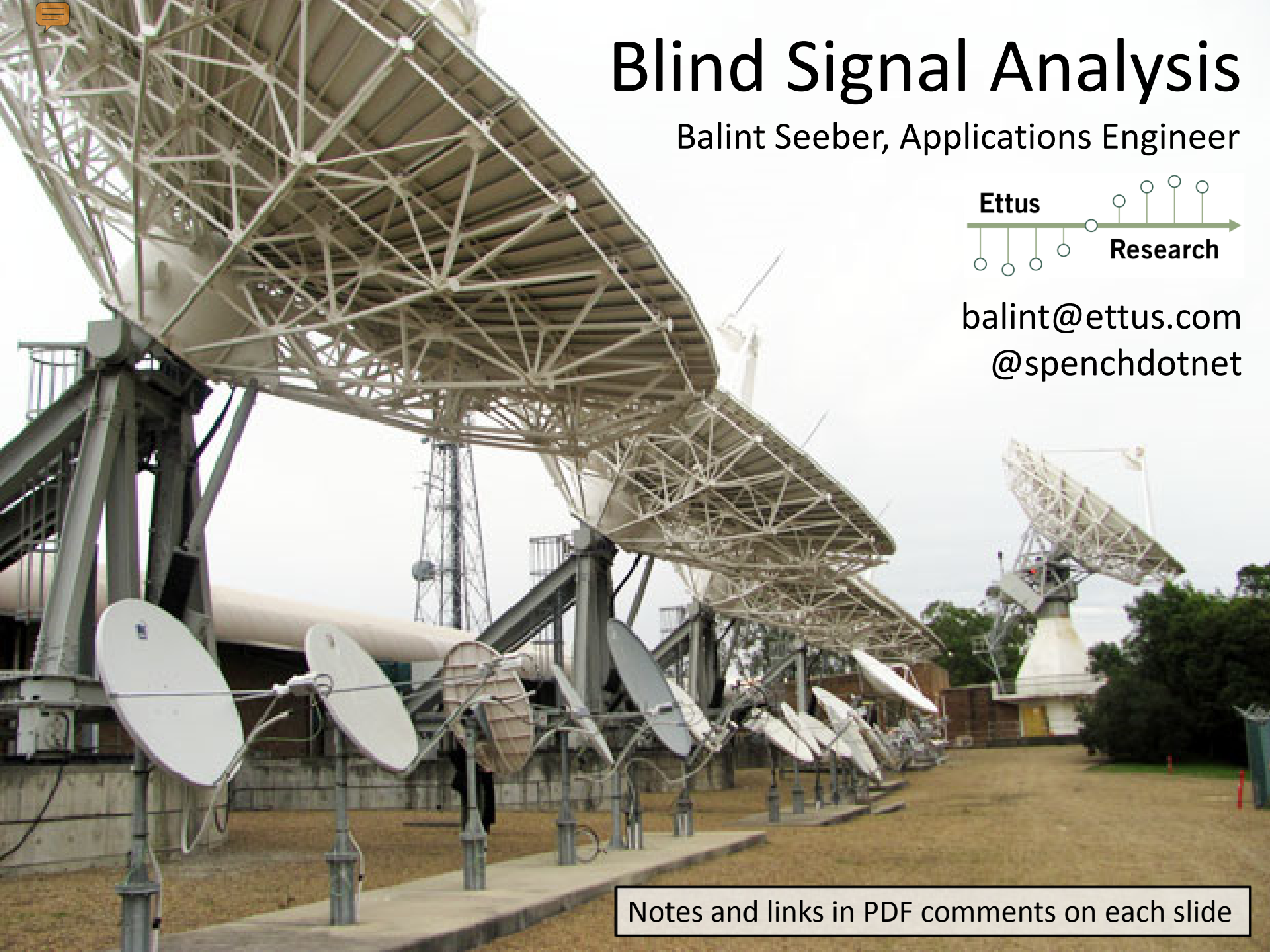
Blind Signal Analysis

Balint Seeber, Applications Engineer

Ettus Research

balint@ettus.com
@spenchdotnet



Notes and links in PDF comments on each slide

Recap

- Lots of different types of satellites
- Variables:
  - Purpose: comms, weather, MIL, amateur
  - Payload: transponders, cameras/sensors
  - Orbit: **L**ow **E**arth **O**rbit, geostationary (geosync)
  - Frequencies: uplink, downlink, beacon, command
- Two categories:
  - **Intelligent**: communication with on-board systems
  - **Dumb**: relay information with linear transponders

Wide-area re-broadcast

- RF megaphone (e.g. satellite TV)
- Single dish sends beam on uplink to satellite
- Linear transponder shifts raw RF to downlink frequency, re-transmitted via spot beams
- Cover any entire country

- Linear transponders are **dumb**: re-broadcast anything onto coverage area

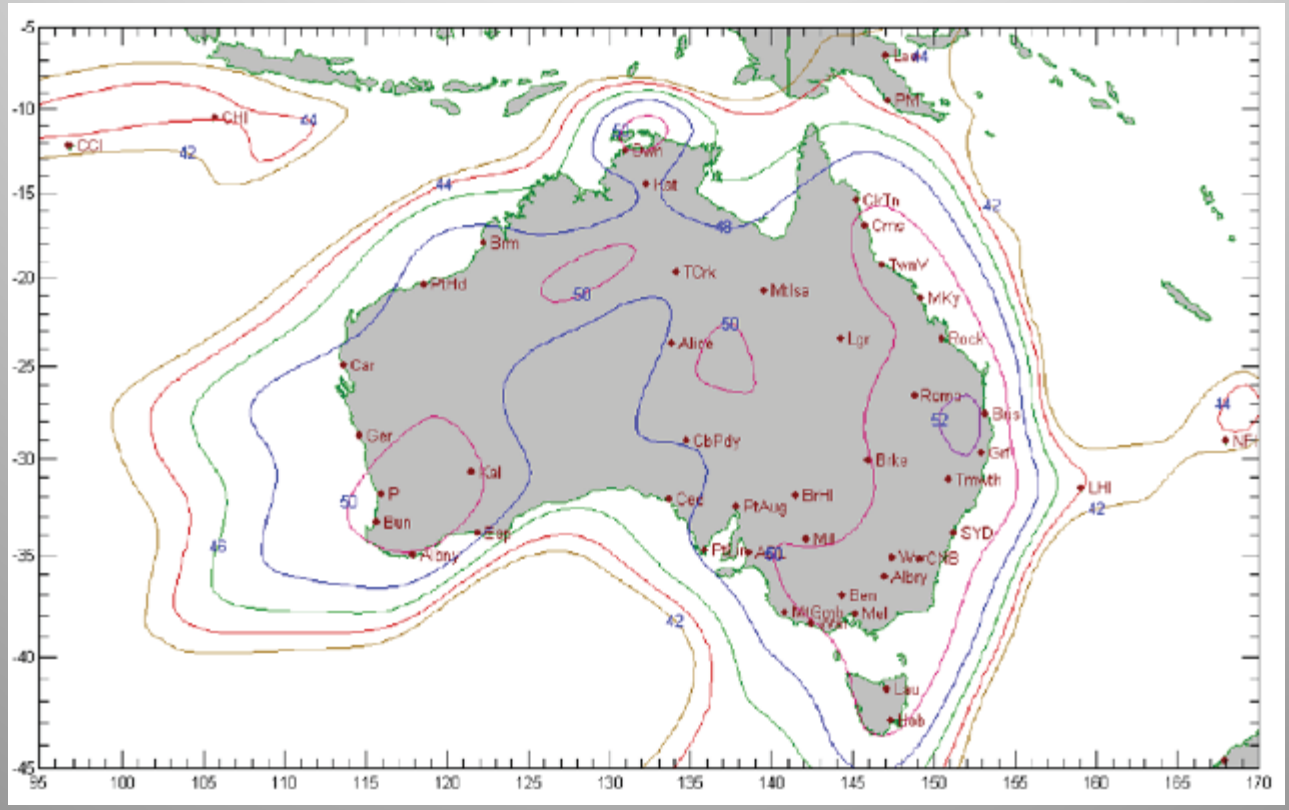
TT&C and UPC

- **T**elemetry, **T**racking and **C**ommand
- Need to be able to send commands to satellite
  - Change payload configuration
    - Multiplexing
    - Switch between redundant systems
    - Orbit
- Check on health of satellite/payload
  - Beacon + telemetry
- Measure affect of weather (combat rain fade)
  - **U**plink **P**ower **C**ontrol
  - Turn up transmitter power (keep at min. = save $$$)

Optus D1

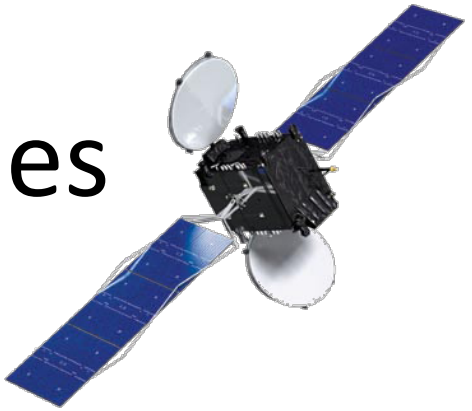
- 24 Ku band transponders
  - Multiplexed spot beams service Aus and NZ
  - Uplink: 14.0 - 14.5 GHz
  - Downlink: 12.25 - 12.75 GHz
  - Bandwidth: 54 MHz
- Mainly TV (wideband DVB-S)
  - ABC, SBS, Se7en, Nin9, SkyNZ
- Some other (narrowband) things…

FNA Beam Coverage

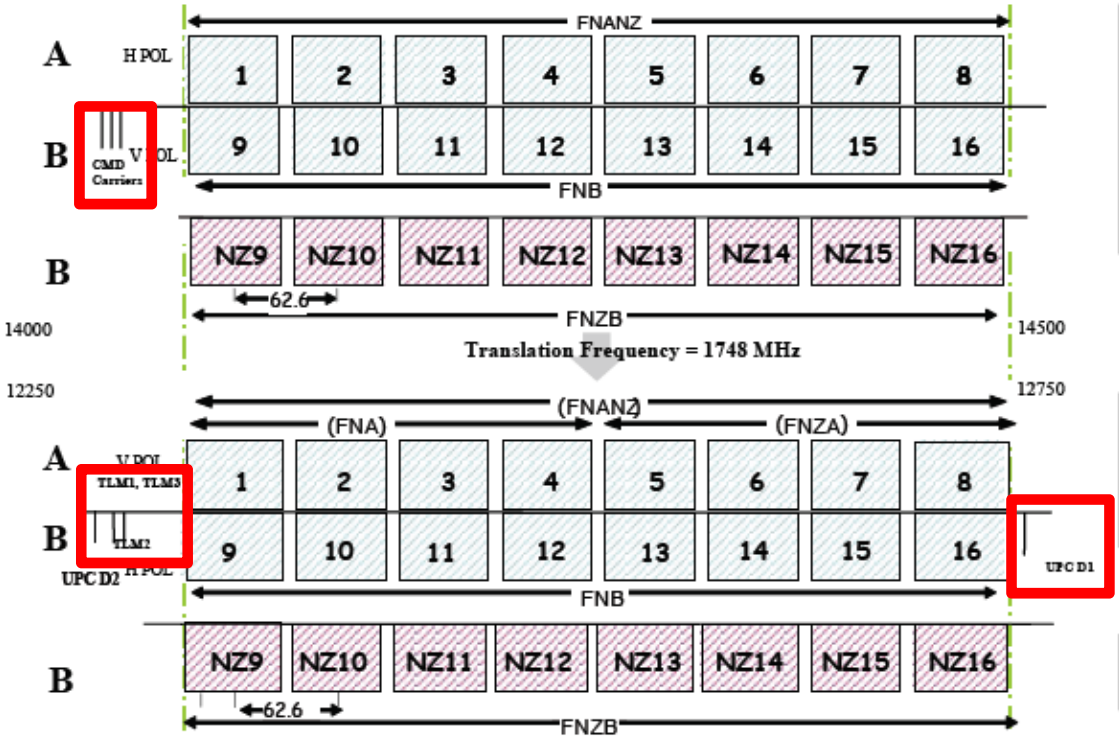


Effective **I**sotropic **R**adiated **P**ower (EIRP)

D1 Channel Frequencies



Uplink



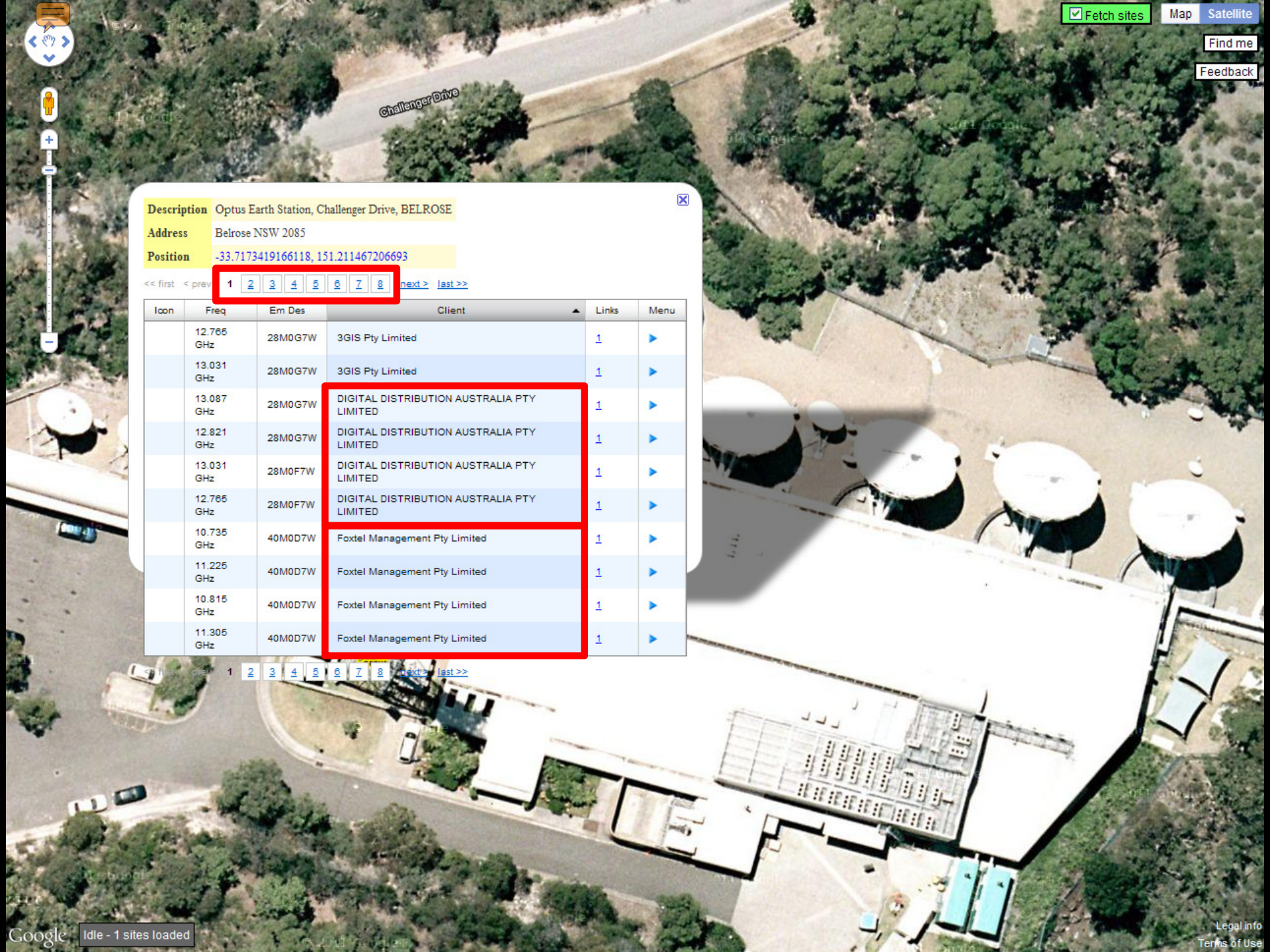
FSS Australia Centre Frequencies (MHz)		
Channel	Uplink	Downlink
1	14029.90	12281.90
2	14092.50	12344.50
3	14155.10	12407.10
4	14217.70	12469.70
5	14280.30	12532.30
6	14342.90	12594.90
7	14405.50	12657.50
8	14468.10	12720.10
9	14029.90	12281.90
10	14092.50	12344.50
11	14155.10	12407.10
12	14217.70	12469.70
13	14280.30	12532.30
14	14342.90	12594.90
15	14405.50	12657.50
16	14468.10	12720.10
TLM1		12243.25
TLM2		12245.25
TLM3		12243.25
UPC		12749.50

FSS NZ Centre Frequencies (MHz)		
Channel	Uplink	Downlink
NZ9	14029.90	12281.90
NZ10	14092.50	12344.50
NZ11	14155.10	12407.10
NZ12	14217.70	12469.70
NZ13	14280.30	12532.30
NZ14	14342.90	12594.90
NZ15	14405.50	12657.50
NZ16	14468.10	12720.10

D1

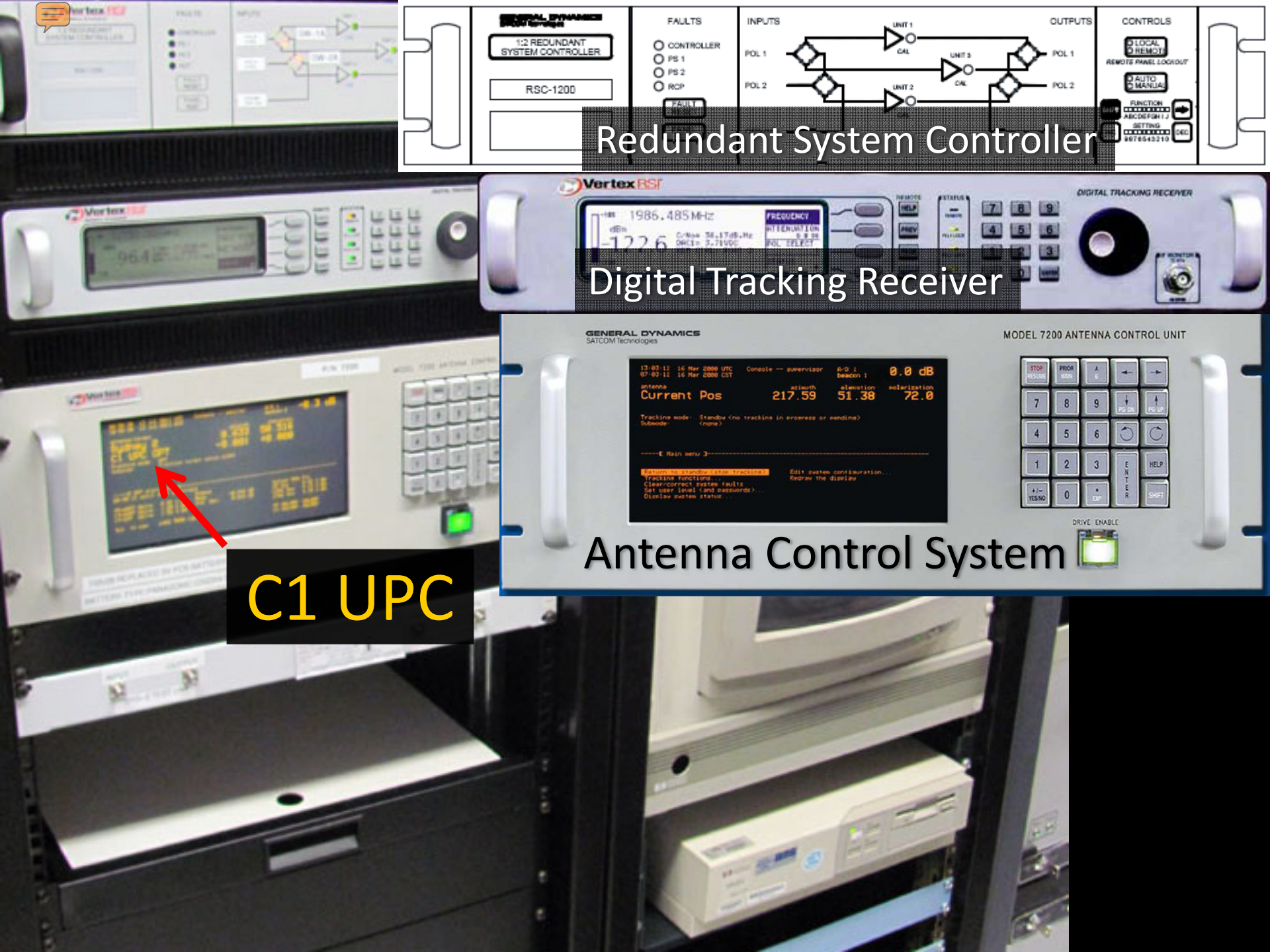
Downlink

Optus Earth Station
Belrose, Sydney


Fetch sites
Map
Satellite
Find me
Feedback
Challenger Drive
Description Optus Earth Station, Challenger Drive, BELROSE
Address Belrose NSW 2085
Position -33.7173419166118, 151.211467206693
<< first < prev 1 2 3 4 5 6 7 8 next > last >>
Icon | Freq | Em Des | Client | Links | Menu
12.765 GHz | 28M0G7W | 3GIS Pty Limited | 1
13.031 GHz | 28M0G7W | 3GIS Pty Limited | 1
13.087 GHz | 28M0G7W | DIGITAL DISTRIBUTION AUSTRALIA PTY LIMITED | 1
12.821 GHz | 28M0G7W | DIGITAL DISTRIBUTION AUSTRALIA PTY LIMITED | 1
13.031 GHz | 28M0F7W | DIGITAL DISTRIBUTION AUSTRALIA PTY LIMITED | 1
12.765 GHz | 28M0F7W | DIGITAL DISTRIBUTION AUSTRALIA PTY LIMITED | 1
10.735 GHz | 40M0D7W | Foxtel Management Pty Limited | 1
11.225 GHz | 40M0D7W | Foxtel Management Pty Limited | 1
10.815 GHz | 40M0D7W | Foxtel Management Pty Limited | 1
11.305 GHz | 40M0D7W | Foxtel Management Pty Limited | 1
1 2 3 4 5 6 7 8 next > last >>
Google
Idle - 1 sites loaded
Legal info
Terms of Use

Spot the satellite modem

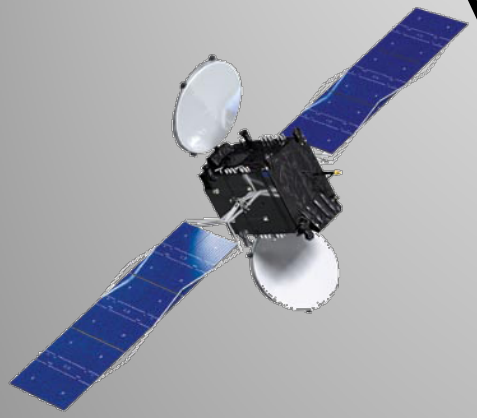
Radyne Comstream Satellite Modem DMD-15

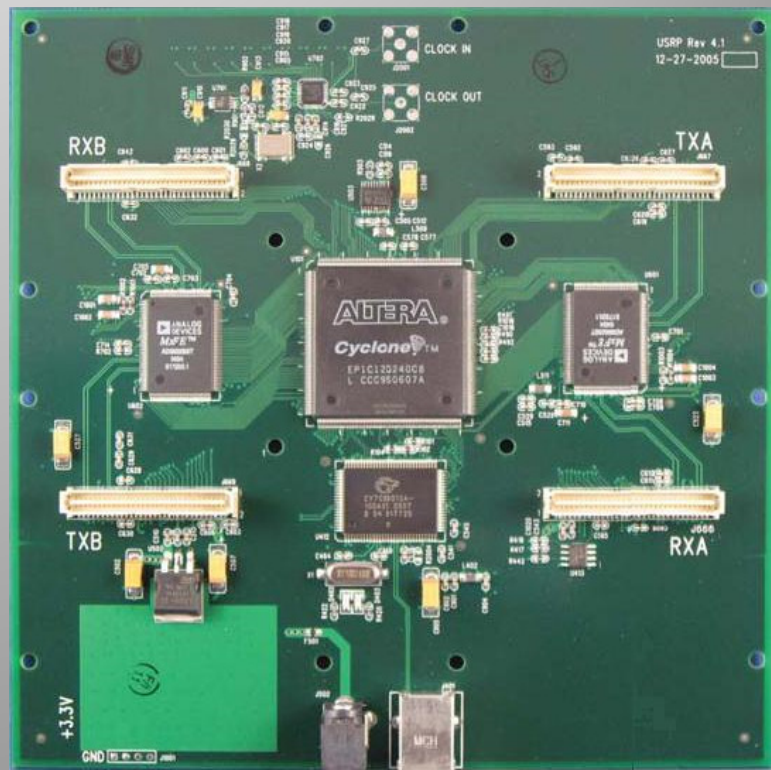

1:2 REDUNDANT SYSTEM CONTROLLER
RSC-1200
FAULTS
CONTROLLER
PS 1
PS 2
RCP
INPUTS
OUTPUTS
POL 1
POL 2
CONTROLS
LOCAL
REMOTE
AUTO
MANUAL
Redundant System Controller
Vertex RSI
DIGITAL TRACKING RECEIVER
1986.485 MHz
FREQUENCY
ATTENUATION
POL SELECT
Digital Tracking Receiver
GENERAL DYNAMICS
SATCOM Technologies
MODEL 7200 ANTENNA CONTROL UNIT
Current Pos
217.59
51.38
72.0
0.0 dB
DRIVE ENABLE
Antenna Control System
C1 UPC

What you need

Dish + LNB + power injector + USRP + GNU Radio

(set-top box with LNB-thru)





Low **N**oise **B**lock down-converter

Subtract 11.3 GHz from downlink frequency: 950 - 1450 MHz

Ku Band High Power TM Transmitters

Applications

- Satellite TC&R subsystems
- Telemetry and ranging transmission and modulation

Main features

- Ku Band
- Compatible with most of bus interfaces (command & telemetry formats)
- Power supplies 22 to 100V
- High power output, 8W EOL, 10W BOL (through SSPA)
- Flight Proven design
- Modulation Index selection
  - By Command
  - Automatic according to modulating tones number

Technologies

- Microwave Integrated Circuit
- Surface Mount Printed Circuit Board
- Thick Film Hybrid

Background

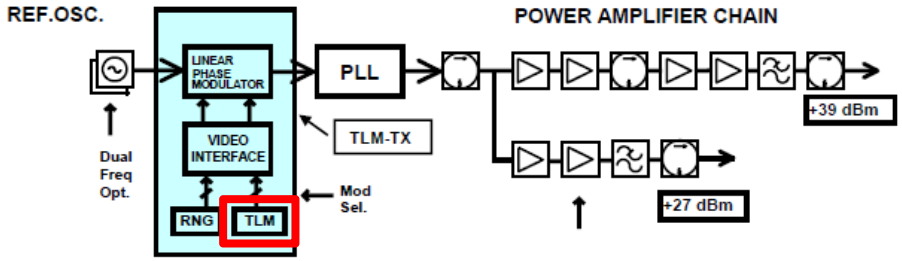
- AMC 14 - AMC 15 - AMC 16
- BSAT 2 A - BSAT 2 B
- BSAT 2 C
- BSAT3A
- ECHOSTAR 10
- ECHOSTAR 7
- GE 2A (NIMIQ2)
- HORIZON 2
- JCSAT 10
- JCSAT 11
- JCSAT 9
- NEWSKIES 6
- NEWSKIES 7
- OPTUS D1
- OPTUS D2
- Panamsat 11
- RAINBOW
- Thor2

Technical Description

- The unit consists of two modules:
  - MPLL module
  - Baseplate module

- The baseplate module houses the DC/DC converter board, which supplies the power voltages to the RF section, and the telemetry interface board, and the Solid State Power Amplifier (SSPA).
- The MPLL module includes all the microwave and RF circuitry to generate and modulate the Ku-band carrier. The modulation inputs interface is implemented on the Telemetry Interface board that is usually tailored on customer's requirements
- The reference crystal oscillator generates a frequency at about 100 MHz, depending on the exact transmitter frequency. The design is based upon a grounded-base configuration with an AT-cut quartz crystal resonator, oscillating in overtone mode. An analog thermal compensation network is implemented.
- Modulation indices may be selected by commands or, as option, automatic selection may be implemented. In this case a specific circuit keeps constant the total power of the modulation signal in presence of one, two or three input signals, in whatever combination
- The signal level emerging from the loop is about +10dBm. The following medium power Ku-band amplifier chain provides +27 dBm power level; it composed by three single ended stages using GaAs FET devices. The following SSPA, delivering 8W E.O.L. power level, is a single ended design, based on two power GaAs FET devices
- As an option, the unit can be equipped with an extra, independent amplifier chain, having an output power up to 0.5 W E.O.L. In this case the transmitter unit can operate in two functional modes: low power mode (0.5W), with high power output isolated (<-30dBm) and high power mode (8W), with low power output isolated (-15dBm)

