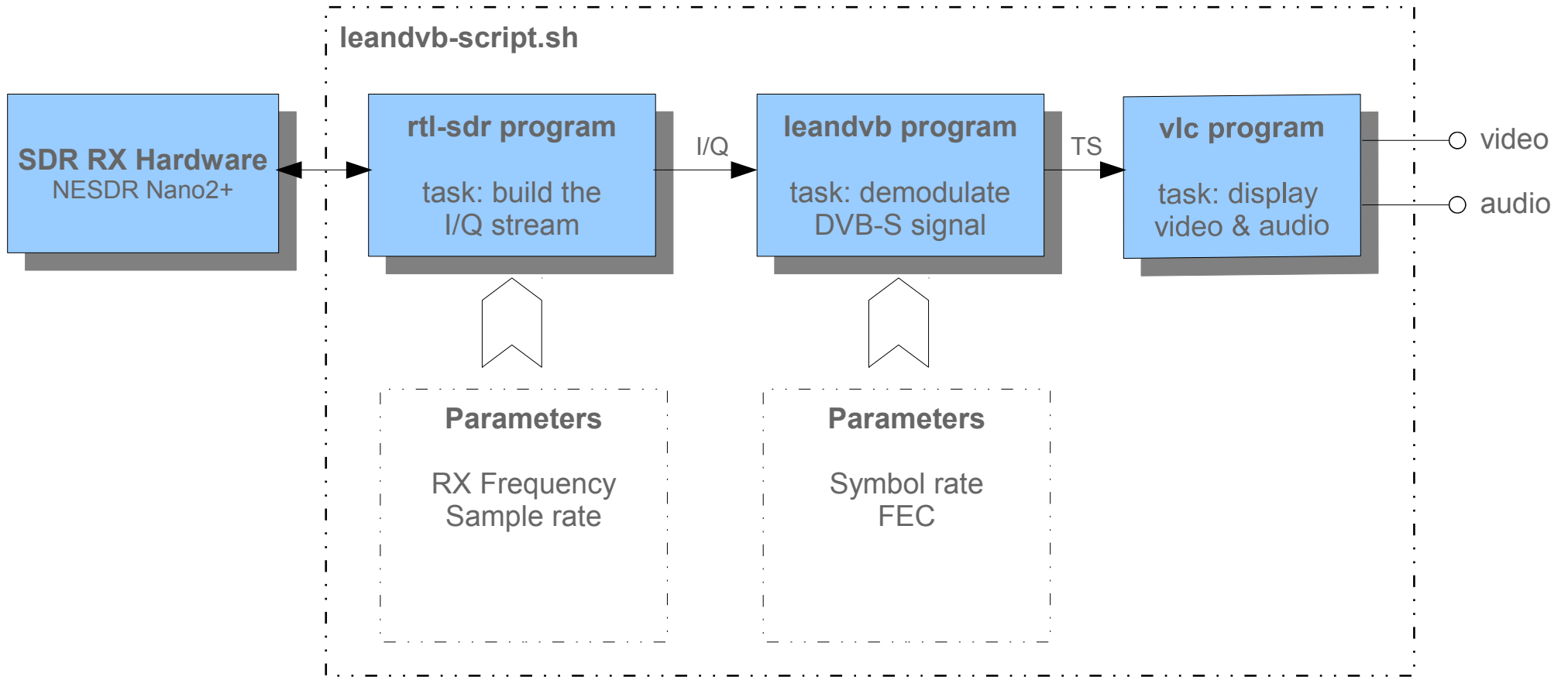
TransEdit, TSReader tools

Restart Preview

Save as XML Save as CSV Start Recording

Data Rate: 19.37 Mbps  
Quality: 48 %  
Rec. Time: 00:00:00  
Written: 0 MB

# Software work-flow for the RX side



# The RX script file, the icing on the cake

```
leansdr-script.sh (~/.grc-files) - gedit
Open Save
echo "LeanDVB tuner"
echo
echo -n "Symbol rate [KS/s]: "
read SR
echo

let SYMBOL_RATE=SR*1000

echo "- - - - -"
echo "Symbol rate [KS/s]: $SR  FEC: $FEC "
echo "- - - - -"
echo

case $SR in
  2000)
    SAMPLE_RATE="2400e3";;
  1000)
    SAMPLE_RATE="2400e3";;
  500)
    SAMPLE_RATE="2400e3";;
  250)
    SAMPLE_RATE="2400e3";;
  125)
    SAMPLE_RATE="2400e3";;
esac

#echo $SAMPLE_RATE

rtl_sdr -g 0 -f 1280e6 -s $SAMPLE_RATE - | ./leandvb --gui --sr $SYMBOL_RATE --cr $FEC | vlc - &

sleep 1
echo ""
echo ""
echo -n "*** Press enter to stop receiving at any time ***"
read var_n

sh Tab Width: 8 Ln 48, Col 39 INS
```



# References

## **Charles G4GUO**

<https://github.com/G4GUO>

<https://twitter.com/g4guo?lang=en>

## **Ron W6RZ**

<https://github.com/drmpeg>

<https://twitter.com/drmpeg?lang=en>

## **Evariste F5OEO**

<https://github.com/F5OEO>

<https://twitter.com/f5oeoevariste?lang=en>

## **Pascal F4DAV**

<http://www.pabr.org/radio/leandvb/leandvb.en.html>

<https://twitter.com/f4dav?lang=en>



# References

The screenshot displays the swissATV.ch website interface. At the top, the logo 'swissATV.ch' is accompanied by the text 'groupe technique ATV de l'IAPC'. A navigation menu includes 'Home', 'News', 'Activités', 'Hardware', 'Académie', and 'Labs', along with a search bar and a 'Font Size' control. Below the navigation, a secondary menu offers categories like 'All', 'News', 'Labs', 'Tests', 'Hardware', 'Software', and 'Académie', as well as sorting options: 'Default', 'Title', 'Date', and 'Random'. The main content area features a grid of article cards. The first card is titled 'A-Tech 2014 Automne' with a date of 2014-10-22 09:50:46 and a photo of a workshop. The second card is 'DATV-Express DVB-T 1 MHz' dated 2014-10-13 11:10:14, showing a green PCB. The third card is 'H264 DigiThin' dated 2014-10-01 17:23:43, featuring a photo of a circuit board. The fourth card is 'DVB-T2, le standard pour...' dated 2014-08-15 12:30:06, with a photo of a tablet displaying 'i-TAB DTV'. Below this grid, a 'Hardware' section contains five smaller article cards: 'SR-Systems', 'MK808 DigiThin', 'BATC DTX1', 'AGAF', and 'Hides USB DVB-T', each with a 'Read More' button.



Good hack !