Ku Band High Power Telemetry Transmitter Block Diagram



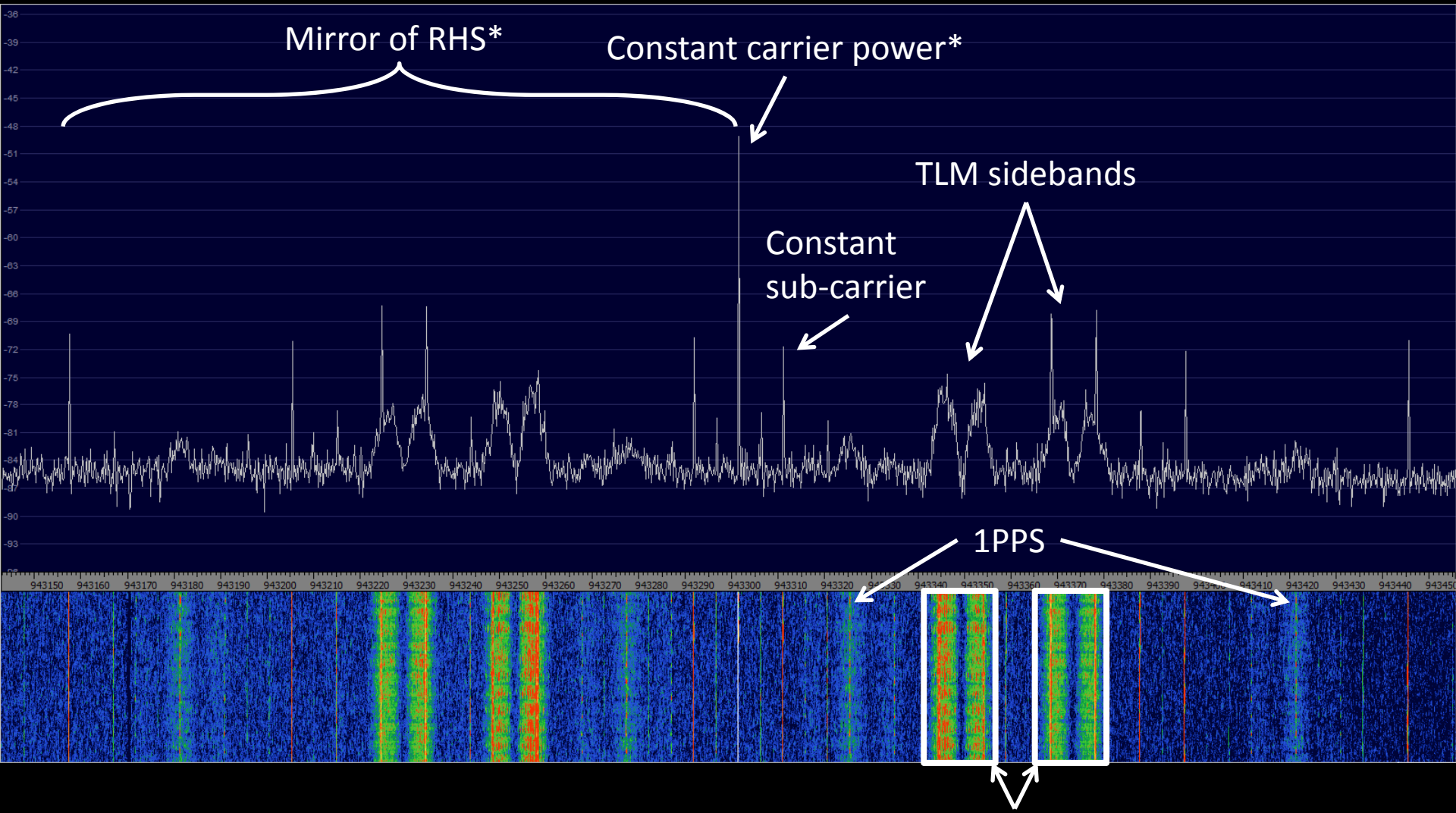
Main Performances

Output Frequency	10.7 – 12.7 GHz
Frequency Stability	± 10 ppm Std Stability Opt ± 5 ppm High Stability Opt
Output Power Level Extra Output	≥ 38.5 dBm (7W) EOL, up to 40dBm (10W) BOL (25C) ≥ 27 dBm EOL Dual Power Opt
Output Phase Noise	< 4 deg_{rms} @ 10 Hz to 1 MHz
PM modulation index	Up to 2.4 radpk
Mod.Index Selection	By command Automatic according to mod.tones number
Modulation Linearity	± 3%
Modulation Op.Mode	TM1, TM2, RNG1, RNG2, RNGS + TMs
DC/DC converter	55/71V – 22/43V (16Vpp max in the range for best efficiency)
Command Interface	HLC
Qualification Temp. Range	-25 / +65 °C

Mass, Dimensions and Consumption

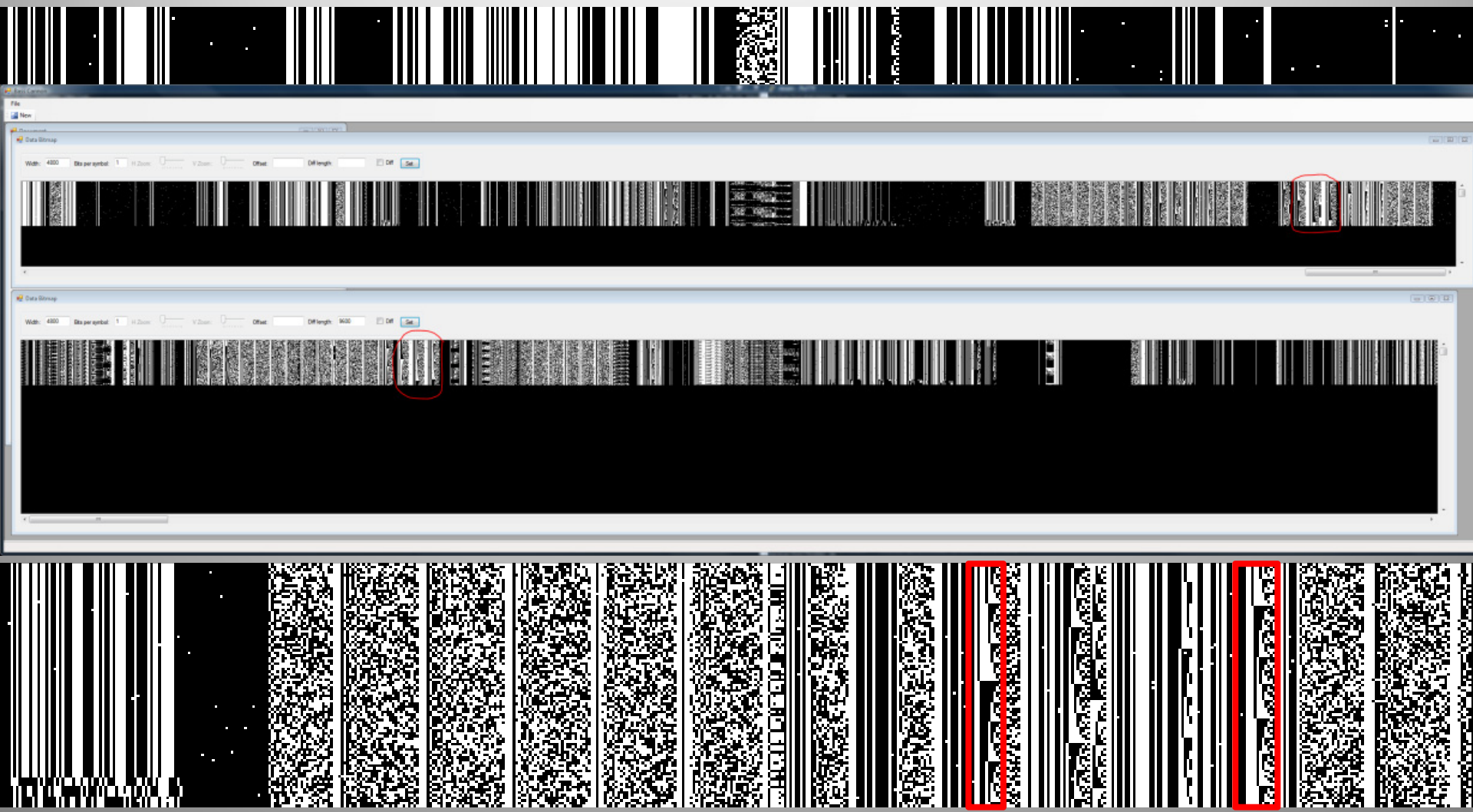
DC Power Consumption	High power mode Low power mode	<55W <18W (Dual Power Opt)
Mass Properties	< 2 kg	
Outline Dimensions	250 x 130 x 80 mm	

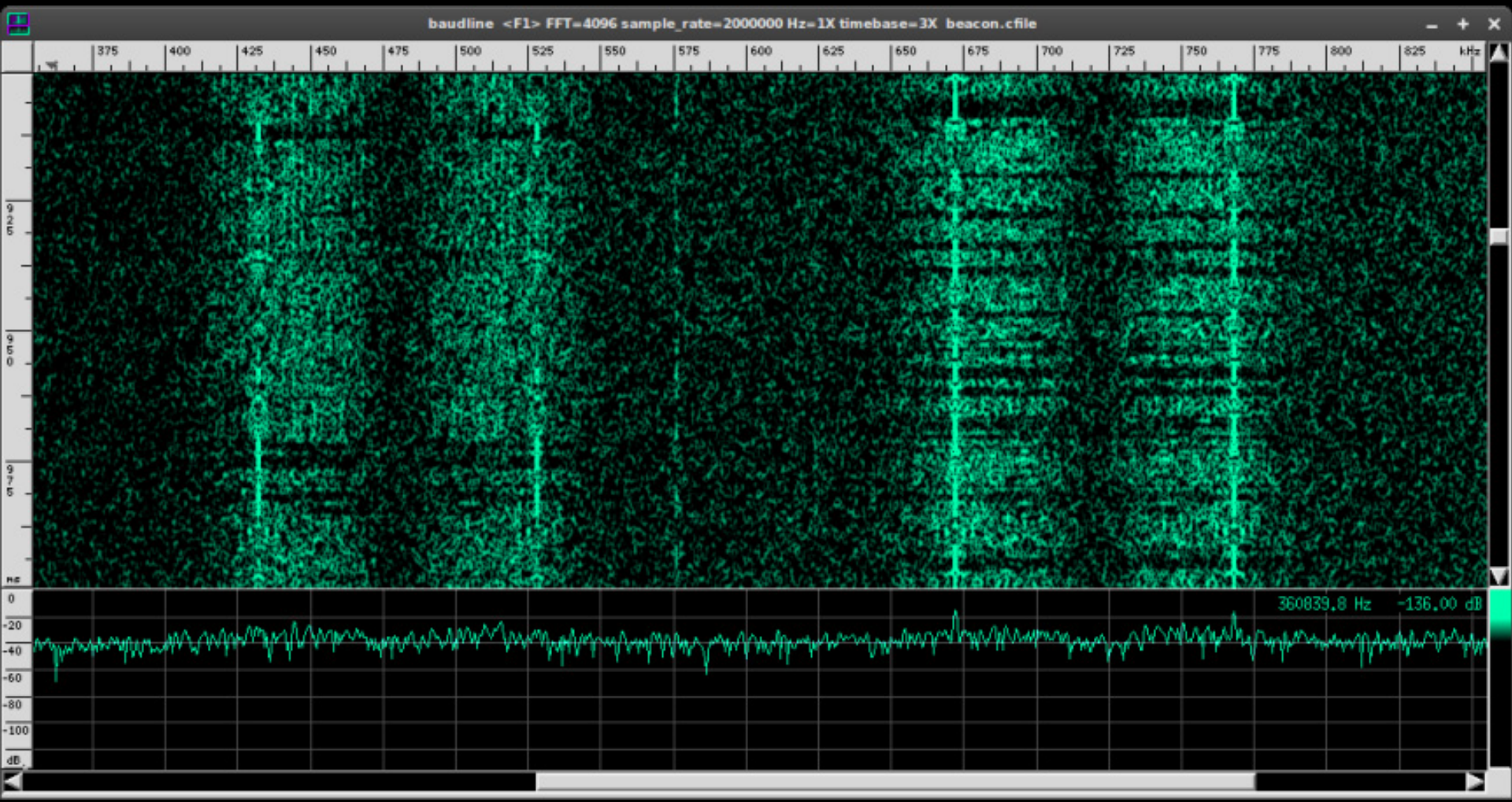
D1 TLM1: 12243.25 MHz



Beacon with **P**hase **M**odulation* (PM): 1PPS and two telemetry streams (sidebands)

Visualisation




baudline <F1> FFT=4096 sample_rate=2000000 Hz=1X timebase=3X beacon.cfile
375
400
425
450
475
500
525
550
575
600
625
650
675
700
725
750
775
800
825
kHz
360839.8 Hz -136.00 dB
0
-20
-40
-60
-80
-100
dB

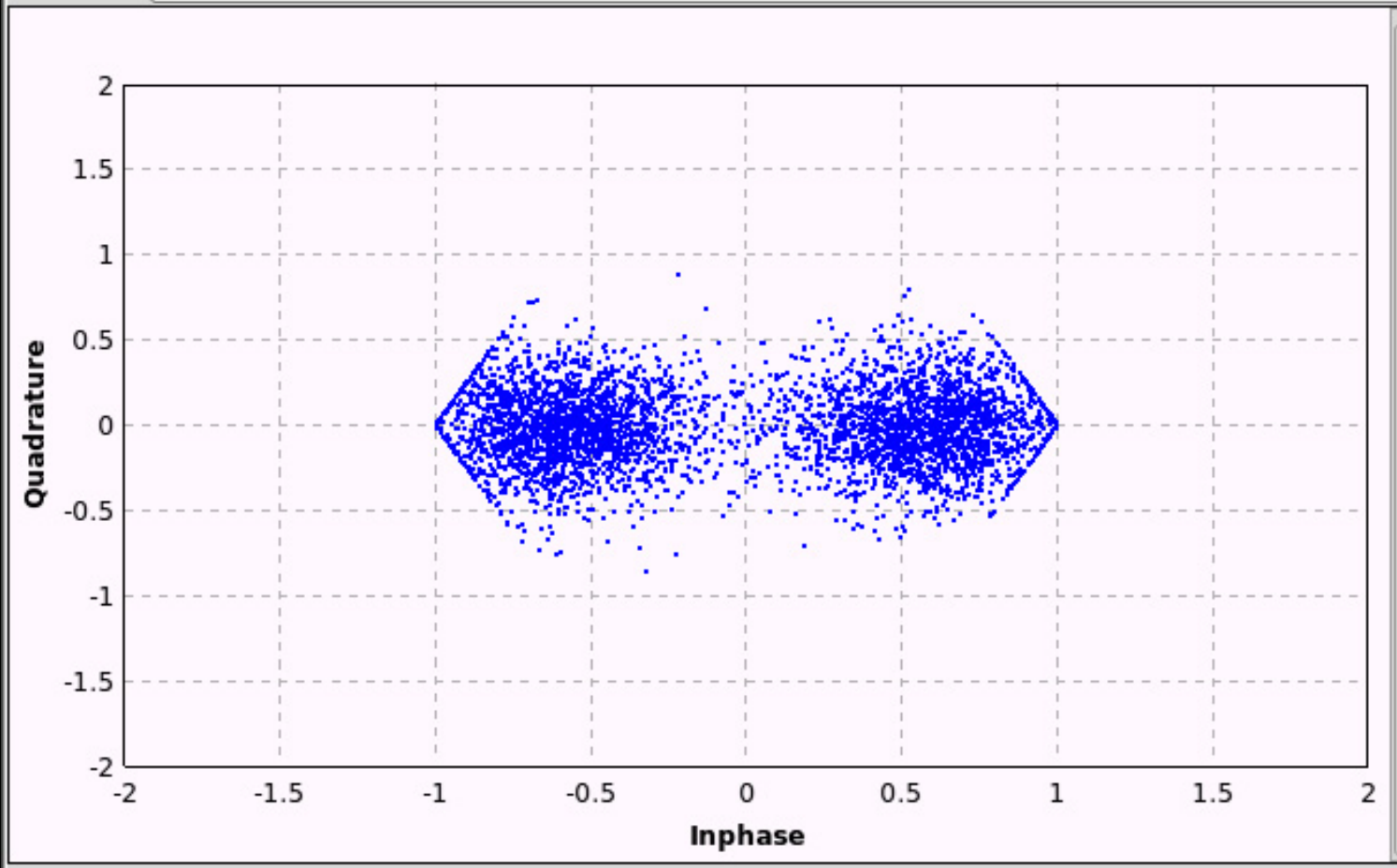
Top Block

BB | Scope | Demod | Pow | Cyclo | FAC | # | Quad | Mag | Test

Symbol rate (fine): 0

sym_rate_coarse: 0

Symbol rate: 9600



Options

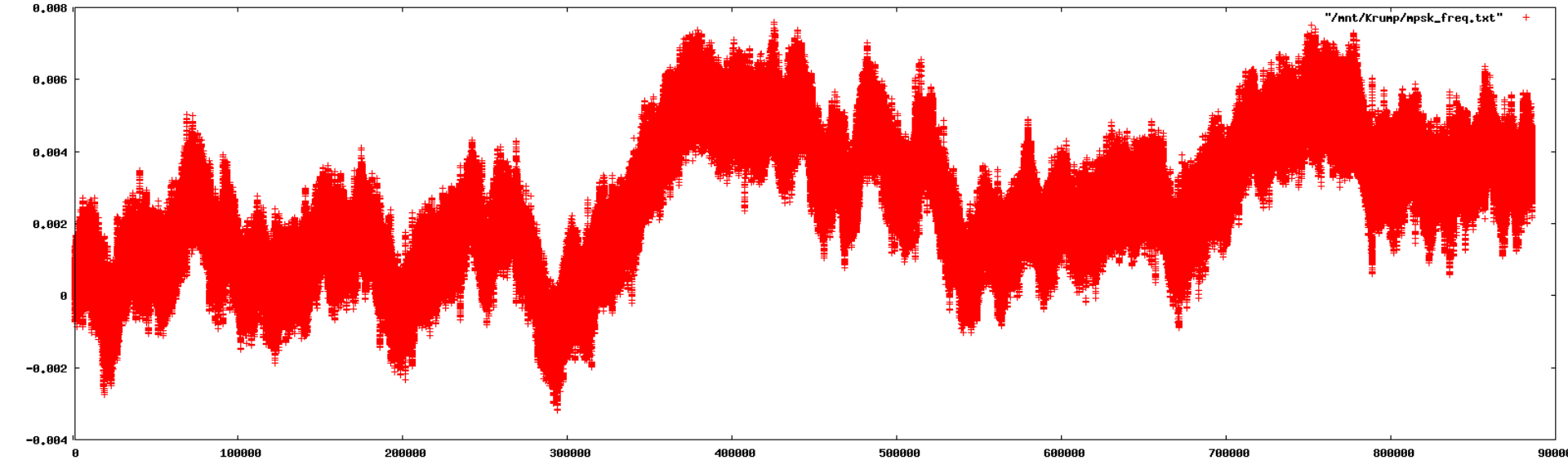
Alpha: 5m

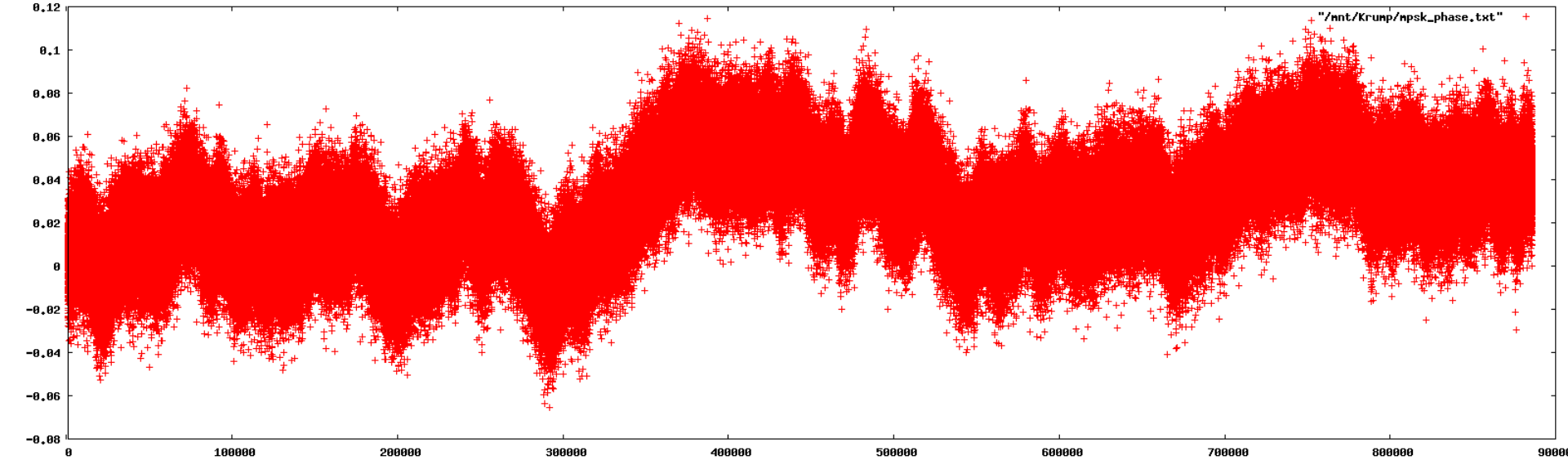
Gain Mu: 5m

Marker: Dot Medium

Run

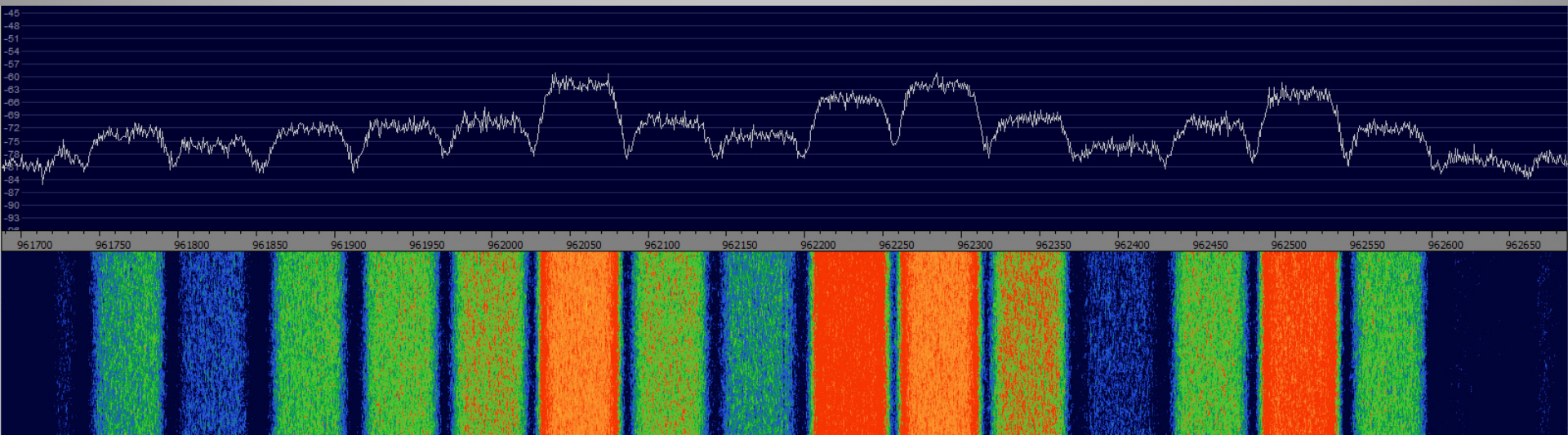
PSK Debug Output





Data Streams

- All sorts of continuous streams of varying bandwidth
- Streams created by manipulating raw data to optimise for transmission over long distance
- Receiver must be able to lock on and decode

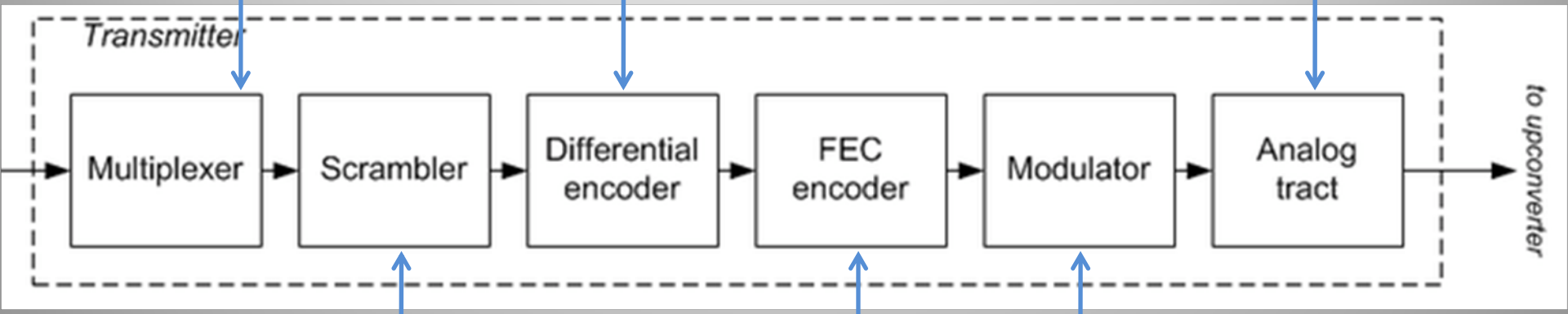


Modulation: pick your parameters

Support multiple data streams, drop-and-insert

Encode changes in data (receiver can be non-coherent)

Create signal suitable for uplink



Make data appear random (increase entropy of structured data)

Turn binary into symbols for baseband RF (0/1 → combinations of waves)

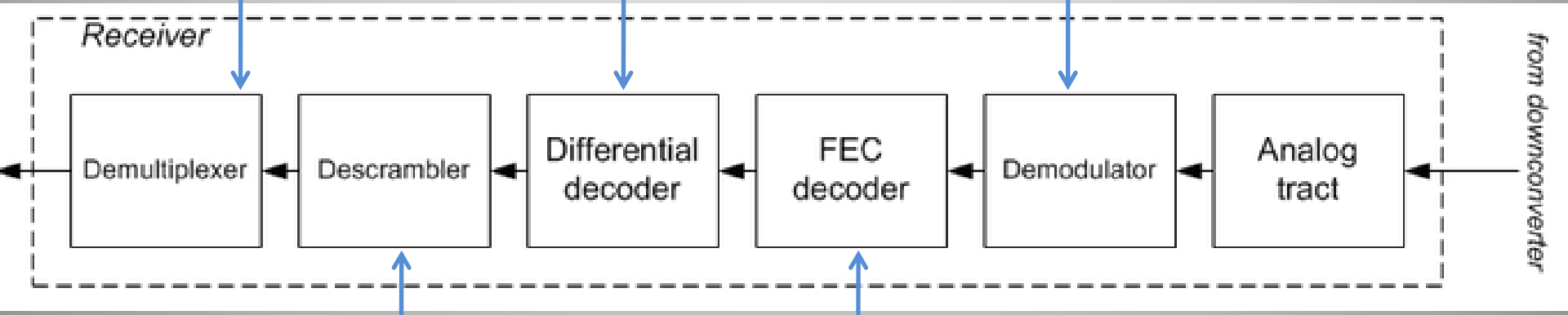
Protect integrity of data (corruption from noise on channel)

Demodulation: easy when you know

Are there multiple streams?
How are they multiplexed?

Is it differential, or
what defines a 0/1?

What is the modulation?
Symbol rate? Require coherence?
What is the phase difference?
Need to conjugate complex plane?



Possible to determine if it is scrambled
(calculate stats), but what is the scrambler?
Is it additive or multiplicative?
How is it synchronised?

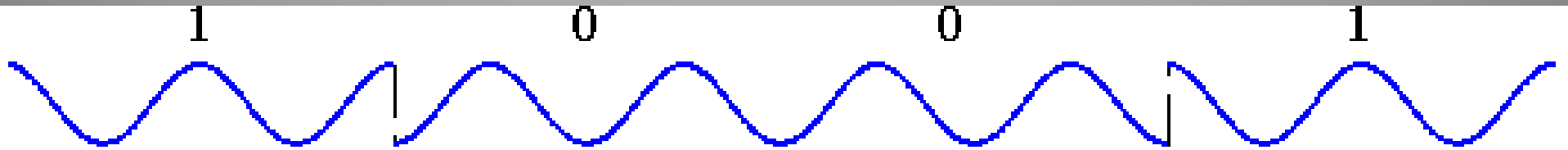
Which FEC(s) is used?
Is it a concatenated code?
What is the code rate?
What is the block size?
How is it synchronised?

If you don’t know…

- Try the most common/default options (RTFMM):
  - Modulation: **P**hase **S**hift **K**eying (BPSK, QPSK)
  - Convolutional code: NASA, K=7 (Voyager Probe)
  - Scrambler: IESS-803 (**I**ntelsat **B**usiness **S**ervice)
- Still need to try each combination of:
  - Differential decoding, synchronisation offset, symbol mapping
- Best option is to try every permutation automatically
- Assuming decent SNR, low **B**it **E**rror **R**ate is an indicator you’re heading the right way!

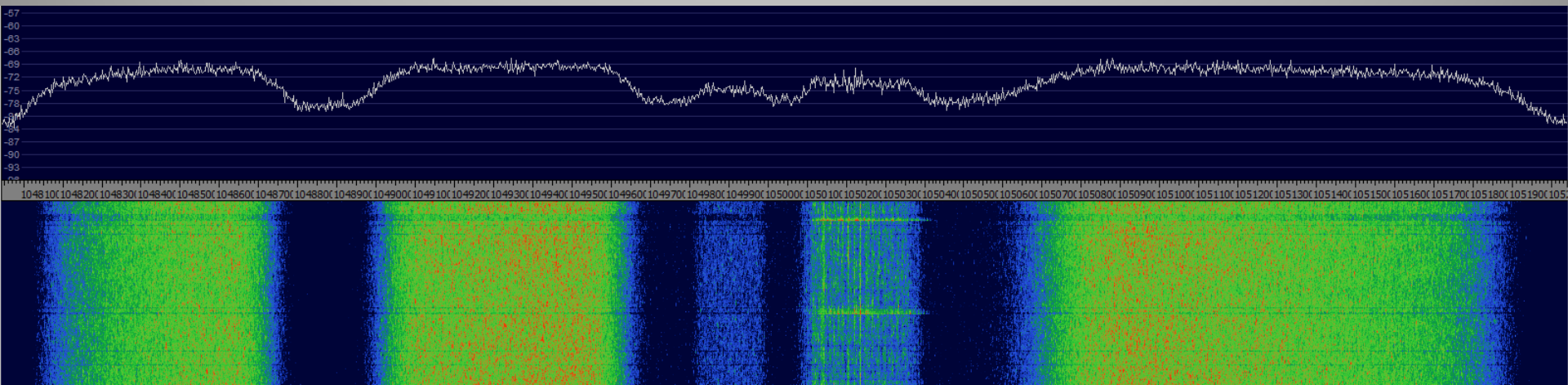
Aside: PSK, Symbols & Bits

- PSK uses changes in phase of a signal (carrier) to convey data
- Demodulator detects phase changes and outputs symbols
- Order of PSK determines # bits in 1 symbol
  - Many bits/symbol thanks to imaginary numbers (I/Q)
- Raw bit rate = symbol rate x (# bits/symbol)
  - Binary PSK (BPSK): 1 bit/symbol
  - Quaternary PSK (QPSK): 2 bits/symbol
  - 8PSK: 3 bits/symbol, etc…

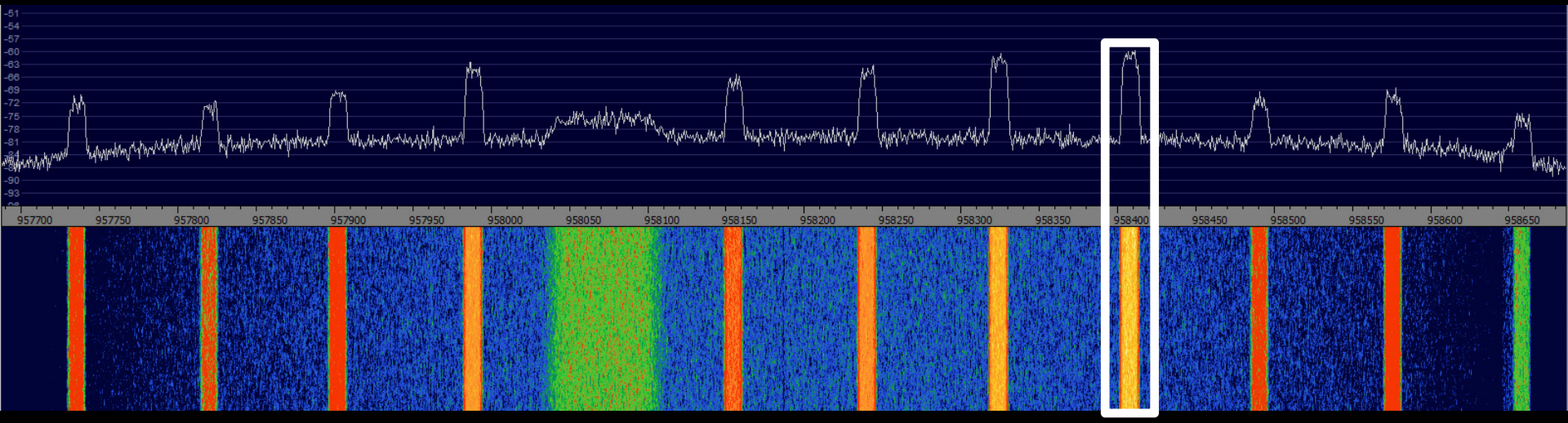


Determining modulation & rate

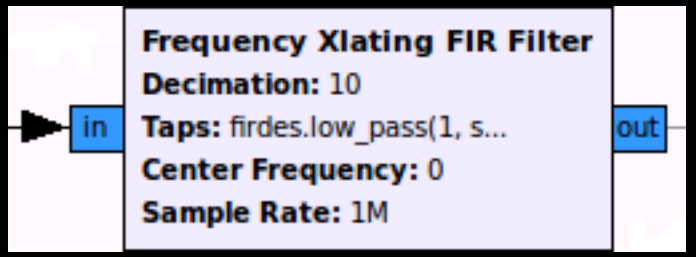
- Assuming PSK, easy to determine:
  - Modulation order: multiply the signal by itself
  - Symbol rate: multiply the signal by a lagged version of itself (cyclostationary analysis)
- Only a few GR blocks required do this



Let’s try one…

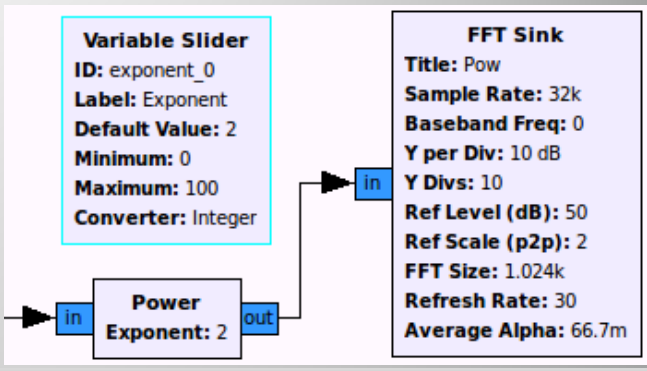


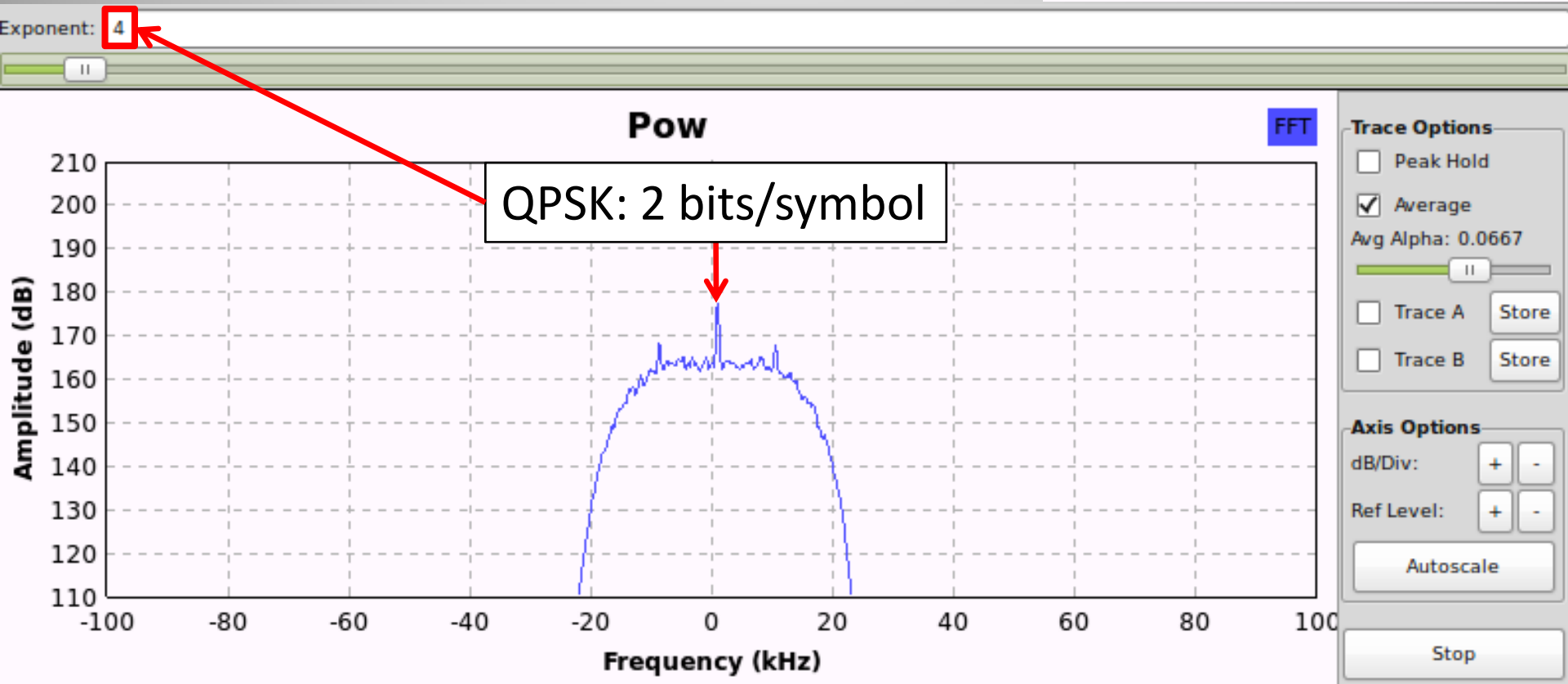
- Feed entire baseband spectrum into GR
- Perform ‘channel selection’ to isolate stream of interest (create new baseband centred on stream)



Determine PSK order

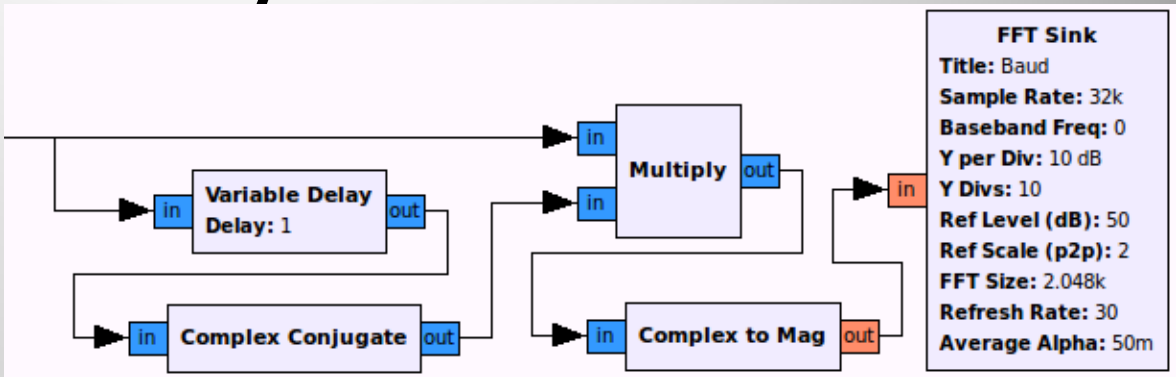
- Start at 2 and go up
- Stop when spike appears



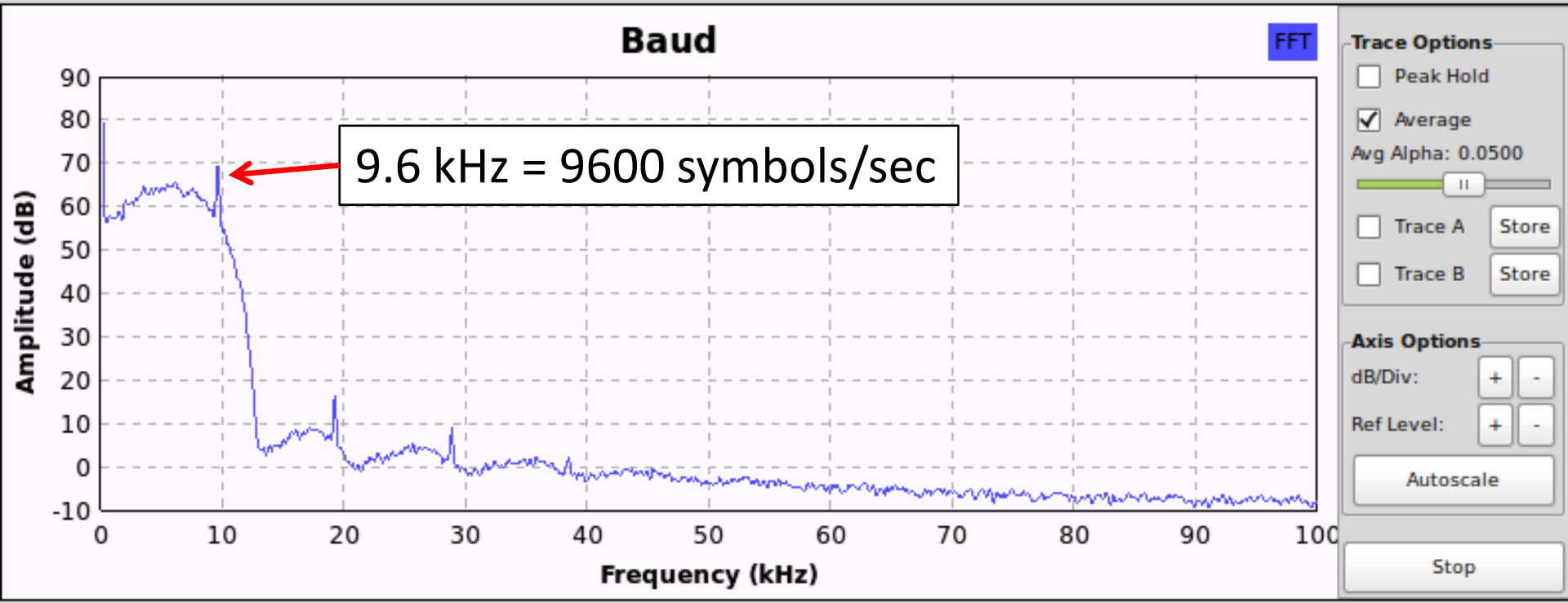


Determine Symbol Rate

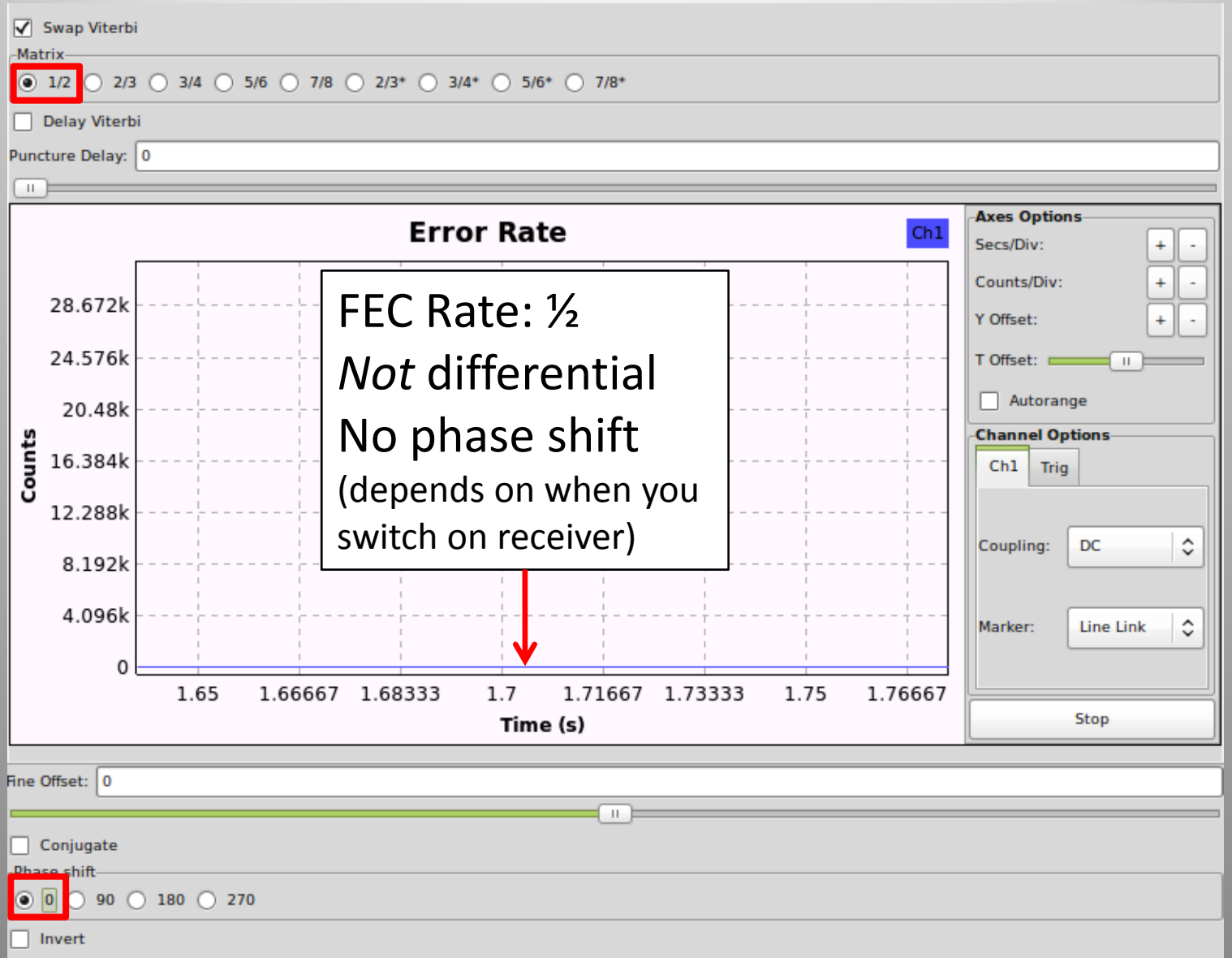
- Find first peak

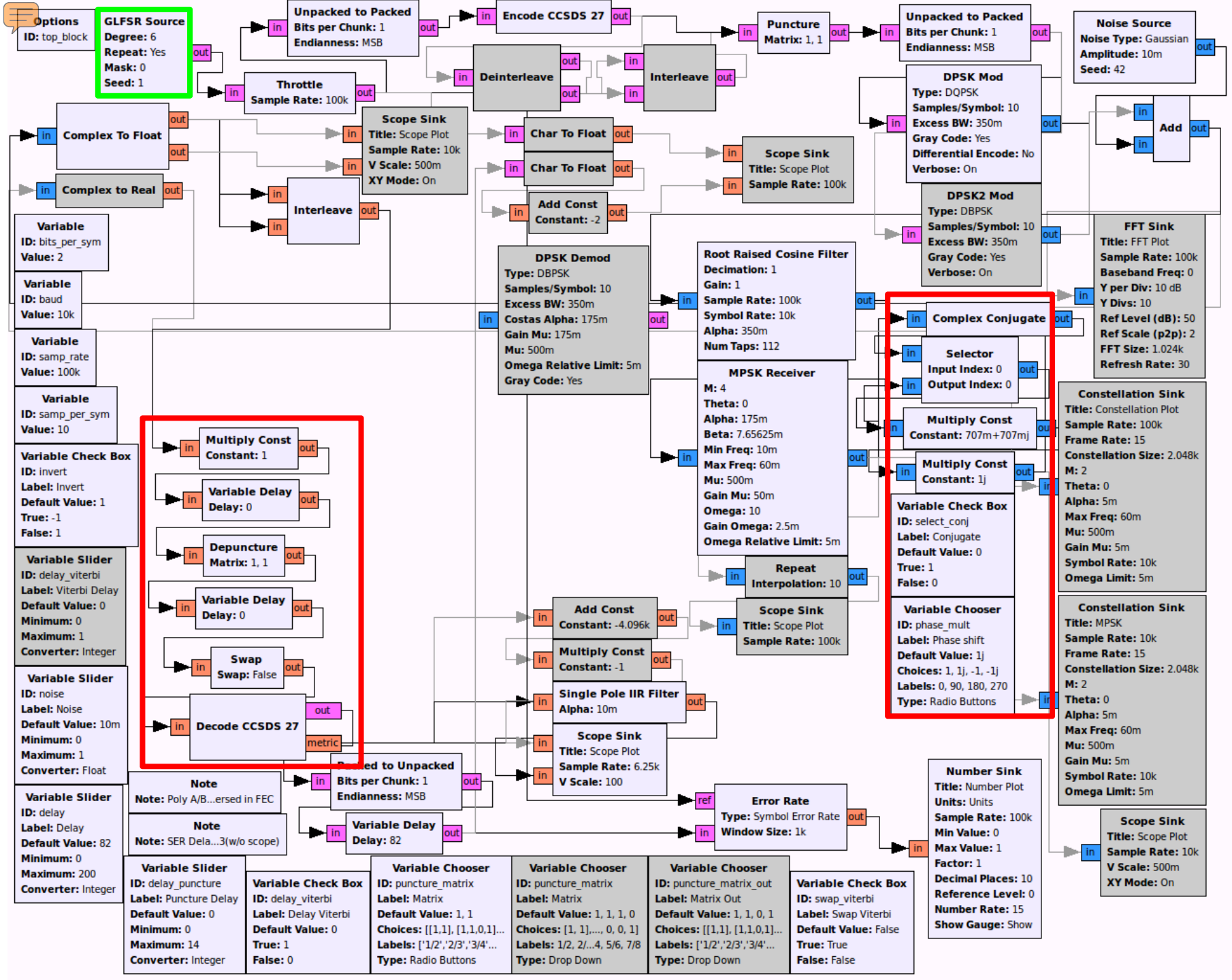


Nominal samples per symbol: 2

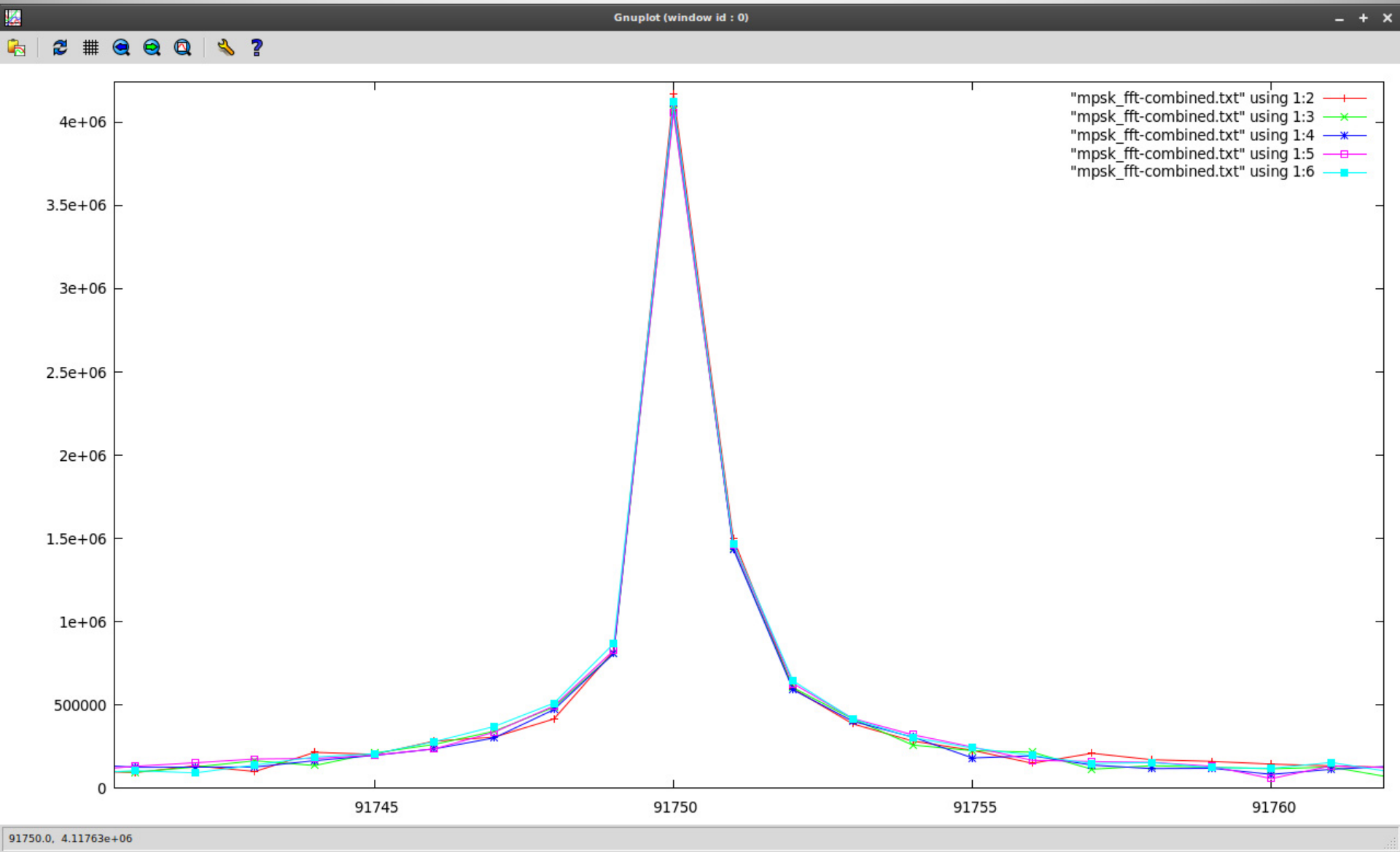


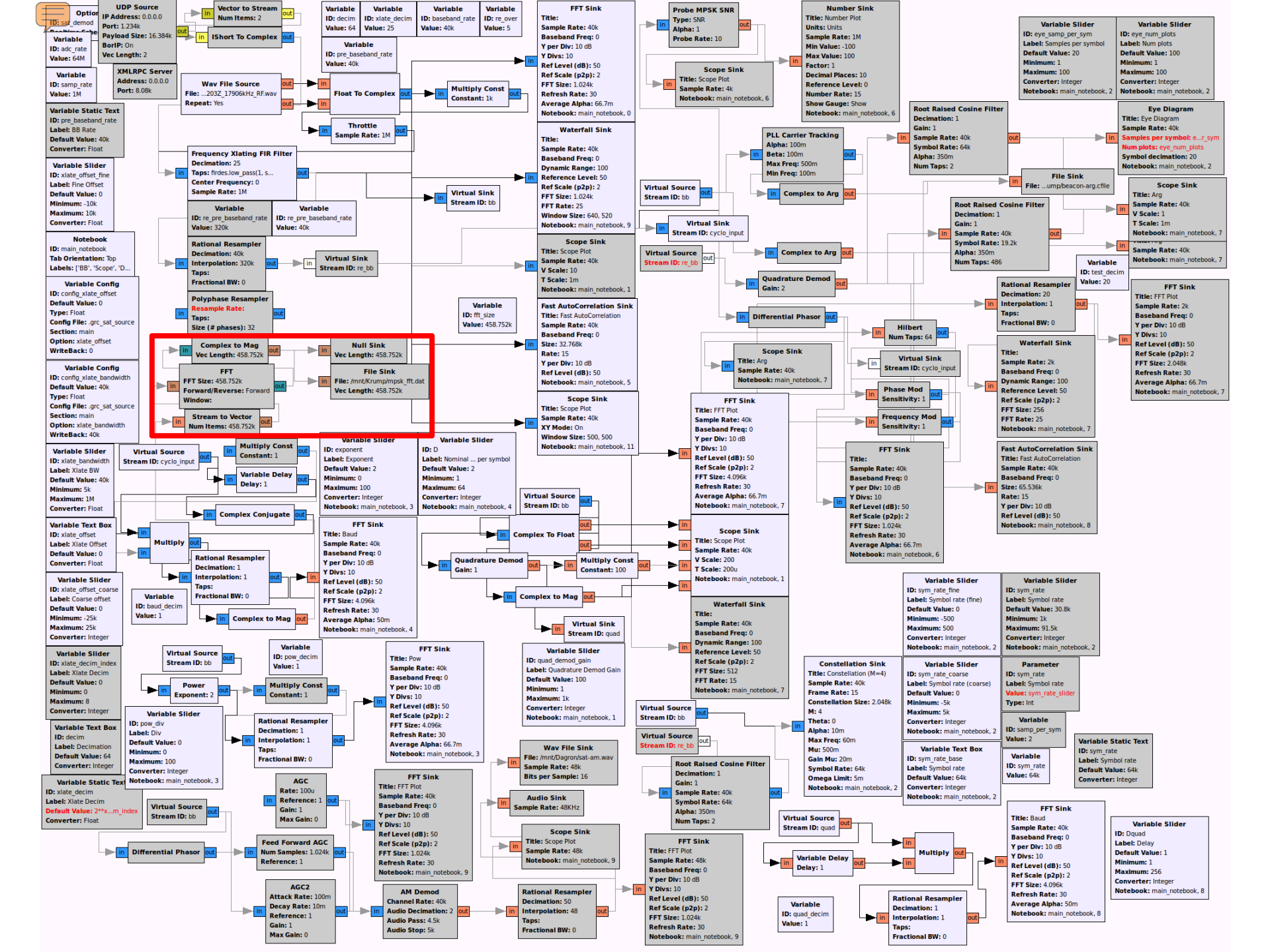
Try synchronisation & FEC

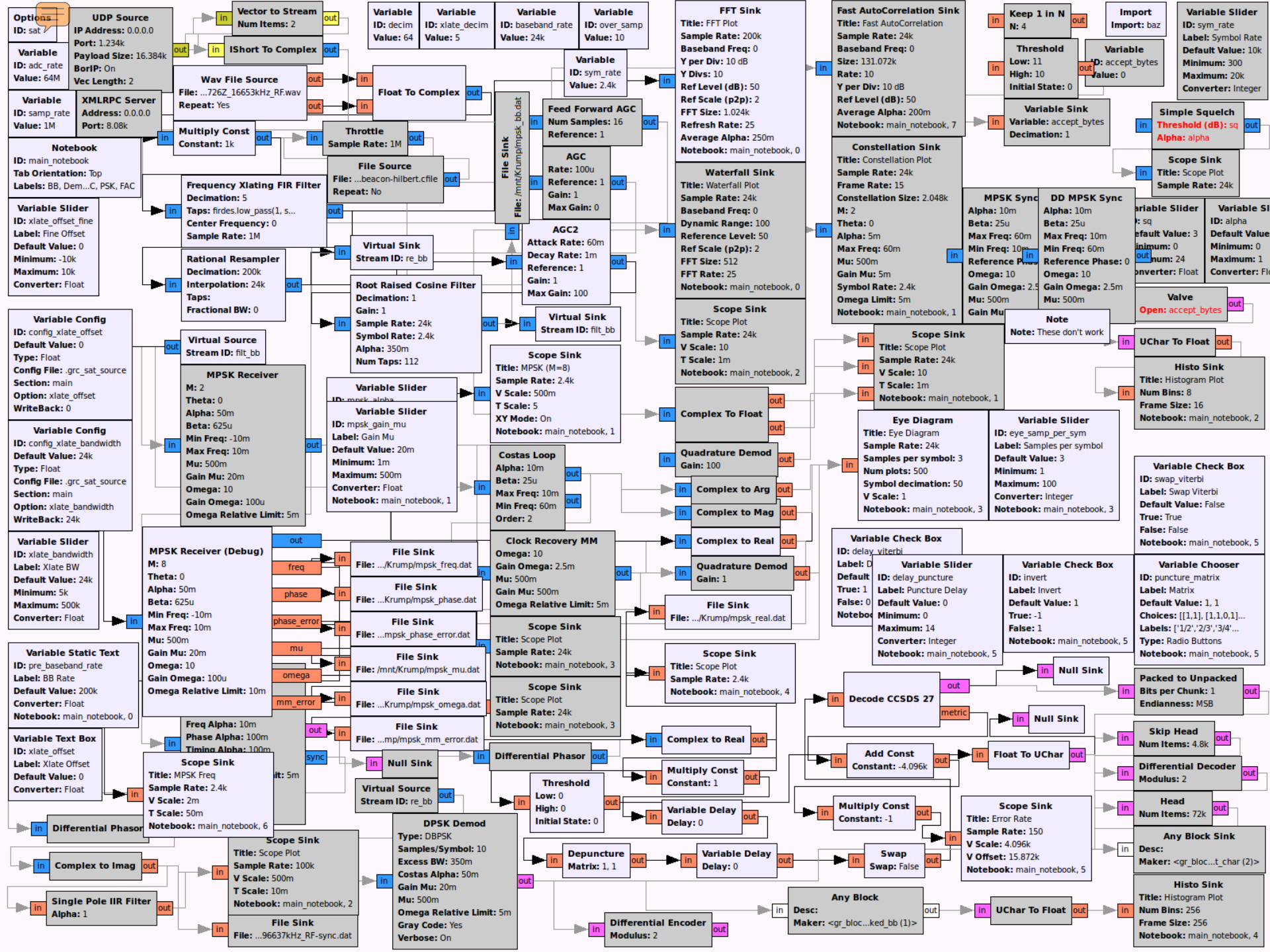


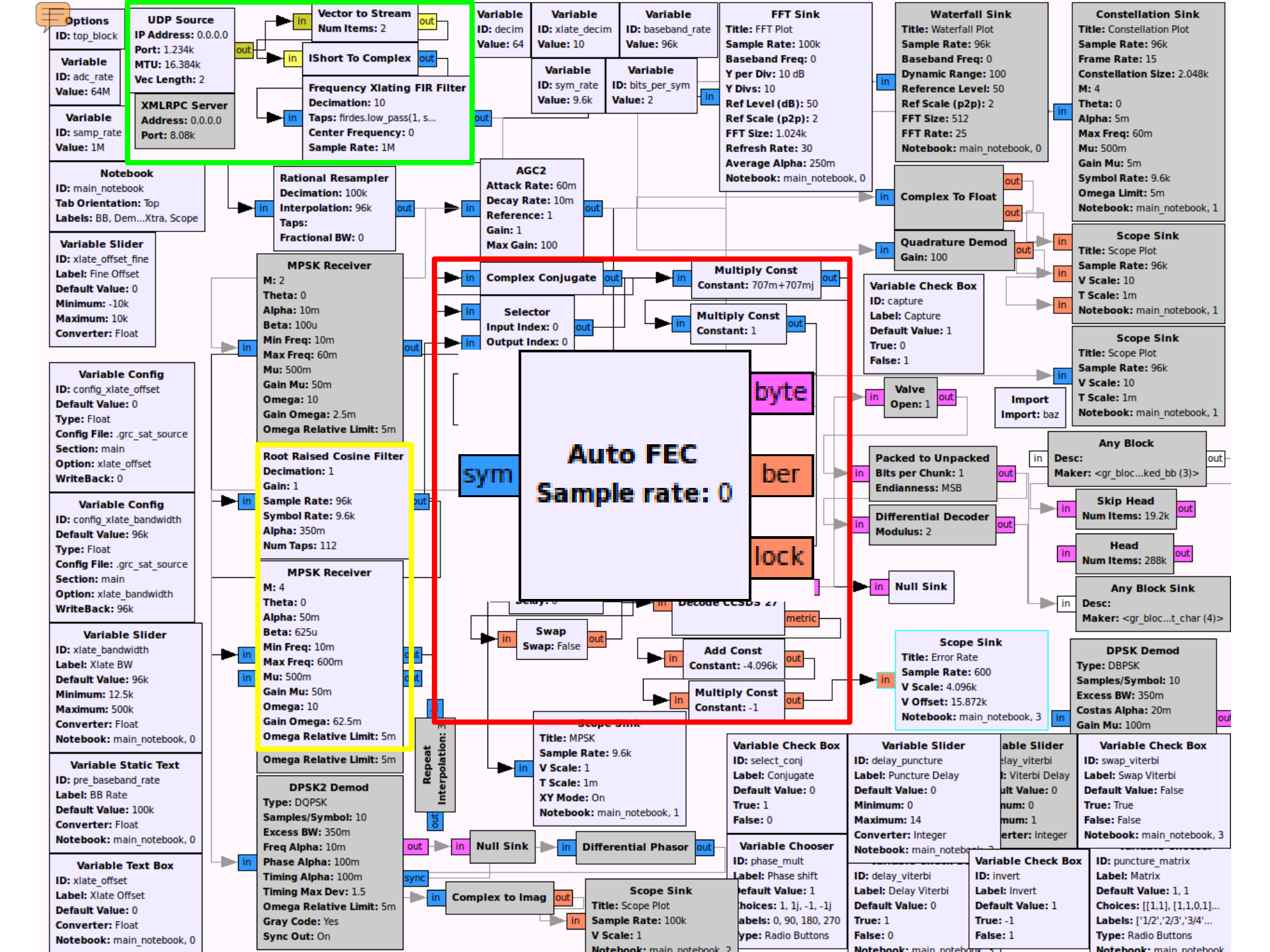

Options
ID: top_block
GLFSR Source
Degree: 6
Repeat: Yes
Mask: 0
Seed: 1
Unpacked to Packed
Bits per Chunk: 1
Endianness: MSB
Encode CCSDS 27
Puncture
Matrix: 1, 1
Unpacked to Packed
Bits per Chunk: 1
Endianness: MSB
Noise Source
Noise Type: Gaussian
Amplitude: 10m
Seed: 42
Throttle
Sample Rate: 100k
Deinterleave
Interleave
DPSK Mod
Type: DQPSK
Samples/Symbol: 10
Excess BW: 350m
Gray Code: Yes
Differential Encode: No
Verbose: On
Add
Complex To Float
Complex to Real
Scope Sink
Title: Scope Plot
Sample Rate: 10k
V Scale: 500m
XY Mode: On
Char To Float
Char To Float
Add Const
Constant: -2
Interleave
Scope Sink
Title: Scope Plot
Sample Rate: 100k
DPSK2 Mod
Type: DBPSK
Samples/Symbol: 10
Excess BW: 350m
Gray Code: Yes
Verbose: On
FFT Sink
Title: FFT Plot
Sample Rate: 100k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 30
Variable
ID: bits_per_sym
Value: 2
Variable
ID: baud
Value: 10k
Variable
ID: samp_rate
Value: 100k
Variable
ID: samp_per_sym
Value: 10
DPSK Demod
Type: DBPSK
Samples/Symbol: 10
Excess BW: 350m
Costas Alpha: 175m
Gain Mu: 175m
Mu: 500m
Omega Relative Limit: 5m
Gray Code: Yes
Root Raised Cosine Filter
Decimation: 1
Gain: 1
Sample Rate: 100k
Symbol Rate: 10k
Alpha: 350m
Num Taps: 112
MPSK Receiver
M: 4
Theta: 0
Alpha: 175m
Beta: 7.65625m
Min Freq: 10m
Max Freq: 60m
Mu: 500m
Gain Mu: 50m
Omega: 10
Gain Omega: 2.5m
Omega Relative Limit: 5m
Complex Conjugate
Selector
Input Index: 0
Output Index: 0
Multiply Const
Constant: 707m+707mj
Multiply Const
Constant: 1j
Variable Check Box
ID: select_conj
Label: Conjugate
Default Value: 0
True: 1
False: 0
Variable Chooser
ID: phase_mult
Label: Phase shift
Default Value: 1j
Choices: 1, 1j, -1, -1j
Labels: 0, 90, 180, 270
Type: Radio Buttons
Constellation Sink
Title: Constellation Plot
Sample Rate: 100k
Frame Rate: 15
Constellation Size: 2.048k
M: 2
Theta: 0
Alpha: 5m
Max Freq: 60m
Mu: 500m
Gain Mu: 5m
Symbol Rate: 10k
Omega Limit: 5m
Constellation Sink
Title: MPSK
Sample Rate: 10k
Frame Rate: 15
Constellation Size: 2.048k
M: 2
Theta: 0
Alpha: 5m
Max Freq: 60m
Mu: 500m
Gain Mu: 5m
Symbol Rate: 10k
Omega Limit: 5m
Multiply Const
Constant: 1
Variable Delay
Delay: 0
Depuncture
Matrix: 1, 1
Variable Delay
Delay: 0
Swap
Swap: False
Decode CCSDS 27
out
metric
Repeat
Interpolation: 10
Scope Sink
Title: Scope Plot
Sample Rate: 100k
Add Const
Constant: -4.096k
Multiply Const
Constant: -1
Single Pole IIR Filter
Alpha: 10m
Scope Sink
Title: Scope Plot
Sample Rate: 6.25k
V Scale: 100
Variable Check Box
ID: invert
Label: Invert
Default Value: 1
True: -1
False: 1
Variable Slider
ID: delay_viterbi
Label: Viterbi Delay
Default Value: 0
Minimum: 0
Maximum: 1
Converter: Integer
Variable Slider
ID: noise
Label: Noise
Default Value: 10m
Minimum: 0
Maximum: 1
Converter: Float
Variable Slider
ID: delay
Label: Delay
Default Value: 82
Minimum: 0
Maximum: 200
Converter: Integer
Note
Note: Poly A/B...ersed in FEC
Note
Note: SER Dela...3(w/o scope)
Bits per Chunk: 1
Endianness: MSB
Variable Delay
Delay: 82
Error Rate
Type: Symbol Error Rate
Window Size: 1k
Number Sink
Title: Number Plot
Units: Units
Sample Rate: 100k
Min Value: 0
Max Value: 1
Factor: 1
Decimal Places: 10
Reference Level: 0
Number Rate: 15
Show Gauge: Show
Scope Sink
Title: Scope Plot
Sample Rate: 10k
V Scale: 500m
XY Mode: On
Variable Slider
ID: delay_puncture
Label: Puncture Delay
Default Value: 0
Minimum: 0
Maximum: 14
Converter: Integer
Variable Check Box
ID: delay_viterbi
Label: Delay Viterbi
Default Value: 0
True: 1
False: 0
Variable Chooser
ID: puncture_matrix
Label: Matrix
Default Value: 1, 1
Choices: [[1,1], [1,1,0,1]...
Labels: ['1/2','2/3','3/4'...
Type: Radio Buttons
Variable Chooser
ID: puncture_matrix
Label: Matrix
Default Value: 1, 1, 1, 0
Choices: [1, 1],...., 0, 0, 1]
Labels: 1/2, 2/...4, 5/6, 7/8
Type: Drop Down
Variable Chooser
ID: puncture_matrix_out
Label: Matrix Out
Default Value: 1, 1, 0, 1
Choices: [[1,1], [1,1,0,1]...
Labels: ['1/2','2/3','3/4'...
Type: Drop Down
Variable Check Box
ID: swap_viterbi
Label: Swap Viterbi
Default Value: False
True: True
False: False

Find Precise Symbol Rate




UDP Source
IP Address: 0.0.0.0
Port: 1.234k
Payload Size: 16.384k
BorIP: On
Vec Length: 2
Vector to Stream
Num Items: 2
IShort To Complex
XMLRPC Server
Address: 0.0.0.0
Port: 8.08k
Variable
ID: adc_rate
Value: 64M
Variable
ID: samp_rate
Value: 1M
Variable Static Text
ID: pre_baseband_rate
Label: BB Rate
Default Value: 40k
Converter: Float
Variable Slider
ID: xlate_offset_fine
Label: Fine Offset
Default Value: 0
Minimum: -10k
Maximum: 10k
Converter: Float
Notebook
ID: main_notebook
Tab Orientation: Top
Labels: ['BB', 'Scope', 'D...
Variable Config
ID: config_xlate_offset
Default Value: 0
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_offset
WriteBack: 0
Variable Config
ID: config_xlate_bandwidth
Default Value: 40k
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_bandwidth
WriteBack: 40k
Variable Slider
ID: xlate_bandwidth
Label: Xlate BW
Default Value: 40k
Minimum: 5k
Maximum: 1M
Converter: Float
Variable Text Box
ID: xlate_offset
Label: Xlate Offset
Default Value: 0
Converter: Float
Variable Slider
ID: xlate_offset_coarse
Label: Coarse offset
Default Value: 0
Minimum: -25k
Maximum: 25k
Converter: Integer
Variable Slider
ID: xlate_decim_index
Label: Xlate Decim
Default Value: 0
Minimum: 0
Maximum: 8
Converter: Integer
Variable Text Box
ID: decim
Label: Decimation
Default Value: 64
Converter: Integer
Variable Static Text
ID: xlate_decim
Label: Xlate Decim
Default Value: 2**x...m_index
Converter: Float
Wav File Source
File: ...203Z_17906kHz_RF.wav
Repeat: Yes
Throttle
Sample Rate: 1M
Float To Complex
Multiply Const
Constant: 1k
Variable
ID: decim
Value: 64
Variable
ID: xlate_decim
Value: 25
Variable
ID: baseband_rate
Value: 40k
Variable
ID: re_over
Value: 5
Variable
ID: pre_baseband_rate
Value: 40k
Frequency Xlating FIR Filter
Decimation: 25
Taps: firdes.low_pass(1, s...
Center Frequency: 0
Sample Rate: 1M
Variable
ID: re_pre_baseband_rate
Value: 320k
Variable
ID: re_pre_baseband_rate
Value: 40k
Rational Resampler
Decimation: 40k
Interpolation: 320k
Taps:
Fractional BW: 0
Virtual Sink
Stream ID: re_bb
Polyphase Resampler
Resample Rate:
Taps:
Size (# phases): 32
Complex to Mag
Vec Length: 458.752k
FFT
FFT Size: 458.752k
Forward/Reverse: Forward
Window:
Stream to Vector
Num Items: 458.752k
Null Sink
Vec Length: 458.752k
File Sink
File: /mnt/Krump/mpsk_fft.dat
Vec Length: 458.752k
Variable
ID: fft_size
Value: 458.752k
Virtual Source
Stream ID: cyclo_input
Multiply Const
Constant: 1
Variable Delay
Delay: 1
Complex Conjugate
Multiply
Rational Resampler
Decimation: 1
Interpolation: 1
Taps:
Fractional BW: 0
Variable
ID: baud_decim
Value: 1
Complex to Mag
Variable Slider
ID: exponent
Label: Exponent
Default Value: 2
Minimum: 0
Maximum: 100
Converter: Integer
Notebook: main_notebook, 3
Variable Slider
ID: D
Label: Nominal ... per symbol
Default Value: 2
Minimum: 1
Maximum: 64
Converter: Integer
Notebook: main_notebook, 4
Virtual Source
Stream ID: bb
Complex To Float
Quadrature Demod
Gain: 1
Multiply Const
Constant: 100
Complex to Mag
Virtual Sink
Stream ID: quad
Variable
ID: pow_decim
Value: 1
Virtual Source
Stream ID: bb
Power
Exponent: 2
Multiply Const
Constant: 1
Variable Slider
ID: pow_div
Label: Div
Default Value: 0
Minimum: 0
Maximum: 100
Converter: Integer
Notebook: main_notebook, 3
Rational Resampler
Decimation: 1
Interpolation: 1
Taps:
Fractional BW: 0
Virtual Source
Stream ID: bb
Differential Phasor
AGC
Rate: 100u
Reference: 1
Gain: 1
Max Gain: 0
Feed Forward AGC
Num Samples: 1.024k
Reference: 1
AGC2
Attack Rate: 100m
Decay Rate: 10m
Reference: 1
Gain: 1
Max Gain: 0
AM Demod
Channel Rate: 40k
Audio Decimation: 2
Audio Pass: 4.5k
Audio Stop: 5k
Rational Resampler
Decimation: 50
Interpolation: 48
Taps:
Fractional BW: 0
Wav File Sink
File: /mnt/Dagron/sat-am.wav
Sample Rate: 48k
Bits per Sample: 16
Audio Sink
Sample Rate: 48KHz
Scope Sink
Title: Scope Plot
Sample Rate: 48k
Notebook: main_notebook, 9
FFT Sink
Title: FFT Plot
Sample Rate: 48k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 30
Notebook: main_notebook, 9
FFT Sink
Title:
Sample Rate: 40k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 30
Average Alpha: 66.7m
Notebook: main_notebook, 0
Waterfall Sink
Title:
Sample Rate: 40k
Baseband Freq: 0
Dynamic Range: 100
Reference Level: 50
Ref Scale (p2p): 2
FFT Size: 1.024k
FFT Rate: 25
Window Size: 640, 520
Notebook: main_notebook, 9
Scope Sink
Title: Scope Plot
Sample Rate: 40k
V Scale: 10
T Scale: 1m
Notebook: main_notebook, 1
Fast AutoCorrelation Sink
Title: Fast AutoCorrelation
Sample Rate: 40k
Baseband Freq: 0
Size: 32.768k
Rate: 15
Y per Div: 10 dB
Ref Level (dB): 50
Notebook: main_notebook, 5
Scope Sink
Title: Scope Plot
Sample Rate: 40k
XY Mode: On
Window Size: 500, 500
Notebook: main_notebook, 11
FFT Sink
Title: Baud
Sample Rate: 40k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 4.096k
Refresh Rate: 30
Average Alpha: 50m
Notebook: main_notebook, 4
FFT Sink
Title: Pow
Sample Rate: 40k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 4.096k
Refresh Rate: 30
Average Alpha: 66.7m
Notebook: main_notebook, 3
Variable Slider
ID: quad_demod_gain
Label: Quadrature Demod Gain
Default Value: 100
Minimum: 1
Maximum: 1k
Converter: Integer
Notebook: main_notebook, 1
Probe MPSK SNR
Type: SNR
Alpha: 1
Probe Rate: 10
Scope Sink
Title: Scope Plot
Sample Rate: 4k
Notebook: main_notebook, 6
Number Sink
Title: Number Plot
Units: Units
Sample Rate: 1M
Min Value: -100
Max Value: 100
Factor: 1
Decimal Places: 10
Reference Level: 0
Number Rate: 15
Show Gauge: Show
Notebook: main_notebook, 6
Virtual Source
Stream ID: bb
Virtual Sink
Stream ID: cyclo_input
Virtual Source
Stream ID: re_bb
Complex to Arg
Quadrature Demod
Gain: 2
Differential Phasor
PLL Carrier Tracking
Alpha: 100m
Beta: 100m
Max Freq: 500m
Min Freq: 100m
Root Raised Cosine Filter
Decimation: 1
Gain: 1
Sample Rate: 40k
Symbol Rate: 64k
Alpha: 350m
Num Taps: 2
Root Raised Cosine Filter
Decimation: 1
Gain: 1
Sample Rate: 40k
Symbol Rate: 19.2k
Alpha: 350m
Num Taps: 486
File Sink
File: ...ump/beacon-arg.cfile
Variable
ID: test_decim
Value: 20
Rational Resampler
Decimation: 20
Interpolation: 1
Taps:
Fractional BW: 0
Hilbert
Num Taps: 64
Phase Mod
Sensitivity: 1
Frequency Mod
Sensitivity: 1
Scope Sink
Title: Arg
Sample Rate: 40k
Notebook: main_notebook, 7
Virtual Sink
Stream ID: cyclo_input
Waterfall Sink
Title:
Sample Rate: 2k
Baseband Freq: 0
Dynamic Range: 100
Reference Level: 50
Ref Scale (p2p): 2
FFT Size: 256
FFT Rate: 25
Notebook: main_notebook, 7
FFT Sink
Title:
Sample Rate: 40k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 4.096k
Refresh Rate: 30
Average Alpha: 66.7m
Notebook: main_notebook, 7
Scope Sink
Title: Scope Plot
Sample Rate: 40k
V Scale: 200
T Scale: 200u
Notebook: main_notebook, 1
Scope Sink
Title: Scope Plot
Sample Rate: 40k
V Scale: 10
T Scale: 1m
Notebook: main_notebook, 6
Waterfall Sink
Title:
Sample Rate: 40k
Baseband Freq: 0
Dynamic Range: 100
Reference Level: 50
Ref Scale (p2p): 2
FFT Size: 512
FFT Rate: 15
Notebook: main_notebook, 7
Virtual Source
Stream ID: bb
Virtual Source
Stream ID: re_bb
Root Raised Cosine Filter
Decimation: 1
Gain: 1
Sample Rate: 40k
Symbol Rate: 64k
Alpha: 350m
Num Taps: 2
Constellation Sink
Title: Constellation (M=4)
Sample Rate: 40k
Frame Rate: 15
Constellation Size: 2.048k
M: 4
Theta: 0
Alpha: 10m
Max Freq: 60m
Mu: 500m
Gain Mu: 20m
Symbol Rate: 64k
Omega Limit: 5m
Notebook: main_notebook, 2
Virtual Source
Stream ID: quad
Variable Delay
Delay: 1
Variable
ID: quad_decim
Value: 1
Multiply
Rational Resampler
Decimation: 1
Interpolation: 1
Taps:
Fractional BW: 0
Variable Slider
ID: eye_samp_per_sym
Label: Samples per symbol
Default Value: 20
Minimum: 1
Maximum: 100
Converter: Integer
Notebook: main_notebook, 2
Variable Slider
ID: eye_num_plots
Label: Num plots
Default Value: 100
Minimum: 1
Maximum: 100
Converter: Integer
Notebook: main_notebook, 2
Eye Diagram
Title: Eye Diagram
Sample Rate: 40k
Samples per symbol: e...r_sym
Num plots: eye_num_plots
Symbol decimation: 20
Notebook: main_notebook, 2
Scope Sink
Title: Arg
Sample Rate: 40k
V Scale: 1
T Scale: 1m
Notebook: main_notebook, 7
Sample Rate: 40k
Notebook: main_notebook, 7
FFT Sink
Title: FFT Plot
Sample Rate: 2k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 2.048k
Refresh Rate: 30
Average Alpha: 66.7m
Notebook: main_notebook, 7
Fast AutoCorrelation Sink
Title: Fast AutoCorrelation
Sample Rate: 40k
Baseband Freq: 0
Size: 65.536k
Rate: 15
Y per Div: 10 dB
Ref Level (dB): 50
Notebook: main_notebook, 8
Variable Slider
ID: sym_rate_fine
Label: Symbol rate (fine)
Default Value: 0
Minimum: -500
Maximum: 500
Converter: Integer
Notebook: main_notebook, 2
Variable Slider
ID: sym_rate
Label: Symbol rate
Default Value: 30.8k
Minimum: 1k
Maximum: 91.5k
Converter: Integer
Notebook: main_notebook, 2
Variable Slider
ID: sym_rate_coarse
Label: Symbol rate (coarse)
Default Value: 0
Minimum: -5k
Maximum: 5k
Converter: Integer
Notebook: main_notebook, 2
Parameter
ID: sym_rate
Label: Symbol rate
Value: sym_rate_slider
Type: Int
Variable Text Box
ID: sym_rate_base
Label: Symbol rate
Default Value: 64k
Converter: Integer
Notebook: main_notebook, 2
Variable
ID: samp_per_sym
Value: 2
Variable
ID: sym_rate
Value: 64k
Variable Static Text
ID: sym_rate
Label: Symbol rate
Default Value: 64k
Converter: Integer
FFT Sink
Title: Baud
Sample Rate: 40k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 4.096k
Refresh Rate: 30
Average Alpha: 50m
Notebook: main_notebook, 8
Variable Slider
ID: Dquad
Label: Delay
Default Value: 1
Minimum: 1
Maximum: 256
Converter: Integer
Notebook: main_notebook, 8


Options
ID: sat
UDP Source
IP Address: 0.0.0.0
Port: 1.234k
Payload Size: 16.384k
BorIP: On
Vec Length: 2
Variable
ID: adc_rate
Value: 64M
Variable
ID: samp_rate
Value: 1M
XMLRPC Server
Address: 0.0.0.0
Port: 8.08k
Notebook
ID: main_notebook
Tab Orientation: Top
Labels: BB, Dem...C, PSK, FAC
Variable Slider
ID: xlate_offset_fine
Label: Fine Offset
Default Value: 0
Minimum: -10k
Maximum: 10k
Converter: Float
Variable Config
ID: config_xlate_offset
Default Value: 0
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_offset
WriteBack: 0
Variable Config
ID: config_xlate_bandwidth
Default Value: 24k
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_bandwidth
WriteBack: 24k
Variable Slider
ID: xlate_bandwidth
Label: Xlate BW
Default Value: 24k
Minimum: 5k
Maximum: 500k
Converter: Float
Variable Static Text
ID: pre_baseband_rate
Label: BB Rate
Default Value: 200k
Converter: Float
Notebook: main_notebook, 0
Variable Text Box
ID: xlate_offset
Label: Xlate Offset
Default Value: 0
Converter: Float
Vector to Stream
Num Items: 2
IShort To Complex
Wav File Source
File: ...726Z_16653kHz_RF.wav
Repeat: Yes
Multiply Const
Constant: 1k
Float To Complex
Throttle
Sample Rate: 1M
File Source
File: ...beacon-hilbert.cfile
Repeat: No
Frequency Xlating FIR Filter
Decimation: 5
Taps: firdes.low_pass(1, s...
Center Frequency: 0
Sample Rate: 1M
Rational Resampler
Decimation: 200k
Interpolation: 24k
Taps:
Fractional BW: 0
Virtual Source
Stream ID: filt_bb
MPSK Receiver
M: 2
Theta: 0
Alpha: 50m
Beta: 625u
Min Freq: -10m
Max Freq: 10m
Mu: 500m
Gain Mu: 20m
Omega: 10
Gain Omega: 100u
Omega Relative Limit: 5m
MPSK Receiver (Debug)
M: 8
Theta: 0
Alpha: 50m
Beta: 625u
Min Freq: -10m
Max Freq: 10m
Mu: 500m
Gain Mu: 20m
Omega: 10
Gain Omega: 100u
Omega Relative Limit: 10m
out
freq
phase
phase_error
mu
omega
mm_error
sync
Freq Alpha: 10m
Phase Alpha: 100m
Timing Alpha: 100m
Scope Sink
Title: MPSK Freq
Sample Rate: 2.4k
V Scale: 2m
T Scale: 50m
Notebook: main_notebook, 6
Differential Phasor
Complex to Imag
Single Pole IIR Filter
Alpha: 1
Scope Sink
Title: Scope Plot
Sample Rate: 100k
V Scale: 500m
T Scale: 10m
Notebook: main_notebook, 2
File Sink
File: ...96637kHz_RF-sync.dat
Variable
ID: decim
Value: 64
Variable
ID: xlate_decim
Value: 5
Variable
ID: baseband_rate
Value: 24k
Variable
ID: over_samp
Value: 10
Variable
ID: sym_rate
Value: 2.4k
File Sink
File: /mnt/Krumpf/mpsk_bb.dat
Feed Forward AGC
Num Samples: 16
Reference: 1
AGC
Rate: 100u
Reference: 1
Gain: 1
Max Gain: 0
AGC2
Attack Rate: 60m
Decay Rate: 1m
Reference: 1
Gain: 1
Max Gain: 100
Virtual Sink
Stream ID: re_bb
Root Raised Cosine Filter
Decimation: 1
Gain: 1
Sample Rate: 24k
Symbol Rate: 2.4k
Alpha: 350m
Num Taps: 112
Virtual Sink
Stream ID: filt_bb
Variable Slider
ID: mpsk_alpha
Variable Slider
ID: mpsk_gain_mu
Label: Gain Mu
Default Value: 20m
Minimum: 1m
Maximum: 500m
Converter: Float
Notebook: main_notebook, 1
Scope Sink
Title: MPSK (M=8)
Sample Rate: 2.4k
V Scale: 500m
T Scale: 5
XY Mode: On
Notebook: main_notebook, 1
Costas Loop
Alpha: 10m
Beta: 25u
Max Freq: 10m
Min Freq: 60m
Order: 2
Clock Recovery MM
Omega: 10
Gain Omega: 2.5m
Mu: 500m
Gain Mu: 500m
Omega Relative Limit: 5m
Scope Sink
Title: Scope Plot
Sample Rate: 24k
Notebook: main_notebook, 3
Scope Sink
Title: Scope Plot
Sample Rate: 24k
Notebook: main_notebook, 3
Scope Sink
Title: Scope Plot
Sample Rate: 2.4k
Notebook: main_notebook, 4
File Sink
File: .../Krumpf/mpsk_freq.dat
File Sink
File: ...Krumpf/mpsk_phase.dat
File Sink
File: ...mpsk_phase_error.dat
File Sink
File: /mnt/Krumpf/mpsk_mu.dat
File Sink
File: ...Krumpf/mpsk_omega.dat
File Sink
File: ...mp/mpsk_mm_error.dat
Null Sink
Virtual Source
Stream ID: re_bb
Differential Phasor
Threshold
Low: 0
High: 0
Initial State: 0
DPSK Demod
Type: DBPSK
Samples/Symbol: 10
Excess BW: 350m
Costas Alpha: 50m
Gain Mu: 20m
Mu: 500m
Omega Relative Limit: 5m
Gray Code: Yes
Verbose: On
Depuncture
Matrix: 1, 1
Variable Delay
Delay: 0
Swap
Swap: False
Differential Encoder
Modulus: 2
Any Block
Desc:
Maker: <gr_bloc...ked_bb (1)>
FFT Sink
Title: FFT Plot
Sample Rate: 200k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 25
Average Alpha: 250m
Notebook: main_notebook, 0
Waterfall Sink
Title: Waterfall Plot
Sample Rate: 24k
Baseband Freq: 0
Dynamic Range: 100
Reference Level: 50
Ref Scale (p2p): 2
FFT Size: 512
FFT Rate: 25
Notebook: main_notebook, 0
Scope Sink
Title: Scope Plot
Sample Rate: 24k
V Scale: 10
T Scale: 1m
Notebook: main_notebook, 2
Complex To Float
Quadrature Demod
Gain: 100
Complex to Arg
Complex to Mag
Complex to Real
Quadrature Demod
Gain: 1
File Sink
File: .../Krumpf/mpsk_real.dat
Complex to Real
Multiply Const
Constant: 1
Variable Delay
Delay: 0
Fast AutoCorrelation Sink
Title: Fast AutoCorrelation
Sample Rate: 24k
Baseband Freq: 0
Size: 131.072k
Rate: 10
Y per Div: 10 dB
Ref Level (dB): 50
Ref Scale (p2p): 2
Average Alpha: 200m
Notebook: main_notebook, 7
Constellation Sink
Title: Constellation Plot
Sample Rate: 24k
Frame Rate: 15
Constellation Size: 2.048k
M: 2
Theta: 0
Alpha: 5m
Max Freq: 60m
Mu: 500m
Gain Mu: 5m
Symbol Rate: 2.4k
Omega Limit: 5m
Notebook: main_notebook, 1
Scope Sink
Title: Scope Plot
Sample Rate: 24k
V Scale: 10
T Scale: 1m
Notebook: main_notebook, 1
Eye Diagram
Title: Eye Diagram
Sample Rate: 24k
Samples per symbol: 3
Num plots: 500
Symbol decimation: 50
V Scale: 1
Notebook: main_notebook, 3
Variable Slider
ID: eye_samp_per_sym
Label: Samples per symbol
Default Value: 3
Minimum: 1
Maximum: 100
Converter: Integer
Notebook: main_notebook, 3
Variable Check Box
ID: delay_viterbi
Variable Slider
ID: delay_puncture
Label: Puncture Delay
Default Value: 0
Minimum: 0
Maximum: 14
Converter: Integer
Notebook: main_notebook, 5
Variable Check Box
ID: invert
Label: Invert
Default Value: 1
True: -1
False: 1
Notebook: main_notebook, 5
Decode CCSDS 27
Add Const
Constant: -4.096k
Multiply Const
Constant: -1
Null Sink
Null Sink
Float To UChar
Scope Sink
Title: Error Rate
Sample Rate: 150
V Scale: 4.096k
V Offset: 15.872k
Notebook: main_notebook, 5
Keep 1 in N
N: 4
Threshold
Low: 11
High: 10
Initial State: 0
Variable
ID: accept_bytes
Value: 0
Variable Sink
Variable: accept_bytes
Decimation: 1
Import
Import: baz
Variable Slider
ID: sym_rate
Label: Symbol Rate
Default Value: 10k
Minimum: 300
Maximum: 20k
Converter: Integer
Simple Squelch
Threshold (dB): sq
Alpha: alpha
Scope Sink
Title: Scope Plot
Sample Rate: 24k
MPSK Sync
Alpha: 10m
Beta: 25u
Max Freq: 60m
Min Freq: 10m
Omega: 10
Gain Omega: 2.5
Mu: 500m
DD MPSK Sync
Alpha: 10m
Beta: 25u
Max Freq: 10m
Min Freq: 60m
Reference Phase: 0
Omega: 10
Gain Omega: 2.5m
Mu: 500m
Valve
Open: accept_bytes
Note
Note: These don't work
UChar To Float
Histo Sink
Title: Histogram Plot
Num Bins: 8
Frame Size: 16
Notebook: main_notebook, 2
Variable Check Box
ID: swap_viterbi
Label: Swap Viterbi
Default Value: False
True: True
False: False
Notebook: main_notebook, 5
Variable Chooser
ID: puncture_matrix
Label: Matrix
Default Value: 1, 1
Choices: [[1,1], [1,1,0,1]...
Labels: ['1/2','2/3','3/4'...
Type: Radio Buttons
Notebook: main_notebook, 5
Packed to Unpacked
Bits per Chunk: 1
Endianness: MSB
Skip Head
Num Items: 4.8k
Differential Decoder
Modulus: 2
Head
Num Items: 72k
Any Block Sink
Desc:
Maker: <gr_bloc...t_char (2)>
Histo Sink
Title: Histogram Plot
Num Bins: 256
Frame Size: 256
Notebook: main_notebook, 4

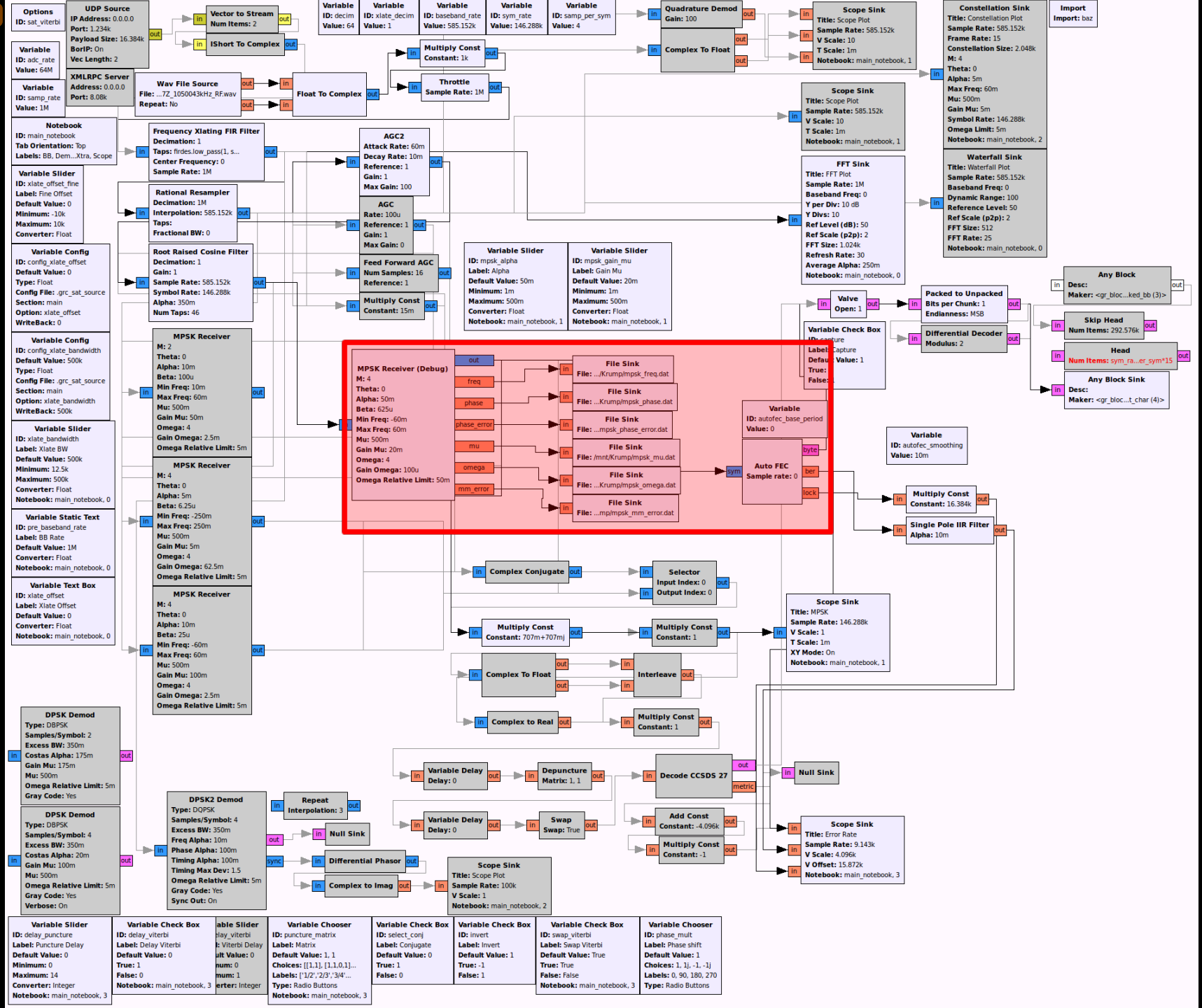

Options
ID: top_block
UDP Source
IP Address: 0.0.0.0
Port: 1.234k
MTU: 16.384k
Vec Length: 2
Vector to Stream
Num Items: 2
IShort To Complex
Frequency Xlating FIR Filter
Decimation: 10
Taps: firdes.low_pass(1, s...
Center Frequency: 0
Sample Rate: 1M
XMLRPC Server
Address: 0.0.0.0
Port: 8.08k
Variable
ID: adc_rate
Value: 64M
Variable
ID: samp_rate
Value: 1M
Notebook
ID: main_notebook
Tab Orientation: Top
Labels: BB, Dem...Xtra, Scope
Variable Slider
ID: xlate_offset_fine
Label: Fine Offset
Default Value: 0
Minimum: -10k
Maximum: 10k
Converter: Float
Variable
ID: decim
Value: 64
Variable
ID: xlate_decim
Value: 10
Variable
ID: baseband_rate
Value: 96k
Variable
ID: sym_rate
Value: 9.6k
Variable
ID: bits_per_sym
Value: 2
FFT Sink
Title: FFT Plot
Sample Rate: 100k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 30
Average Alpha: 250m
Notebook: main_notebook, 0
Waterfall Sink
Title: Waterfall Plot
Sample Rate: 96k
Baseband Freq: 0
Dynamic Range: 100
Reference Level: 50
Ref Scale (p2p): 2
FFT Size: 512
FFT Rate: 25
Notebook: main_notebook, 0
Constellation Sink
Title: Constellation Plot
Sample Rate: 96k
Frame Rate: 15
Constellation Size: 2.048k
M: 4
Theta: 0
Alpha: 5m
Max Freq: 60m
Mu: 500m
Gain Mu: 5m
Symbol Rate: 9.6k
Omega Limit: 5m
Notebook: main_notebook, 1
Rational Resampler
Decimation: 100k
Interpolation: 96k
Taps:
Fractional BW: 0
AGC2
Attack Rate: 60m
Decay Rate: 10m
Reference: 1
Gain: 1
Max Gain: 100
Complex To Float
Quadrature Demod
Gain: 100
Scope Sink
Title: Scope Plot
Sample Rate: 96k
V Scale: 10
T Scale: 1m
Notebook: main_notebook, 1
MPSK Receiver
M: 2
Theta: 0
Alpha: 10m
Beta: 100u
Min Freq: 10m
Max Freq: 60m
Mu: 500m
Gain Mu: 50m
Omega: 10
Gain Omega: 2.5m
Omega Relative Limit: 5m
Complex Conjugate
Selector
Input Index: 0
Output Index: 0
Multiply Const
Constant: 707m+707mj
Multiply Const
Constant: 1
Variable Check Box
ID: capture
Label: Capture
Default Value: 1
True: 0
False: 1
Valve
Open: 1
Import
Import: baz
Variable Config
ID: config_xlate_offset
Default Value: 0
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_offset
WriteBack: 0
Root Raised Cosine Filter
Decimation: 1
Gain: 1
Sample Rate: 96k
Symbol Rate: 9.6k
Alpha: 350m
Num Taps: 112
byte
sym
Auto FEC
Sample rate: 0
ber
lock
Packed to Unpacked
Bits per Chunk: 1
Endianness: MSB
Differential Decoder
Modulus: 2
Any Block
Desc:
Maker: <gr_bloc...ked_bb (3)>
Skip Head
Num Items: 19.2k
Head
Num Items: 288k
Any Block Sink
Desc:
Maker: <gr_bloc...t_char (4)>
Null Sink
Variable Config
ID: config_xlate_bandwidth
Default Value: 96k
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_bandwidth
WriteBack: 96k
MPSK Receiver
M: 4
Theta: 0
Alpha: 50m
Beta: 625u
Min Freq: 10m
Max Freq: 600m
Mu: 500m
Gain Mu: 50m
Omega: 10
Gain Omega: 62.5m
Omega Relative Limit: 5m
Swap
Swap: False
Add Const
Constant: -4.096k
Multiply Const
Constant: -1
metric
Scope Sink
Title: Error Rate
Sample Rate: 600
V Scale: 4.096k
V Offset: 15.872k
Notebook: main_notebook, 3
DPSK Demod
Type: DBPSK
Samples/Symbol: 10
Excess BW: 350m
Costas Alpha: 20m
Gain Mu: 100
Variable Slider
ID: xlate_bandwidth
Label: Xlate BW
Default Value: 96k
Minimum: 12.5k
Maximum: 500k
Converter: Float
Notebook: main_notebook, 0
Omega Relative Limit: 5m
Repeat
Interpolation: 3
Scope Sink
Title: MPSK
Sample Rate: 9.6k
V Scale: 1
T Scale: 1m
XY Mode: On
Notebook: main_notebook, 1
Variable Check Box
ID: select_conj
Label: Conjugate
Default Value: 0
True: 1
False: 0
Variable Slider
ID: delay_puncture
Label: Puncture Delay
Default Value: 0
Minimum: 0
Maximum: 14
Converter: Integer
Notebook: main_notebook, 2
Variable Check Box
ID: swap_viterbi
Label: Swap Viterbi
Default Value: False
True: True
False: False
Notebook: main_notebook, 3
Variable Static Text
ID: pre_baseband_rate
Label: BB Rate
Default Value: 100k
Converter: Float
Notebook: main_notebook, 0
DPSK2 Demod
Type: DQPSK
Samples/Symbol: 10
Excess BW: 350m
Freq Alpha: 10m
Phase Alpha: 100m
Timing Alpha: 100m
Timing Max Dev: 1.5
Omega Relative Limit: 5m
Gray Code: Yes
Sync Out: On
Null Sink
Differential Phasor
Variable Chooser
ID: phase_mult
Label: Phase shift
Default Value: 1
Choices: 1, 1j, -1, -1j
Labels: 0, 90, 180, 270
Type: Radio Buttons
Variable Text Box
ID: xlate_offset
Label: Xlate Offset
Default Value: 0
Converter: Float
Notebook: main_notebook, 0
Complex to Imag
Scope Sink
Title: Scope Plot
Sample Rate: 100k
V Scale: 1
Notebook: main_notebook, 2
Variable Check Box
ID: invert
Label: Invert
Default Value: 1
True: -1
False: 1
ID: puncture_matrix
Label: Matrix
Default Value: 1, 1
Choices: [[1,1], [1,1,0,1]...
Labels: ['1/2','2/3','3/4'...
Type: Radio Buttons

Auto FEC

```
Creating Auto-FEC:
    sample_rate:                800000
    ber_threshold:              2048
    ber_smoothing:              0.01
    ber_duration:               8192
    ber_sample_decimation:      1
    settling_period:  4096
    pre_lock_duration:          8192

De-puncturer relative rate: 1.000000
==> Using throttle at sample rate: 800000
==> Using lock throttle rate: 50000
Auto-FEC thread started: Thread-1
Skipping initial samples while MPSK receiver locks: 4096

Reached excess BER limit: 11437.1352901 , locked: False , current puncture matrix: 0 , total samples
    received: 12289
    Applying lock value: 0
Beginning search...
    Applying rotation: 1j

Reached excess BER limit: 11870.4144919 , locked: False , current puncture matrix: 0 , total samples
    received: 24586
    Applying rotation: 1
    Applying conjugation: 0

Locking current XForm
=====================================================
```

FEC locked: 1/2

```
=====================================================
    Applying lock value: 1
```

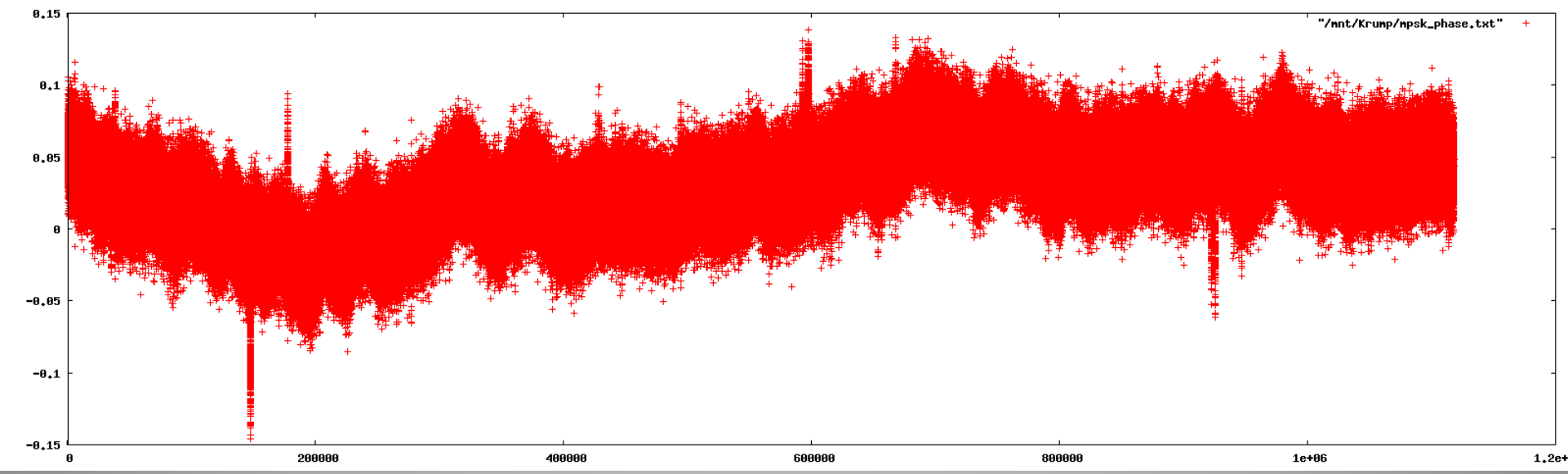

Options
ID: sat_viterbi
UDP Source
IP Address: 0.0.0.0
Port: 1.234k
Payload Size: 16.384k
BorIP: On
Vec Length: 2
Vector to Stream
Num Items: 2
IShort To Complex
Variable
ID: adc_rate
Value: 64M
XMLRPC Server
Address: 0.0.0.0
Port: 8.08k
Variable
ID: samp_rate
Value: 1M
Wav File Source
File: ...7Z_1050043kHz_RF.wav
Repeat: No
Float To Complex
Variable
ID: decim
Value: 64
Variable
ID: xlate_decim
Value: 1
Variable
ID: baseband_rate
Value: 585.152k
Variable
ID: sym_rate
Value: 146.288k
Variable
ID: samp_per_sym
Value: 4
Multiply Const
Constant: 1k
Throttle
Sample Rate: 1M
Quadrature Demod
Gain: 100
Complex To Float
Scope Sink
Title: Scope Plot
Sample Rate: 585.152k
V Scale: 10
T Scale: 1m
Notebook: main_notebook, 1
Constellation Sink
Title: Constellation Plot
Sample Rate: 585.152k
Frame Rate: 15
Constellation Size: 2.048k
M: 4
Theta: 0
Alpha: 5m
Max Freq: 60m
Mu: 500m
Gain Mu: 5m
Symbol Rate: 146.288k
Omega Limit: 5m
Notebook: main_notebook, 2
Import
Import: baz
Scope Sink
Title: Scope Plot
Sample Rate: 585.152k
V Scale: 10
T Scale: 1m
Notebook: main_notebook, 1
Waterfall Sink
Title: Waterfall Plot
Sample Rate: 585.152k
Baseband Freq: 0
Dynamic Range: 100
Reference Level: 50
Ref Scale (p2p): 2
FFT Size: 512
FFT Rate: 25
Notebook: main_notebook, 0
FFT Sink
Title: FFT Plot
Sample Rate: 1M
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 30
Average Alpha: 250m
Notebook: main_notebook, 0
Notebook
ID: main_notebook
Tab Orientation: Top
Labels: BB, Dem...Xtra, Scope
Frequency Xlating FIR Filter
Decimation: 1
Taps: firdes.low_pass(1, s...
Center Frequency: 0
Sample Rate: 1M
AGC2
Attack Rate: 60m
Decay Rate: 10m
Reference: 1
Gain: 1
Max Gain: 100
Variable Slider
ID: xlate_offset_fine
Label: Fine Offset
Default Value: 0
Minimum: -10k
Maximum: 10k
Converter: Float
Rational Resampler
Decimation: 1M
Interpolation: 585.152k
Taps:
Fractional BW: 0
AGC
Rate: 100u
Reference: 1
Gain: 1
Max Gain: 0
Variable Slider
ID: mpsk_alpha
Label: Alpha
Default Value: 50m
Minimum: 1m
Maximum: 500m
Converter: Float
Notebook: main_notebook, 1
Variable Slider
ID: mpsk_gain_mu
Label: Gain Mu
Default Value: 20m
Minimum: 1m
Maximum: 500m
Converter: Float
Notebook: main_notebook, 1
Variable Config
ID: config_xlate_offset
Default Value: 0
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_offset
WriteBack: 0
Root Raised Cosine Filter
Decimation: 1
Gain: 1
Sample Rate: 585.152k
Symbol Rate: 146.288k
Alpha: 350m
Num Taps: 46
Feed Forward AGC
Num Samples: 16
Reference: 1
Multiply Const
Constant: 15m
Valve
Open: 1
Packed to Unpacked
Bits per Chunk: 1
Endianness: MSB
Differential Decoder
Modulus: 2
Variable Check Box
ID: capture
Label: Capture
Default Value: 1
True:
False:
Any Block
Desc:
Maker: <gr_bloc...ked_bb (3)>
Skip Head
Num Items: 292.576k
Head
Num Items: sym_ra...er_sym*15
Any Block Sink
Desc:
Maker: <gr_bloc...t_char (4)>
Variable Config
ID: config_xlate_bandwidth
Default Value: 500k
Type: Float
Config File: .grc_sat_source
Section: main
Option: xlate_bandwidth
WriteBack: 500k
MPSK Receiver
M: 2
Theta: 0
Alpha: 10m
Beta: 100u
Min Freq: 10m
Max Freq: 60m
Mu: 500m
Gain Mu: 50m
Omega: 4
Gain Omega: 2.5m
Omega Relative Limit: 5m
MPSK Receiver (Debug)
M: 4
Theta: 0
Alpha: 50m
Beta: 625u
Min Freq: -60m
Max Freq: 60m
Mu: 500m
Gain Mu: 20m
Omega: 4
Gain Omega: 100u
Omega Relative Limit: 50m
out
freq
phase
phase_error
mu
omega
mm_error
File Sink
File: .../Krump/mpsk_freq.dat
File Sink
File: ...Krump/mpsk_phase.dat
File Sink
File: ...mpsk_phase_error.dat
File Sink
File: /mnt/Krump/mpsk_mu.dat
File Sink
File: ...Krump/mpsk_omega.dat
File Sink
File: ...mp/mpsk_mm_error.dat
Variable
ID: autofec_base_period
Value: 0
Auto FEC
Sample rate: 0
sym
byte
ber
lock
Variable
ID: autofec_smoothing
Value: 10m
Variable Slider
ID: xlate_bandwidth
Label: Xlate BW
Default Value: 500k
Minimum: 12.5k
Maximum: 500k
Converter: Float
Notebook: main_notebook, 0
MPSK Receiver
M: 4
Theta: 0
Alpha: 5m
Beta: 6.25u
Min Freq: -250m
Max Freq: 250m
Mu: 500m
Gain Mu: 5m
Omega: 4
Gain Omega: 62.5m
Omega Relative Limit: 5m
Multiply Const
Constant: 16.384k
Single Pole IIR Filter
Alpha: 10m
Variable Static Text
ID: pre_baseband_rate
Label: BB Rate
Default Value: 1M
Converter: Float
Notebook: main_notebook, 0
MPSK Receiver
M: 4
Theta: 0
Alpha: 10m
Beta: 25u
Min Freq: -60m
Max Freq: 60m
Mu: 500m
Gain Mu: 100m
Omega: 4
Gain Omega: 2.5m
Omega Relative Limit: 5m
Complex Conjugate
Selector
Input Index: 0
Output Index: 0
Variable Text Box
ID: xlate_offset
Label: Xlate Offset
Default Value: 0
Converter: Float
Notebook: main_notebook, 0
Multiply Const
Constant: 707m+707mj
Multiply Const
Constant: 1
Scope Sink
Title: MPSK
Sample Rate: 146.288k
V Scale: 1
T Scale: 1m
XY Mode: On
Notebook: main_notebook, 1
Complex To Float
Interleave
Complex to Real
Multiply Const
Constant: 1
DPSK Demod
Type: DBPSK
Samples/Symbol: 2
Excess BW: 350m
Costas Alpha: 175m
Gain Mu: 175m
Mu: 500m
Omega Relative Limit: 5m
Gray Code: Yes
Variable Delay
Delay: 0
Depuncture
Matrix: 1, 1
Decode CCSDS 27
Null Sink
DPSK Demod
Type: DBPSK
Samples/Symbol: 4
Excess BW: 350m
Costas Alpha: 20m
Gain Mu: 100m
Mu: 500m
Omega Relative Limit: 5m
Gray Code: Yes
Verbose: On
DPSK2 Demod
Type: DQPSK
Samples/Symbol: 4
Excess BW: 350m
Freq Alpha: 10m
Phase Alpha: 100m
Timing Alpha: 100m
Timing Max Dev: 1.5
Omega Relative Limit: 5m
Gray Code: Yes
Sync Out: On
Repeat
Interpolation: 3
Null Sink
Differential Phasor
Complex to Imag
Variable Delay
Delay: 0
Swap
Swap: True
Add Const
Constant: -4.096k
Multiply Const
Constant: -1
Scope Sink
Title: Error Rate
Sample Rate: 9.143k
V Scale: 4.096k
V Offset: 15.872k
Notebook: main_notebook, 3
Scope Sink
Title: Scope Plot
Sample Rate: 100k
V Scale: 1
Notebook: main_notebook, 2
Variable Slider
ID: delay_puncture
Label: Puncture Delay
Default Value: 0
Minimum: 0
Maximum: 14
Converter: Integer
Notebook: main_notebook, 3
Variable Check Box
ID: delay_viterbi
Label: Delay Viterbi
Default Value: 0
True: 1
False: 0
Notebook: main_notebook, 3
Variable Chooser
ID: puncture_matrix
Label: Matrix
Default Value: 1, 1
Choices: [[1,1], [1,1,0,1]...
Labels: ['1/2','2/3','3/4'...
Type: Radio Buttons
Notebook: main_notebook, 3
Variable Check Box
ID: select_conj
Label: Conjugate
Default Value: 0
True: 1
False: 0
Variable Check Box
ID: invert
Label: Invert
Default Value: 1
True: -1
False: 1
Variable Check Box
ID: swap_viterbi
Label: Swap Viterbi
Default Value: True
True: True
False: False
Notebook: main_notebook, 3
Variable Chooser
ID: phase_mult
Label: Phase shift
Default Value: 1
Choices: 1, 1j, -1, -1j
Labels: 0, 90, 180, 270
Type: Radio Buttons

Demodulated & error-corrected

- Symbol rate = 9600 symbols/sec
- Pre-FEC raw bit rate = 19200 bits/sec
- Post-FEC raw bit rate = 9600 bits/sec (½ rate)

- Visualise data: look for additional clues
  - Differential encoding
  - Scrambling
  - Structure

QPSK Phase Debug

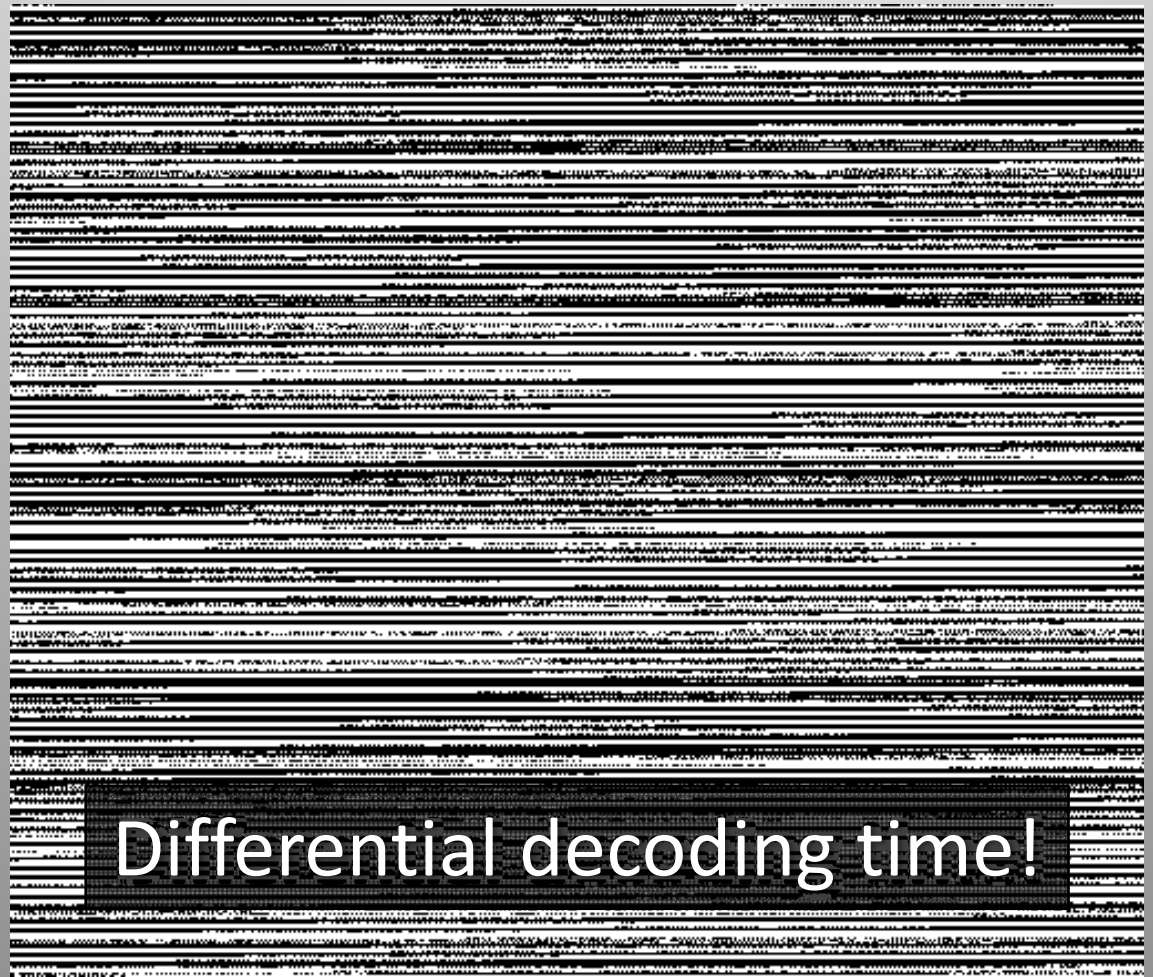


Visualisation

- Raw data (0: black, 1: white)

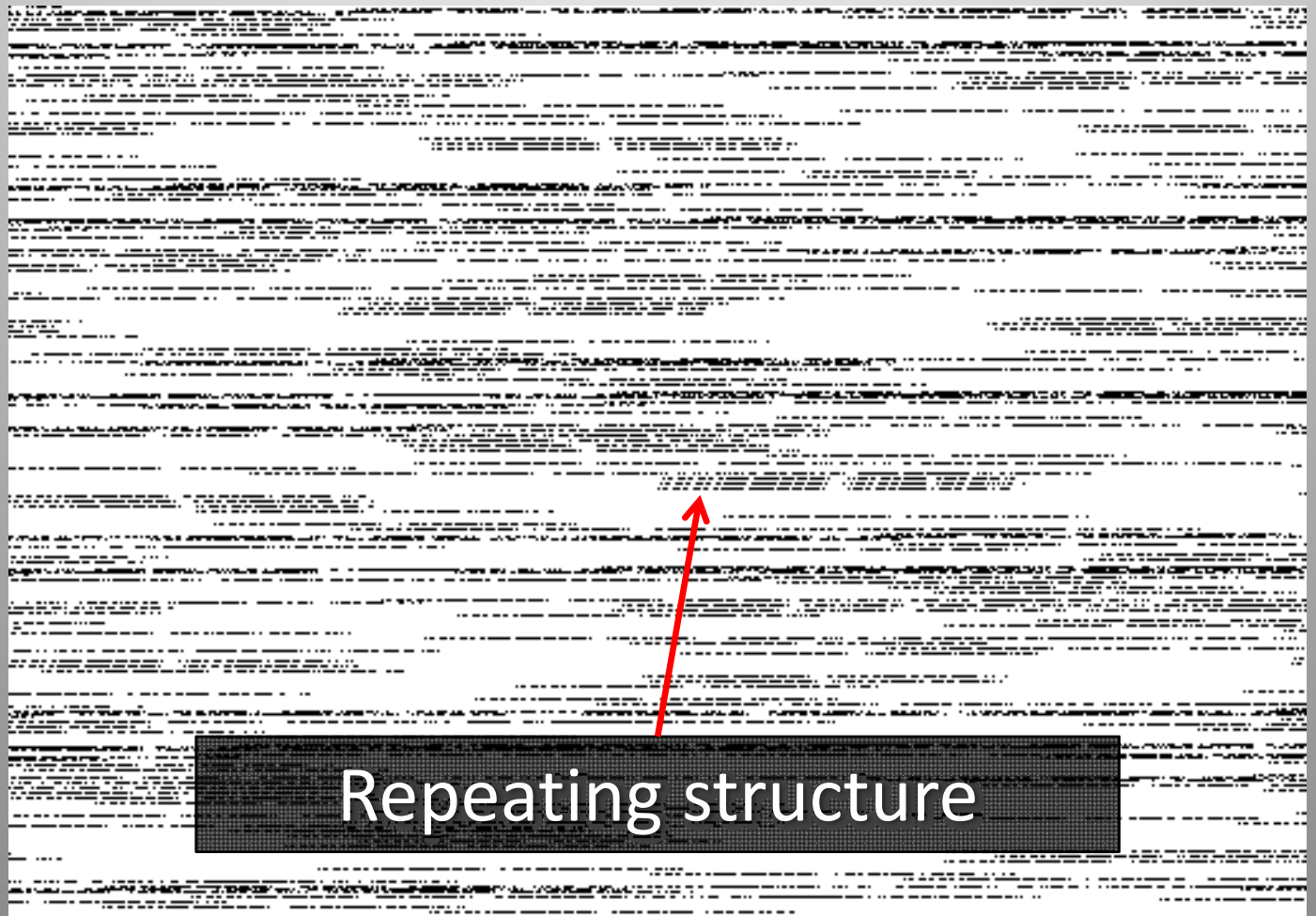
De-scrambled

- Better, but long runs of 0s and 1s (not ideal)



Diff. decoded & de-scrambled

- Structured, asynchronous packets of data!



Pattern Search

```
44 bits #0002-0002[+0000, /0000]: 00000001000011101000000010001011101111111011 (dfdd1017080)
44 bits #0002-0002[+0000, /0000]: 00000001100000011111000010111101010101111111 (feabd0f8180)
44 bits #0002-0002[+0000, /0000]: 00000001100001011111000010111101010101111111 (feabd0fa180)
44 bits #0004-0004[+0000, /0000]: 00000001100000110000100010111101010101111111 (feabd10c180)

43 bits #0000-0005[+0001, /0000]: 01101111001100000010011001100010000011000000 (1846640cf6)

42 bits #0002-0002[+0000, /0000]: 00000001100100011101001100001100001000000000 (430cb8980)
42 bits #0002-0002[+0000, /0000]: 00000001000001000010000001100110110000000010 (10366042080)
42 bits #0002-0002[+0000, /0000]: 00000001100100010001101100000011111000000000 (7c0d88980)
42 bits #0001-0003[+0000, /0000]: 00000001000011101000000010001011011111111110 (1fdd1017080)
42 bits #0003-0003[+0000, /0000]: 00000001100010011101001100001100001000000000 (430cb9180)
42 bits #0000-0004[+0002, /0000]: 00000011000001100001000101111010101011111111 (3f55e8860c0)

41 bits #0002-0002[+0000, /0000]: 00000001000011001001110000100111110000000000 (3e4393080)
41 bits #0003-0003[+0000, /0000]: 00000001000101001001110000001111110000000000 (3f0392880)
41 bits #0001-0003[+0000, /0000]: 00000001000011101000000011110101110000000001 (1036f017080)
41 bits #0000-0003[+0001, /0000]: 00000010000111010000000100010111011111111110 (fee880b840)
41 bits #0000-0004[+0002, /0000]: 00000001000011101000000010100000010101111111 (1f505017080)
41 bits #0006-0006[+0000, /0000]: 00000001000001000010000001011111110000000000 (3fa042080)

40 bits #0002-0002[+0000, /0000]: 11000010001011111001010000010001100000000 (18829f443)
40 bits #0002-0002[+0000, /0000]: 01100001011111110101000010001100000000111 (e0310afe86)
40 bits #0002-0002[+0000, /0000]: 00000001000011101000000010001011001111111 (fcd1017080)
40 bits #0002-0002[+0000, /0000]: 00011101001011001101000000100011000000001 (81881674b8)
40 bits #0000-0003[+0001, /0000]: 00000010000111010000000011110111011000000001 (81b780b840)
40 bits #0000-0003[+0001, /0000]: 00000011000100111010011000011000001000000000 (21865c8c0)
40 bits #0001-0004[+0000, /0000]: 00000001000011101000000010001011101111111111 (fdd1017080)
40 bits #0001-0004[+0000, /0000]: 00000001000011101000000011111011011000000000 (36f017080)
40 bits #0001-0005[+0000, /0000]: 00000001000011101000000010100000010101111111 (f505017080)
40 bits #0006-0006[+0000, /0000]: 00000001000001000010000001011111110000000000 (1fa042080)

39 bits #0002-0002[+0000, /0000]: 11111010010111001111010000100011000000000 (c42f3a5f)
39 bits #0002-0002[+0000, /0000]: 00100000011111111010010111000010111111111 (7f43a5fc04)
39 bits #0002-0002[+0000, /0000]: 00000001010101010010001101000111100000001 (41e2c4aa80)
39 bits #0002-0002[+0000, /0000]: 01110100101110011010000001000110000000010 (2062059d2e)
39 bits #0002-0002[+0000, /0000]: 01111101001011100111101000010001100000000 (1885e74be)
39 bits #0002-0002[+0000, /0000]: 01011010010111000110000000100011000000000 (c4063a5a)
39 bits #0000-0003[+0001, /0000]: 00000010001010010011100000011111000000000 (1f81c9440)
39 bits #0000-0004[+0001, /0000]: 00000010000111010000000100010111011111111 (7ee880b
39 bits #0000-0004[+0001, /0000]: 00000010000111010000000111101101100000000 (1b780b8
39 bits #0000-0005[+0002, /0000]: 00000010000111010000000101000001010111111 (7a8280b
39 bits #0000-0006[+0004, /0000]: 00000010000010000100000010111111110000000 (1fd0210
39 bits #0166-0172[+0000, /0000]: 11111110011000100110001001100100000000 (9919197

38 bits #0002-0002[+0000, /0000]: 01001000101110100001100001000110000000 (62185d12
38 bits #0002-0002[+0000, /0000]: 11110100101111011110100001000110000001 (206217bd
38 bits #0002-0002[+0000, /0000]: 00011000010111001011010000100011000000 (c42d3a18)
38 bits #0002-0002[+0000, /0000]: 00110000101111100110100001000110000000 (62167d0c)
38 bits #0001-0003[+0000, /0000]: 00000001010101010010001101000111100000 (1e2c4aa80)
38 bits #0000-0003[+0001, /0000]: 11111010010111001111010000100011000000 (c42f3a5f)
38 bits #0000-0003[+0001, /0000]: 01110100101110011010000001000110000001 (2062059d2e)
38 bits #0000-0006[+0004, /0000]: 00000010000010000100000010111111000000 (fd021040)
38 bits #0000-0172[+0166, /0000]: 111111010011000100110001001100100000000 (4c8c8cbf)

37 bits #0002-0002[+0000, /0000]: 11101100000001110101101100000001000000 (40dae037)
37 bits #0002-0002[+0000, /0000]: 10110100101111101101000001000110000000 (6205bd2d)
37 bits #0002-0002[+0000, /0000]: 00000001111011000010111001101011111111 (1fd6743780)
37 bits #0000-0003[+0001, /0000]: 00000010101010100100011010000111100000 (f1625540)
37 bits #0000-0010[+0008, /0000]: 00000001000001000010000001011111111010 (bfa042080)
37 bits #0000-0010[+0008, /0000]: 00000001000001000010000001011111110110 (dfa042080)
37 bits #0000-0010[+0008, /0000]: 00000001000001000010000001011111110001 (11fa042080)
```

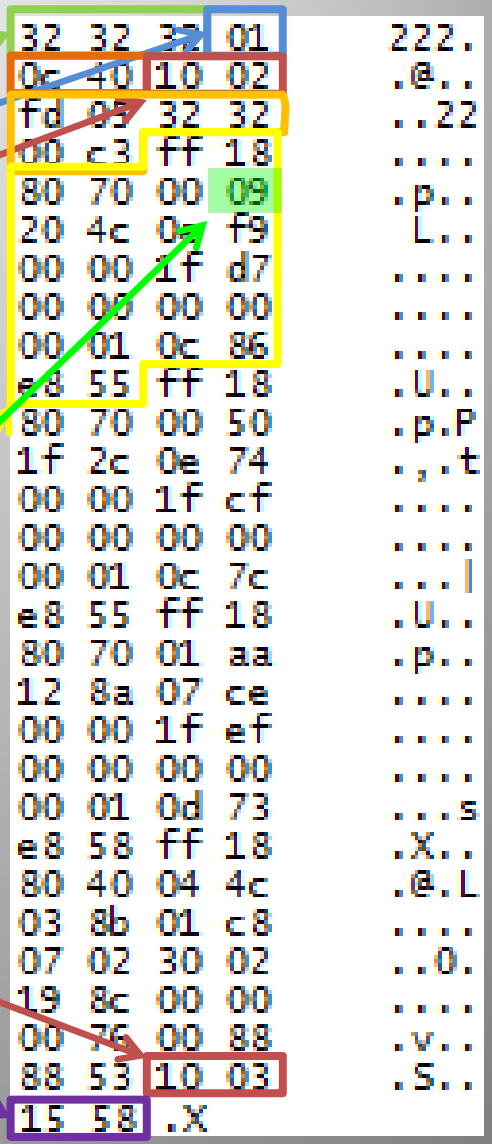
- Search for repeating strings of bits
- Try to find frame header
- Clue: sudden increase in # of occurrences

```
38 bits #0000-0006[+0004, /0000]: 00000010000010000100000010111111000000 (fd021040)
38 bits #0000-0172[+0166, /0000]: 111111010011000100110001001100100000000 (4c8c8cbf)

37 bits #0002-0002[+0000, /0000]: 11101100000001110101101100000001000000 (40dae037)
37 bits #0002-0002[+0000, /0000]: 10110100101111101101000001000110000000 (6205bd2d)
```

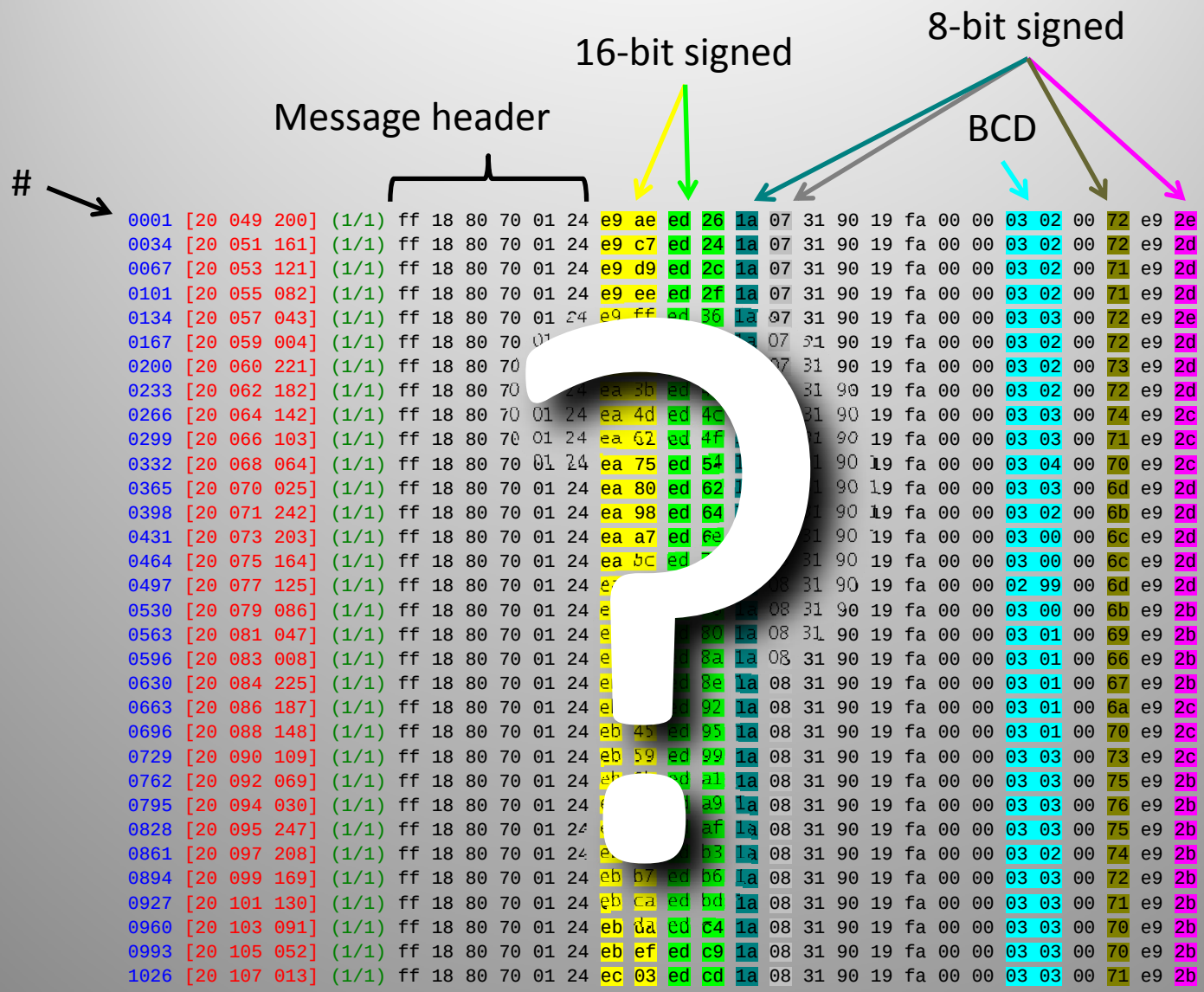
Preceding 1s are just part of ‘idle’ stream when no data is being sent

Frame analysis

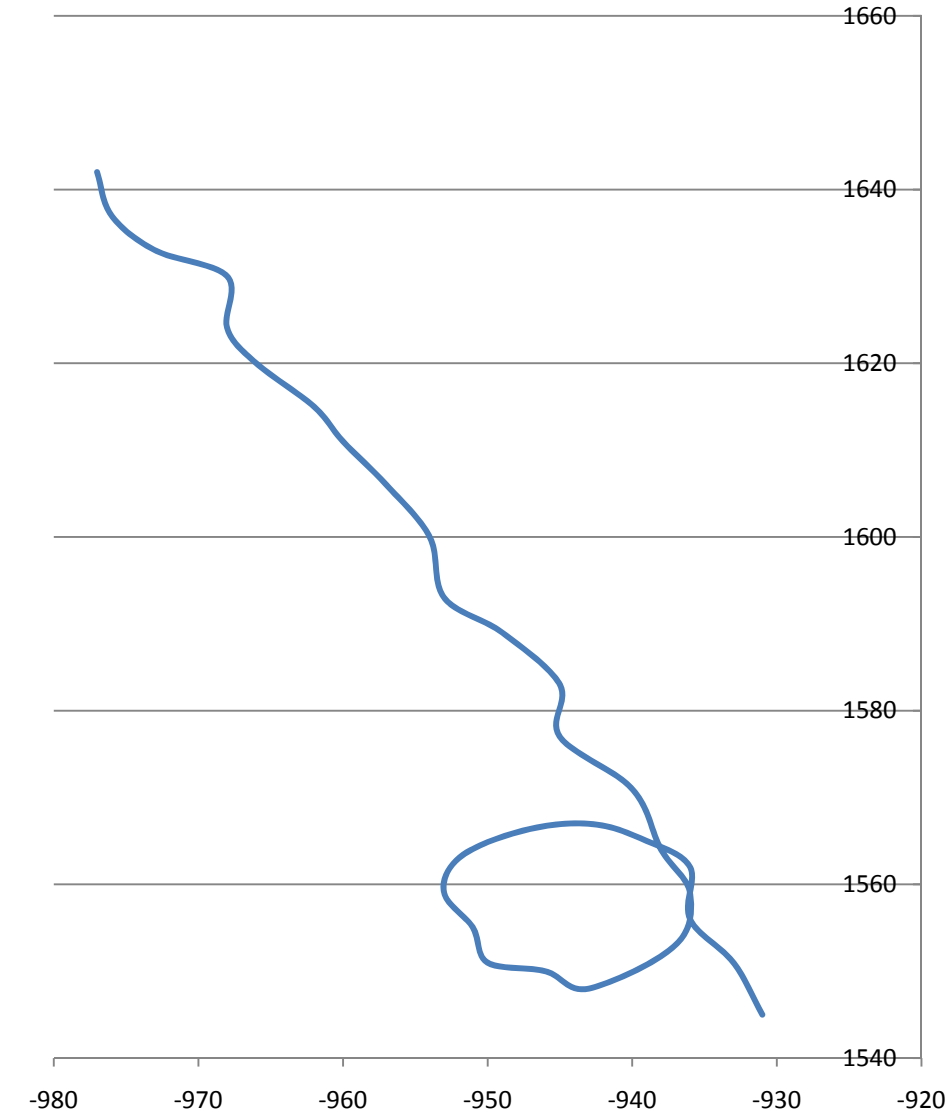
- Header
  - SYN SYN SYN (EBCDIC)
- Character-oriented encoding:
  - SOH
  - STX
  - ETX
  - CRC (CCITT-16)
- Numbers of fixed-length messages
  - Each contains an ID

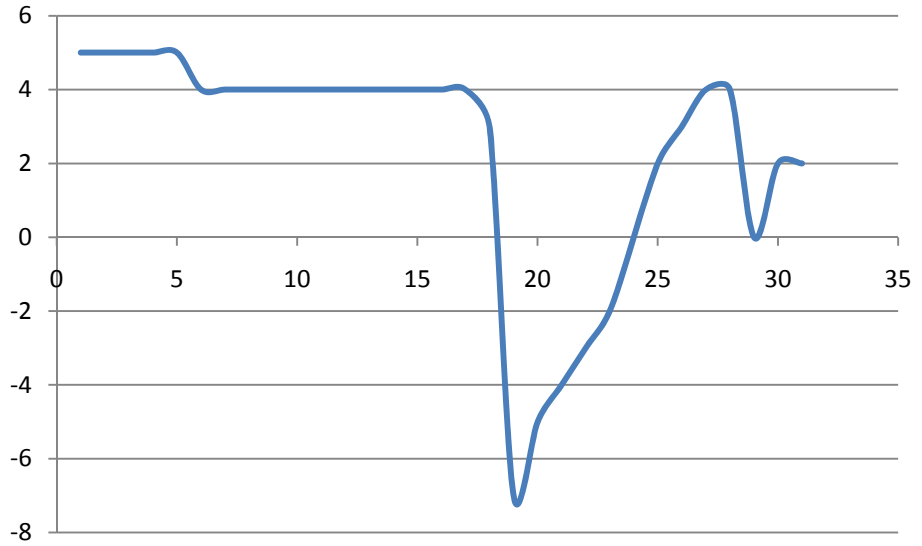


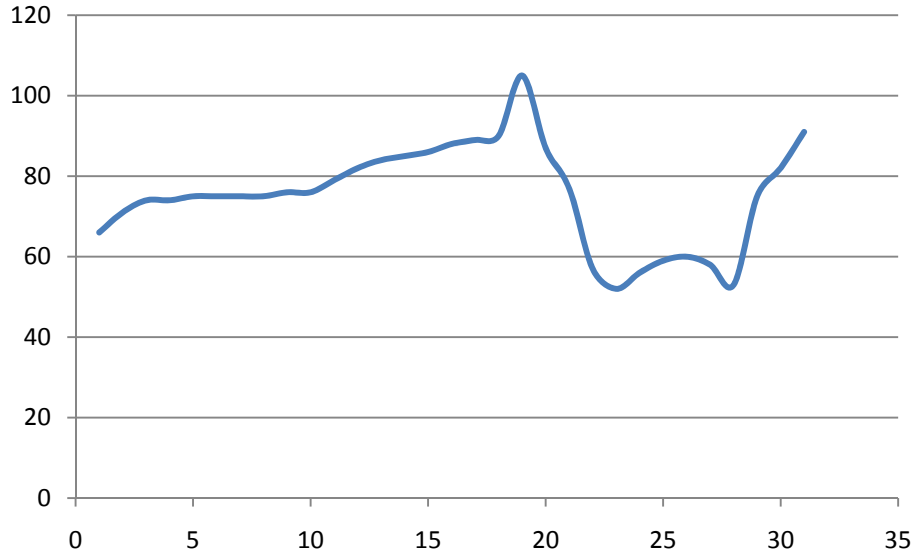
Un-pack & find patterns



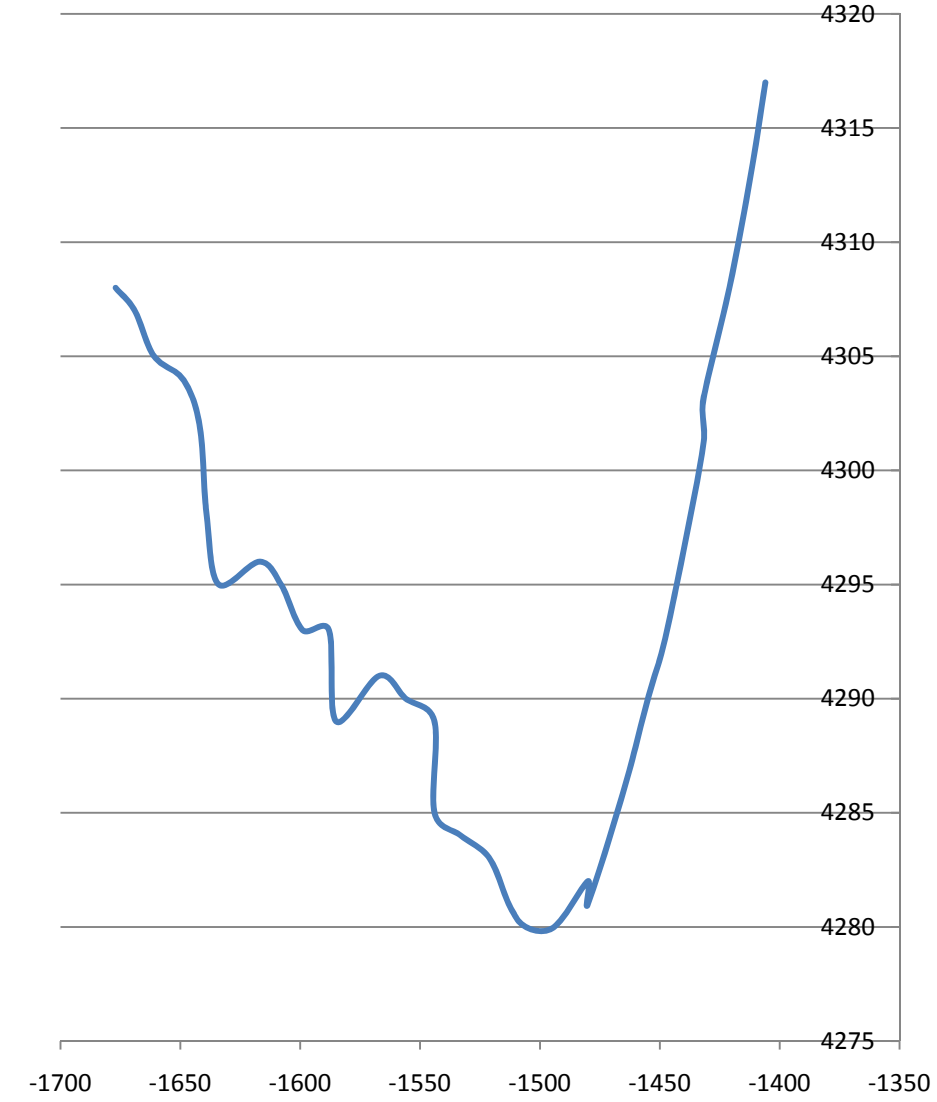
Graphing the Data

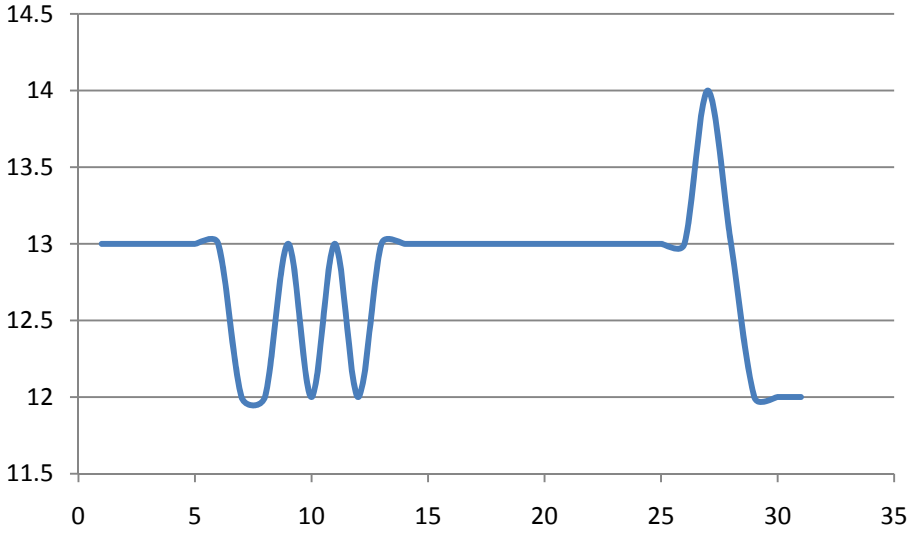


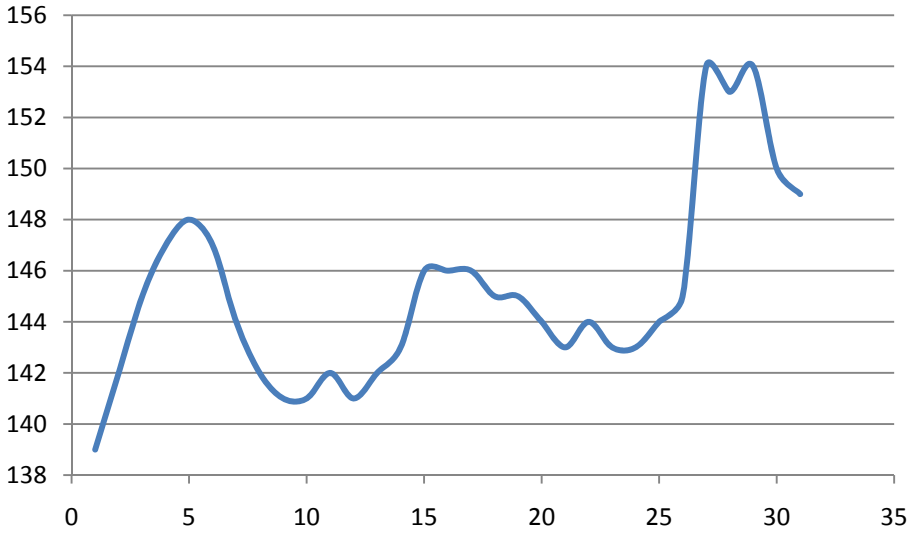


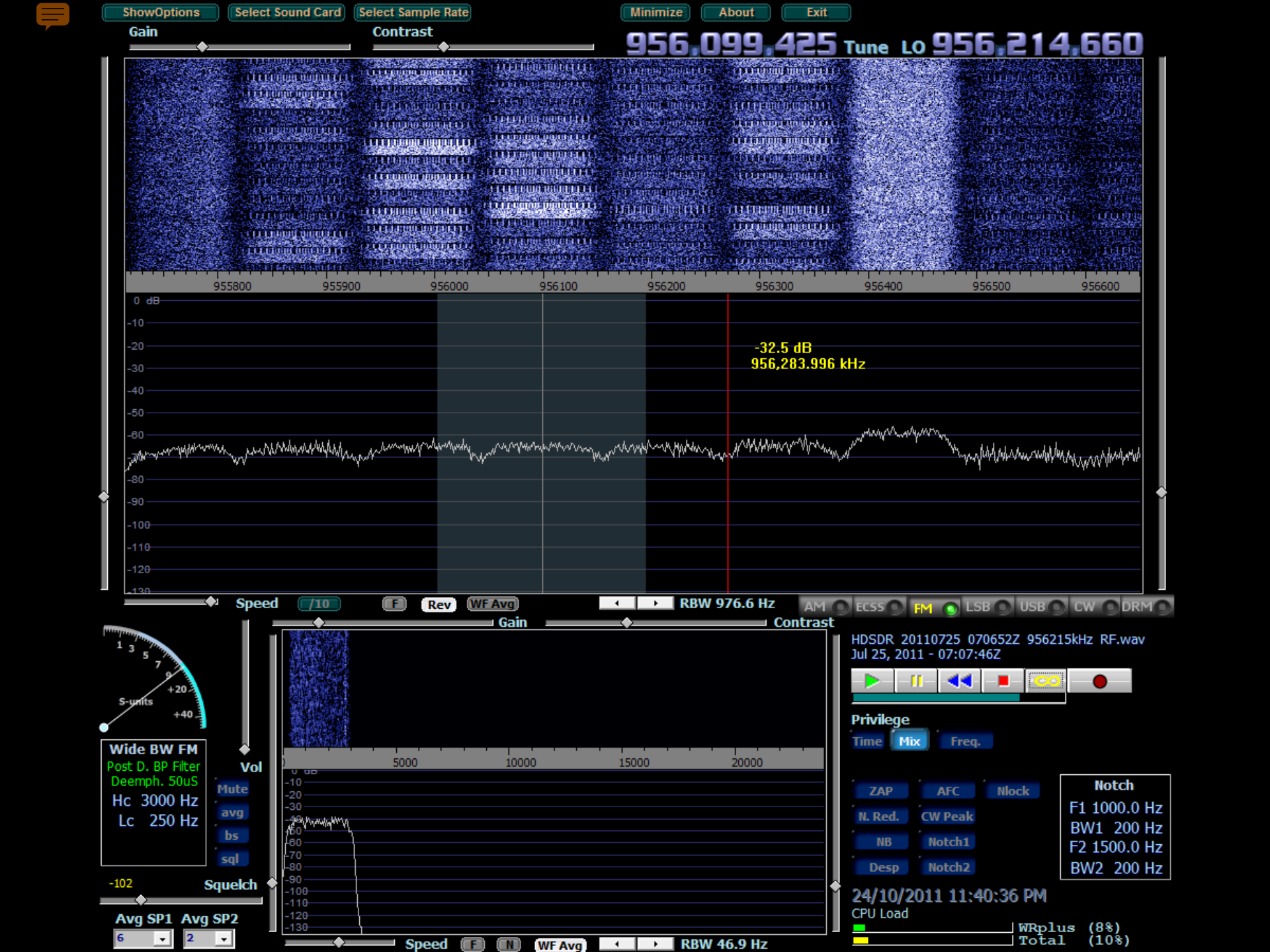


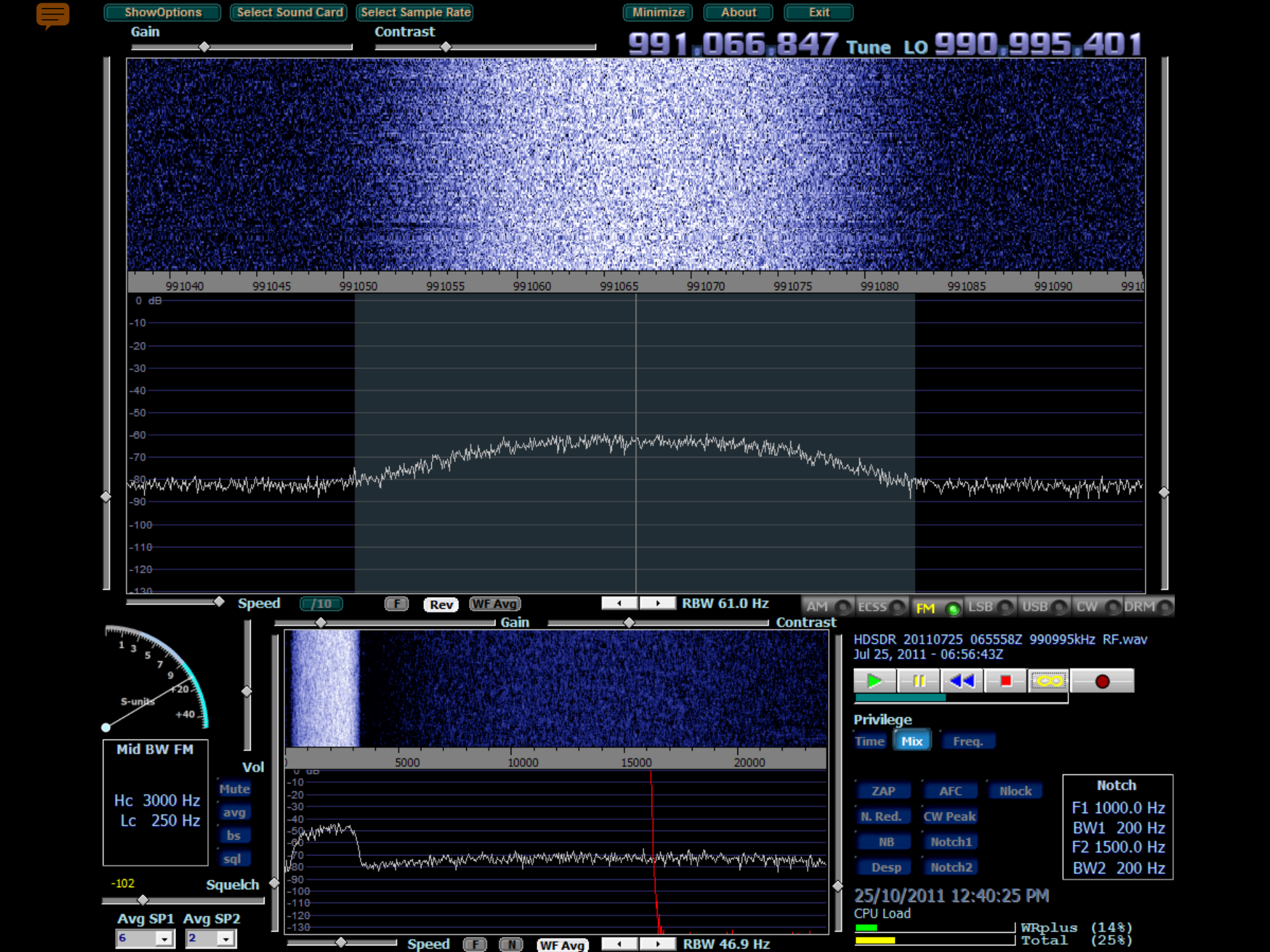
Graphing the Data

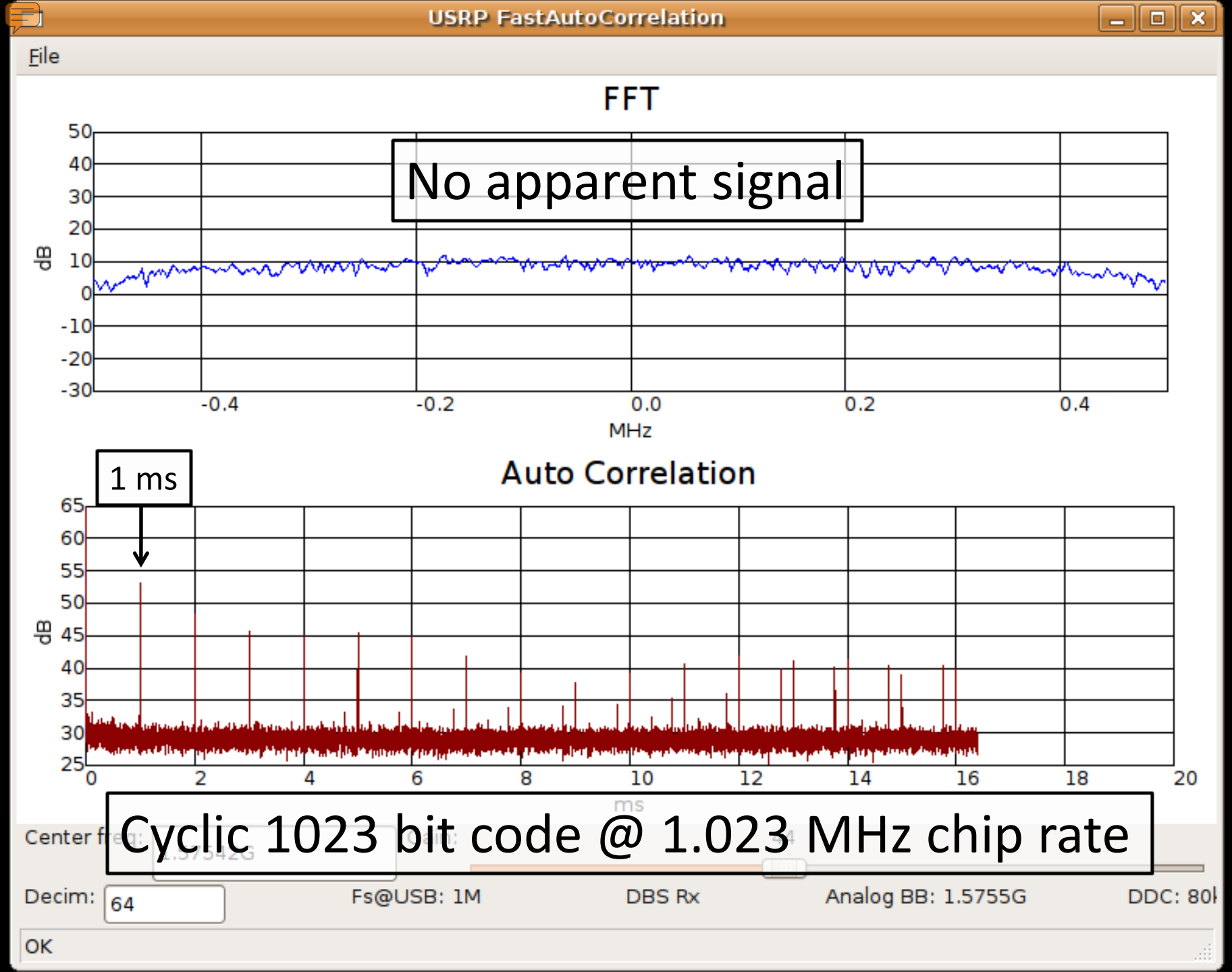




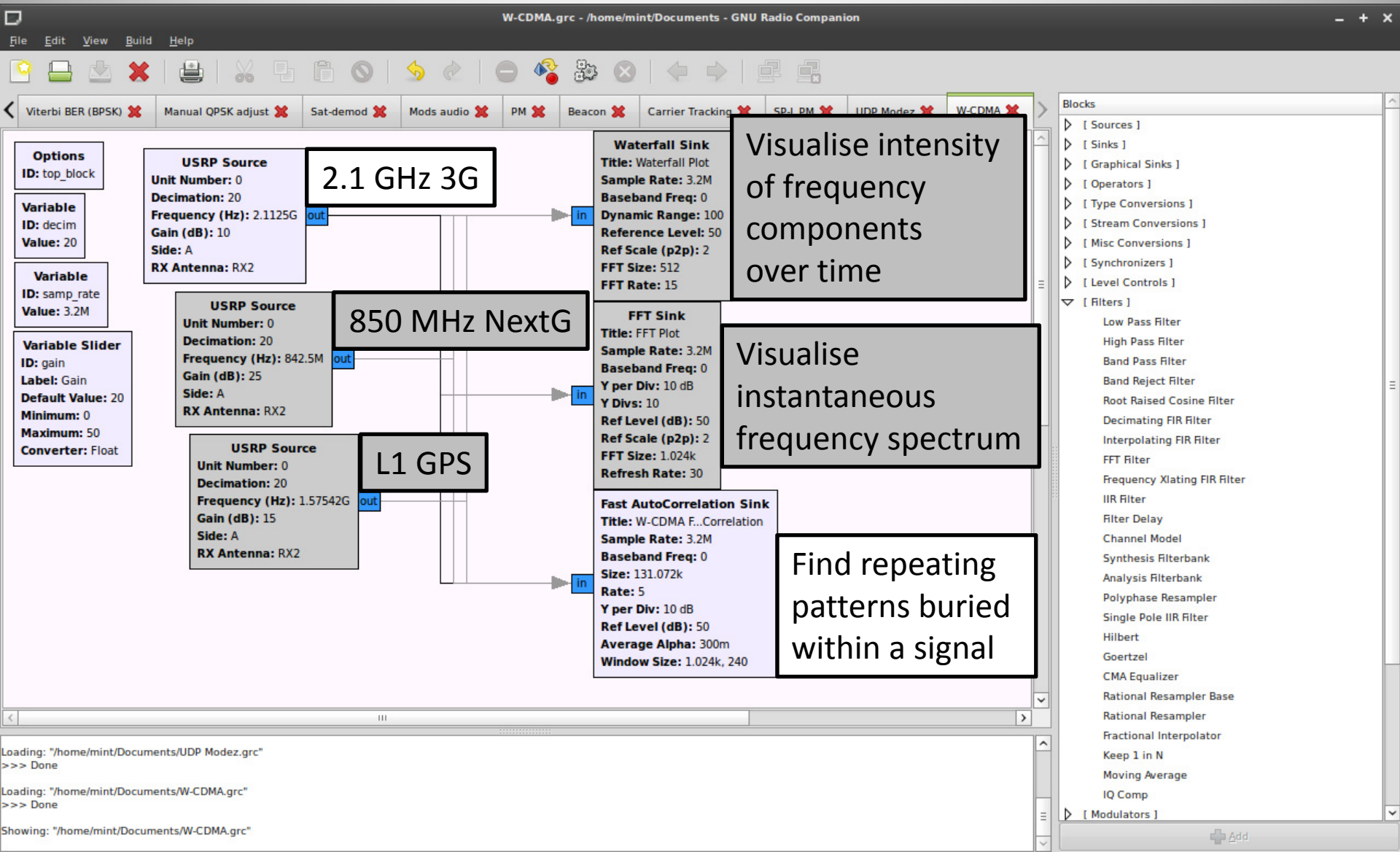



ShowOptions
Select Sound Card
Select Sample Rate
Minimize
About
Exit
Gain
Contrast
956.099.425 Tune LO 956.214.660
955800
955900
956000
956100
956200
956300
956400
956500
956600
0 dB
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-32.5 dB
956,283.996 kHz
Speed
/10
F
Rev
WF Avg
RBW 976.6 Hz
AM
ECSS
FM
LSB
USB
CW
DRM
S-units
1
3
5
7
9
+20
+40
Wide BW FM
Post D. BP Filter
Deemph. 50uS
Hc 3000 Hz
Lc 250 Hz
Vol
Mute
avg
bs
sql
-102
Squelch
Avg SP1
Avg SP2
6
2
Gain
Contrast
5000
10000
15000
20000
Speed
F
N
WF Avg
RBW 46.9 Hz
HDSDR 20110725 070652Z 956215kHz RF.wav
Jul 25, 2011 - 07:07:46Z
Privilege
Time
Mix
Freq.
ZAP
AFC
Nlock
N. Red.
CW Peak
NB
Notch1
Desp
Notch2
Notch
F1 1000.0 Hz
BW1 200 Hz
F2 1500.0 Hz
BW2 200 Hz
24/10/2011 11:40:36 PM
CPU Load
WRplus (8%)
Total (10%)


ShowOptions
Select Sound Card
Select Sample Rate
Minimize
About
Exit
Gain
Contrast
991,066,847 Tune LO 990,995,401
991040
991045
991050
991055
991060
991065
991070
991075
991080
991085
991090
0 dB
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Speed
/10
F
Rev
WF Avg
RBW 61.0 Hz
AM
ECSS
FM
LSB
USB
CW
DRM
Gain
Contrast
5000
10000
15000
20000
Speed
F
N
WF Avg
RBW 46.9 Hz
S-units
Mid BW FM
Hc 3000 Hz
Lc 250 Hz
Vol
Mute
avg
bs
sql
-102
Squelch
Avg SP1
Avg SP2
HDSDR 20110725 065558Z 990995kHz RF.wav
Jul 25, 2011 - 06:56:43Z
Privilege
Time
Mix
Freq.
ZAP
AFC
Nlock
N. Red.
CW Peak
NB
Notch1
Desp
Notch2
Notch
F1 1000.0 Hz
BW1 200 Hz
F2 1500.0 Hz
BW2 200 Hz
25/10/2011 12:40:25 PM
CPU Load
WRplus (14%)
Total (25%)

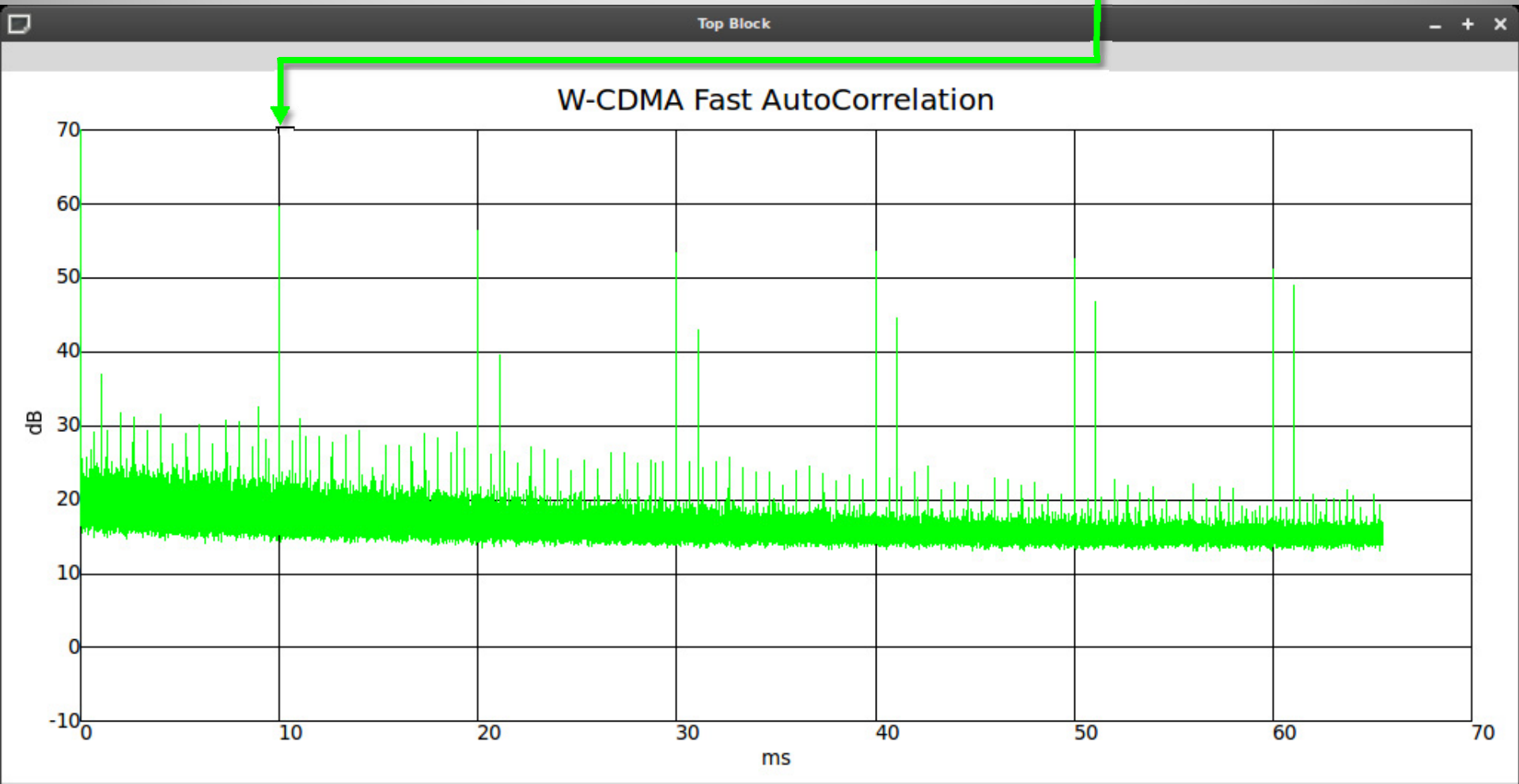

USRP FastAutoCorrelation
File
FFT
No apparent signal
50
40
30
20
10
0
-10
-20
-30
dB
-0.4
-0.2
0.0
0.2
0.4
MHz
1 ms
Auto Correlation
65
60
55
50
45
40
35
30
25
dB
0
2
4
6
8
10
12
14
16
18
20
ms
Cyclic 1023 bit code @ 1.023 MHz chip rate
Center freq:
Decim:
64
Fs@USB: 1M
DBS Rx
Analog BB: 1.5755G
DDC: 80k
OK

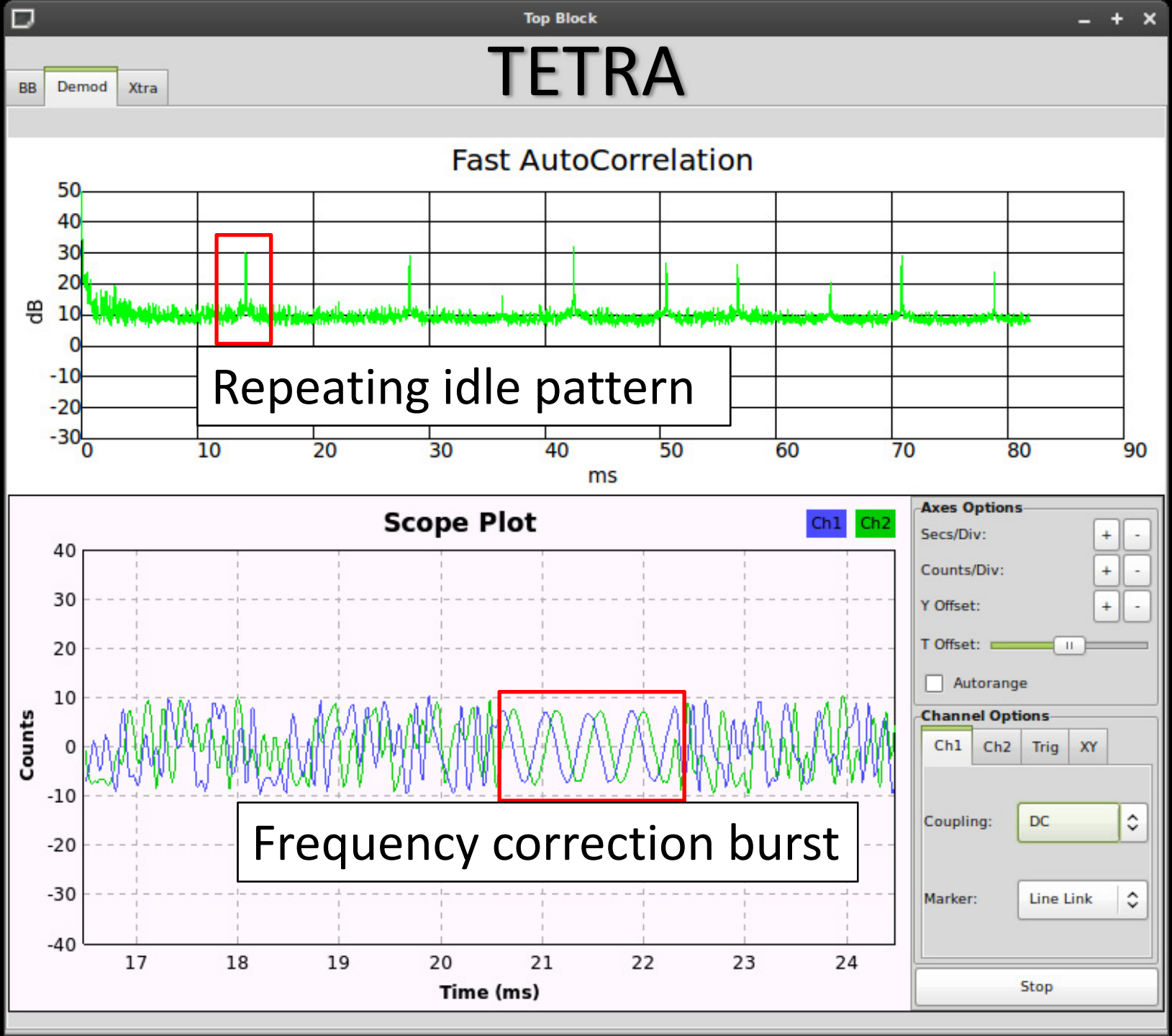
CDMA Detection with GRC



3G W-CDMA

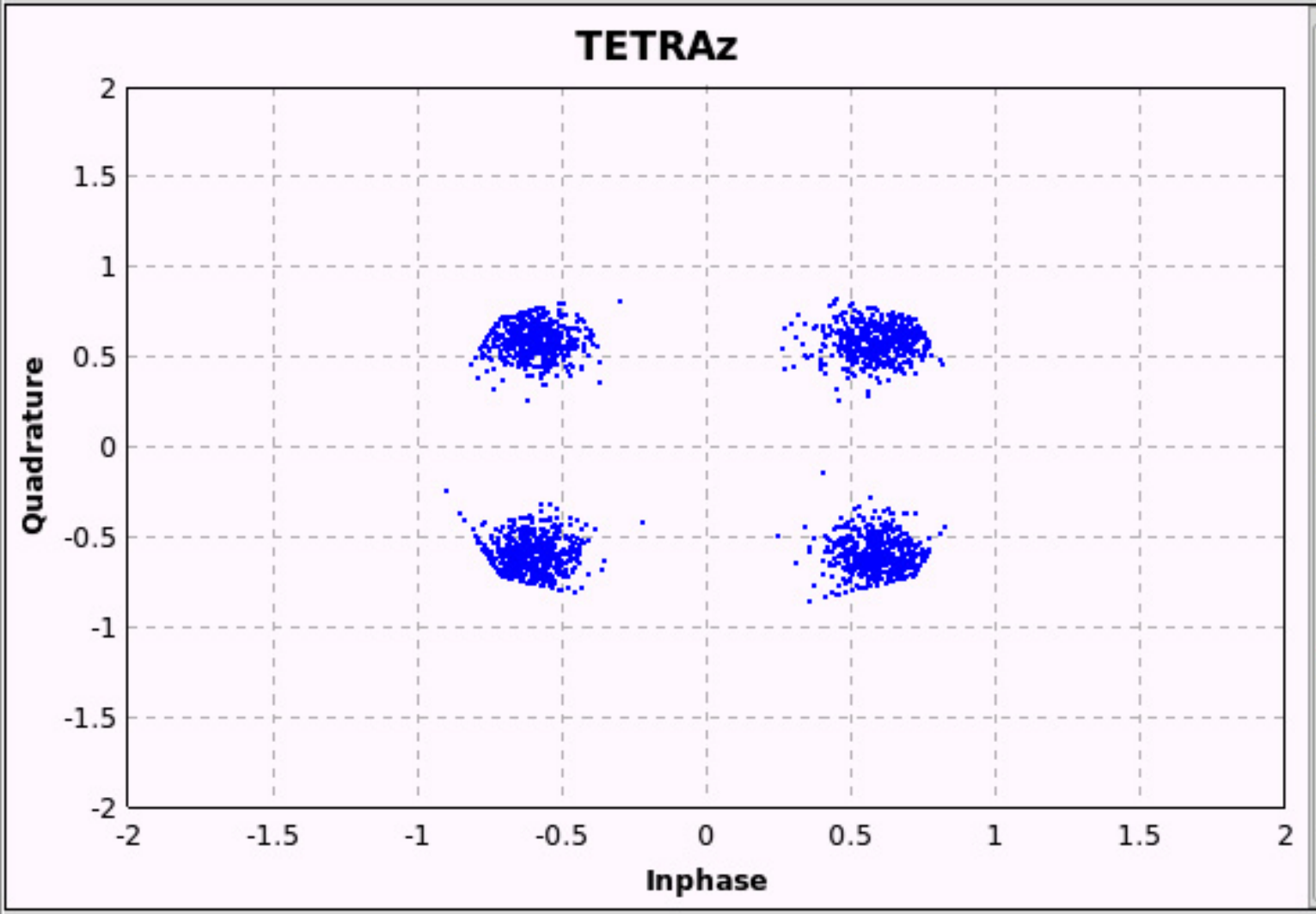
Signature of UMTS: repeating data in CPICH at 10 ms intervals




Top Block
TETRA
BB
Demod
Xtra
Fast AutoCorrelation
dB
ms
Repeating idle pattern
Scope Plot
Ch1
Ch2
Counts
Time (ms)
Frequency correction burst
Axes Options
Secs/Div:
Counts/Div:
Y Offset:
T Offset:
Autorange
Channel Options
Ch1
Ch2
Trig
XY
Coupling:
DC
Marker:
Line Link
Stop

Top Block

BB | Demod | Xtra



Options

Alpha: 10m

Gain Mu: 50m

Marker: Dot Medium

Stop

TETRA

Sat Demod

BB | Scope | Demod | Pow | Cyclo | FAC | # | Quad | Mag | Test

Symbol rate (fine): 0

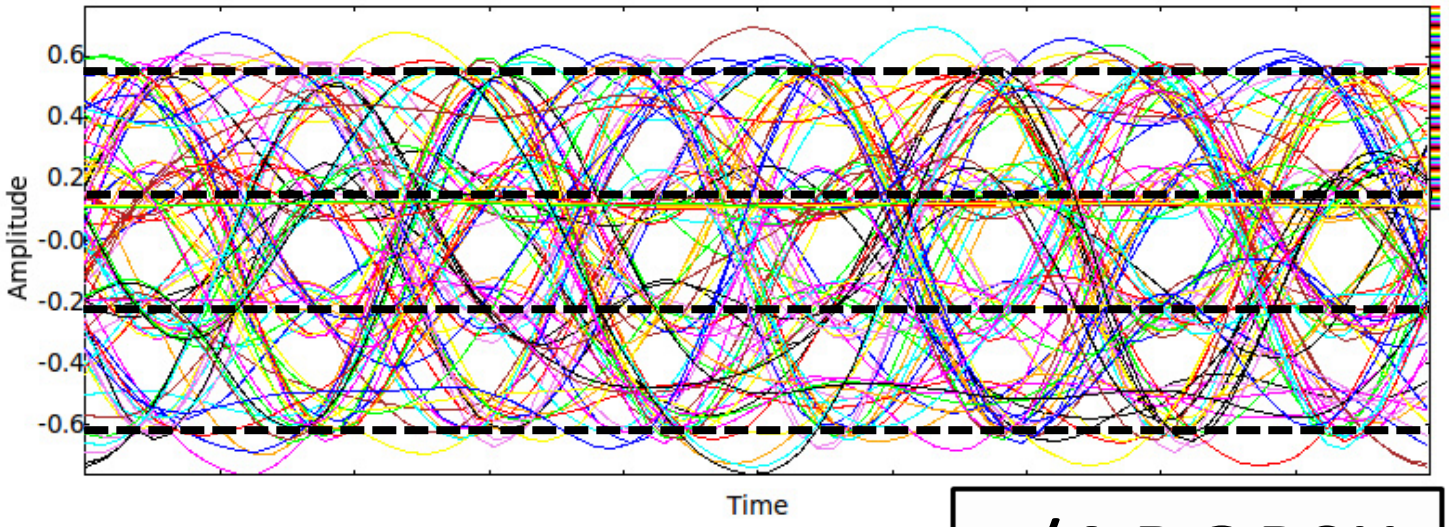
Symbol rate (coarse): 0

Symbol rate: 18000

Samples per symbol: 80

Num plots: 100

Data Scope



π/4 DQPSK

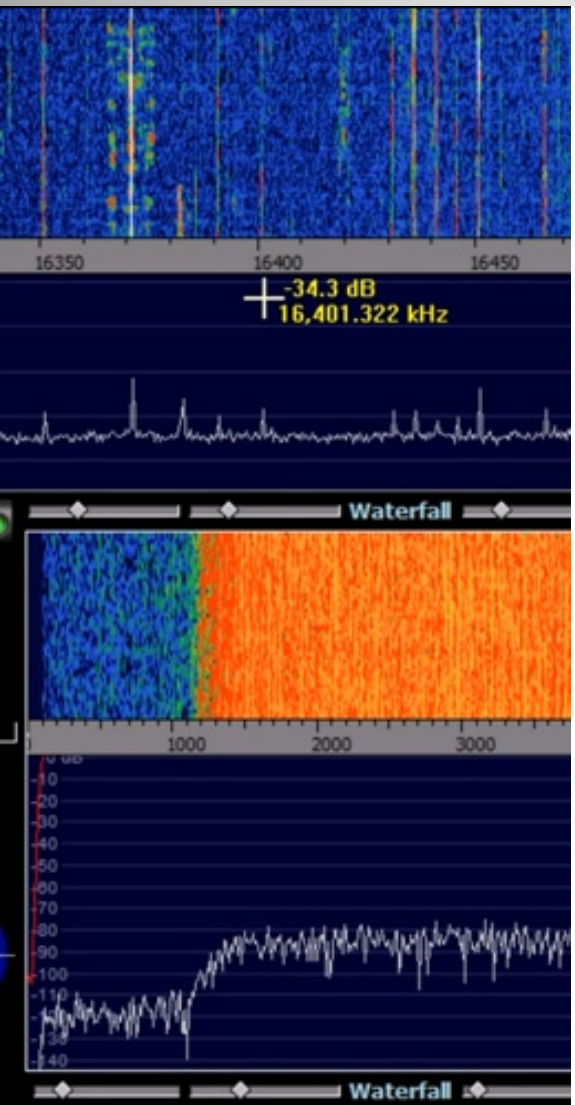
Fine Offset: 0

Coarse offset: 0

Xlate Offset: 117.708k

Xlate BW: 34.4375k

STANAG 4285



STANAG-4285

STANAG-4285 is specified by the NATO (North Atlantic Treaty Organization) Military Agency for Standardization in "Characteristics of 1200 / 2400 / 3600 Bits per Second Single Tone Modulators / Demodulators for HF Radio Links" (16. February 1989).

Parameter	Value
Frequency range	HF
Operation modes	Broadcast/Simplex FEC
Modulation	8-PSK
Center frequency	1800 Hz
Symbol rate	2400 Bd
Receiver settings	DATA, CW, LSB or USB
Input format(s)	AF, IF

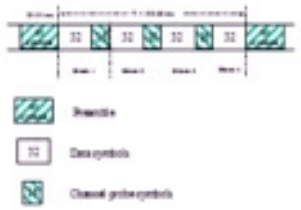
The modulation technique used in this mode consists of phase shift keying (8-PSK) of a single tone sub-carrier of 1800 Hz. The modulation speed (symbol rate) is always 2400 Bd.

Using different M-PSK modulations and FEC (Forward Error Correction) coding rates, serial binary user information (raw data) accepted at the line side input can be transmitted at different user data rates.

STANAG 4285 single tone waveform has the following characteristics which may be selected from **Options |Frame Format...**:

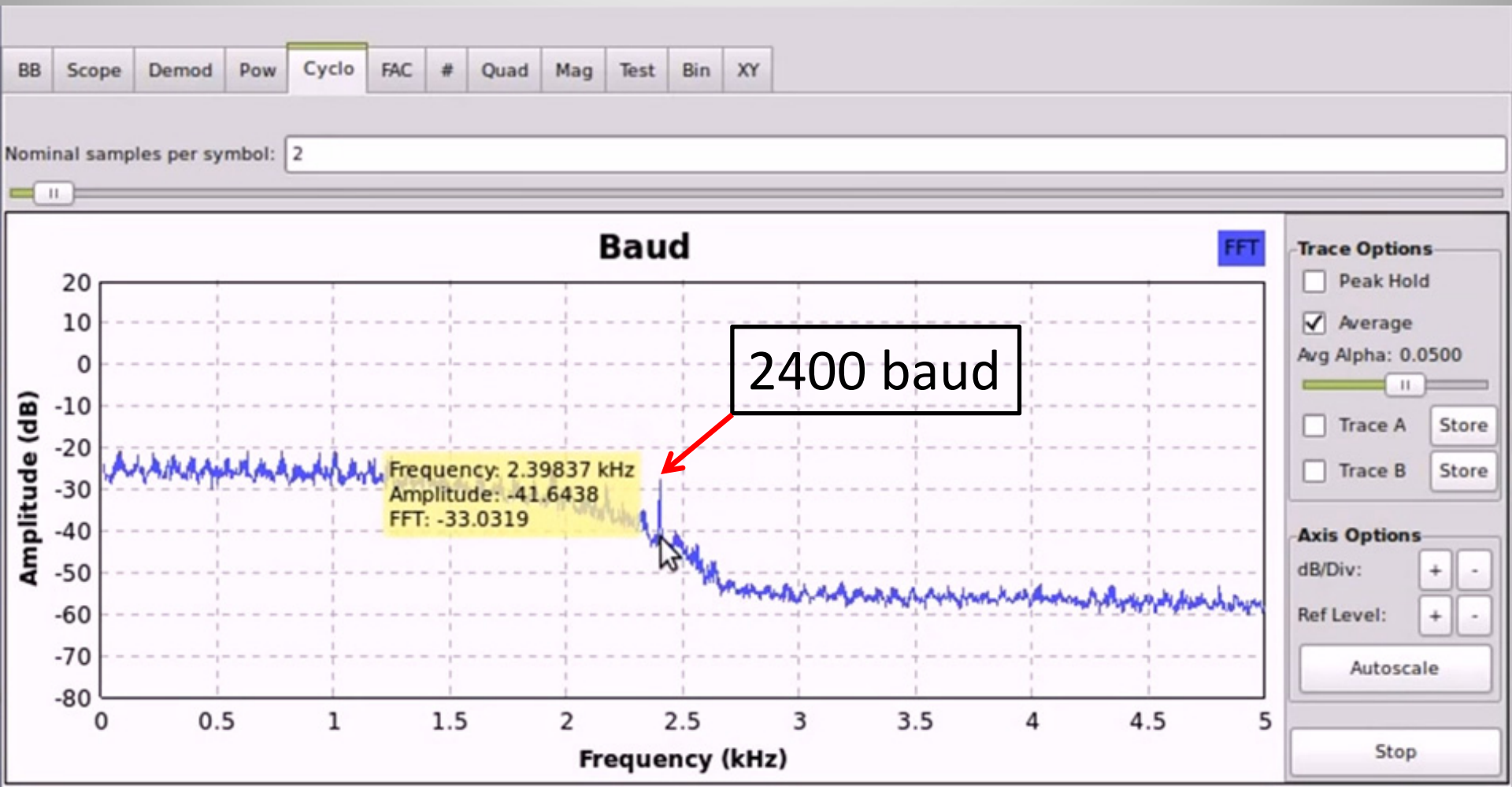
Baud Rate	User data rate (bps)	User data rate (bps)	FEC coding rate	Interleaver	No. of unknown 8-phase symbols (User Data)	No. of known 8-phase symbols (Channel Probe)
2400	2400	3 (8-PSK)	2 / 3	SHORT or LONG	32	16
2400	1200	2 (QPSK)	1 / 2	SHORT or LONG	32	16
2400	600	1 (BPSK)	1 / 2	SHORT or LONG	32	16
2400	300	1 (BPSK)	1 / 4	SHORT or LONG	32	16
2400	150	1 (BPSK)	1 / 8	SHORT or LONG	32	16
2400	75	1 (BPSK)	1 / 16	SHORT or LONG	32	16
2400	3600	3 (8-PSK)	No coding	ZERO	32	16
2400	2400	2 (QPSK)	No coding	ZERO	32	16
2400	1200	1 (BPSK)	No coding	ZERO	32	16

The user data is transmitted using a continuous frame structure. Each frame begins with a 33.33 ms preamble containing 80 symbols, the next 176 symbols are divided into four 32-symbol data segments and three 16-symbol channel probe segments.



At the end of transmission, a certain bit-pattern (in hexadecimal notation, 4B65A5B2, MSB first) is sent to mark the end of message (EOM). The

STANAG 4285


BB
Scope
Demod
Pow
Cyclo
FAC
#
Quad
Mag
Test
Bin
XY
Nominal samples per symbol:
2
Baud
FFT
2400 baud
Frequency: 2.39837 kHz
Amplitude: -41.6438
FFT: -33.0319
Amplitude (dB)
Frequency (kHz)
Trace Options
Peak Hold
Average
Avg Alpha: 0.0500
Trace A
Store
Trace B
Store
Axis Options
dB/Div:
Ref Level:
Autoscale
Stop

80 (preamble) +
4 x 32 (data) +
3 x 16 (channel probe)
@ 2400 bps
= **106.66 ms**

Fine Offset: 0

Coarse offset: 0

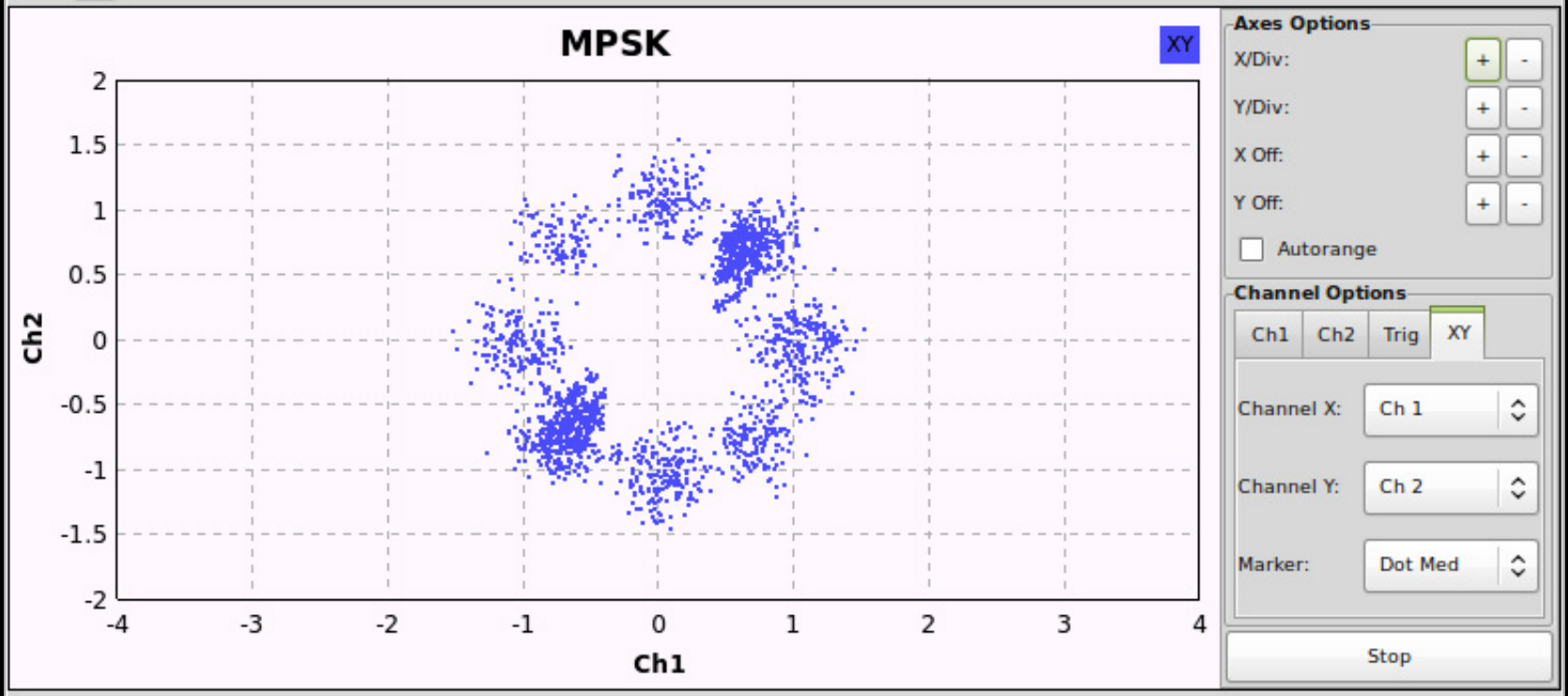
Xlate Offset: -306.325k

Xlate BW: 5k

BB | Demod | Xtra | Eye | Histo | FEC | PSK | FAC

Gain Mu: 10.481m

Alpha: 20.96m



Axes Options

X/Div: + -

Y/Div: + -

X Off: + -

Y Off: + -

Autorange

Channel Options

Ch1 | Ch2 | Trig | XY

Channel X: Ch 1

Channel Y: Ch 2

Marker: Dot Med

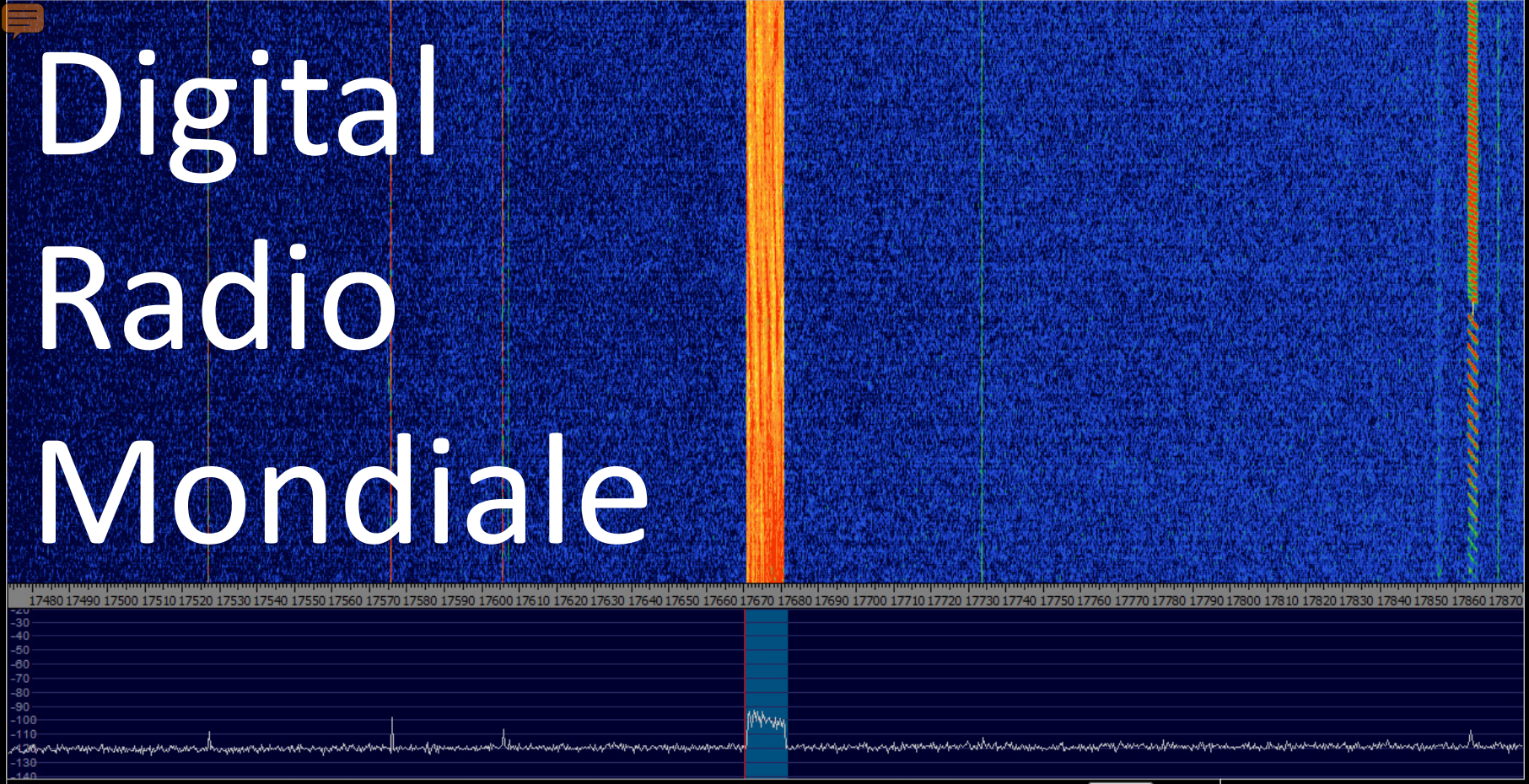
Stop

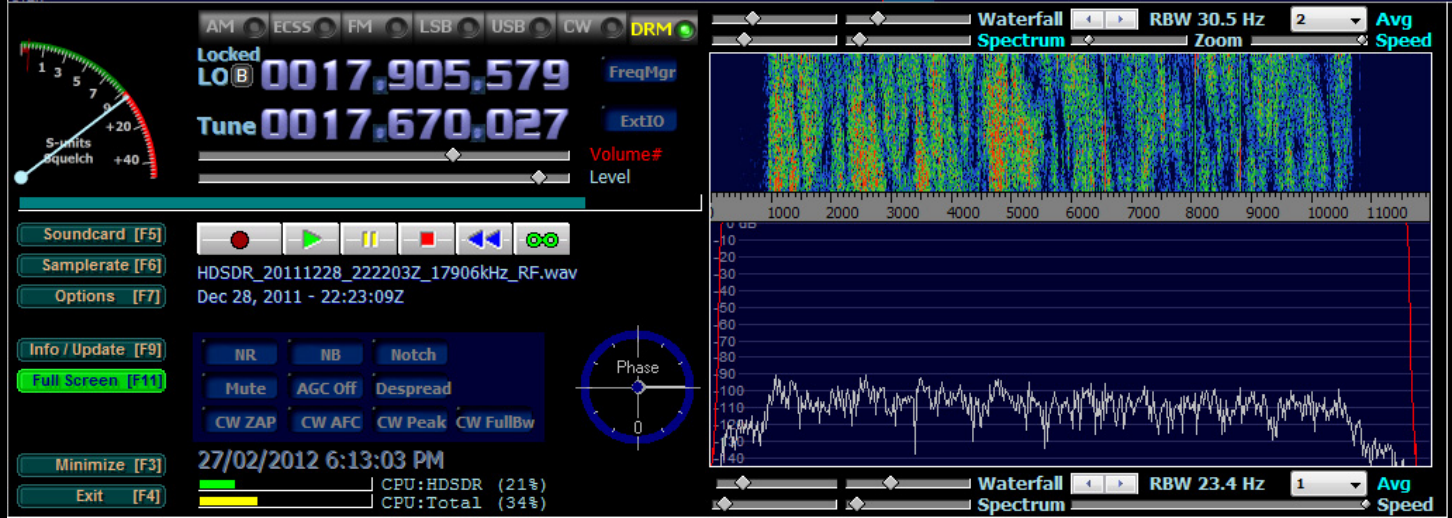
Fine Offset: 0

Xlate Offset: -306.325k

Xlate BW: 5k

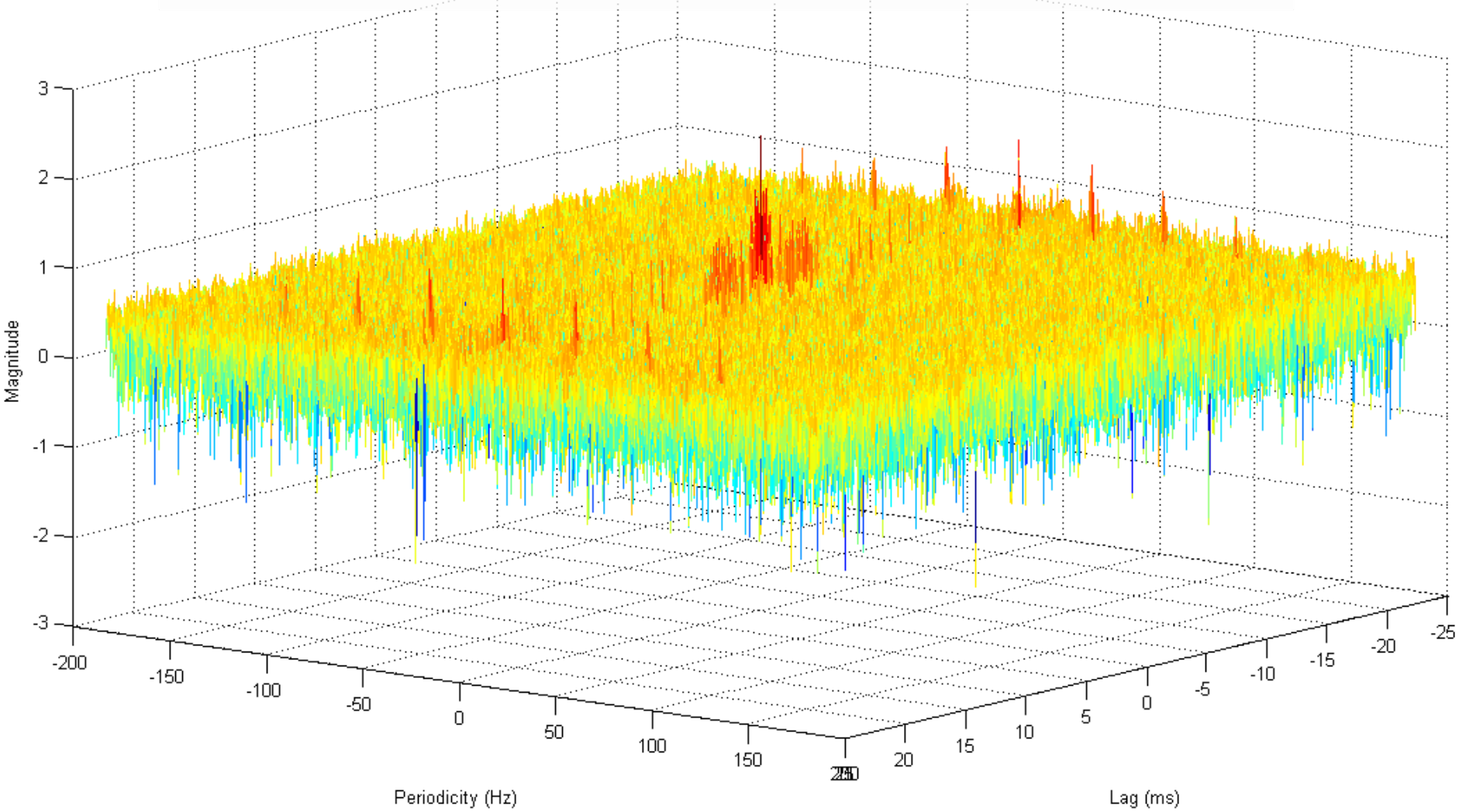
Digital Radio Mondiale



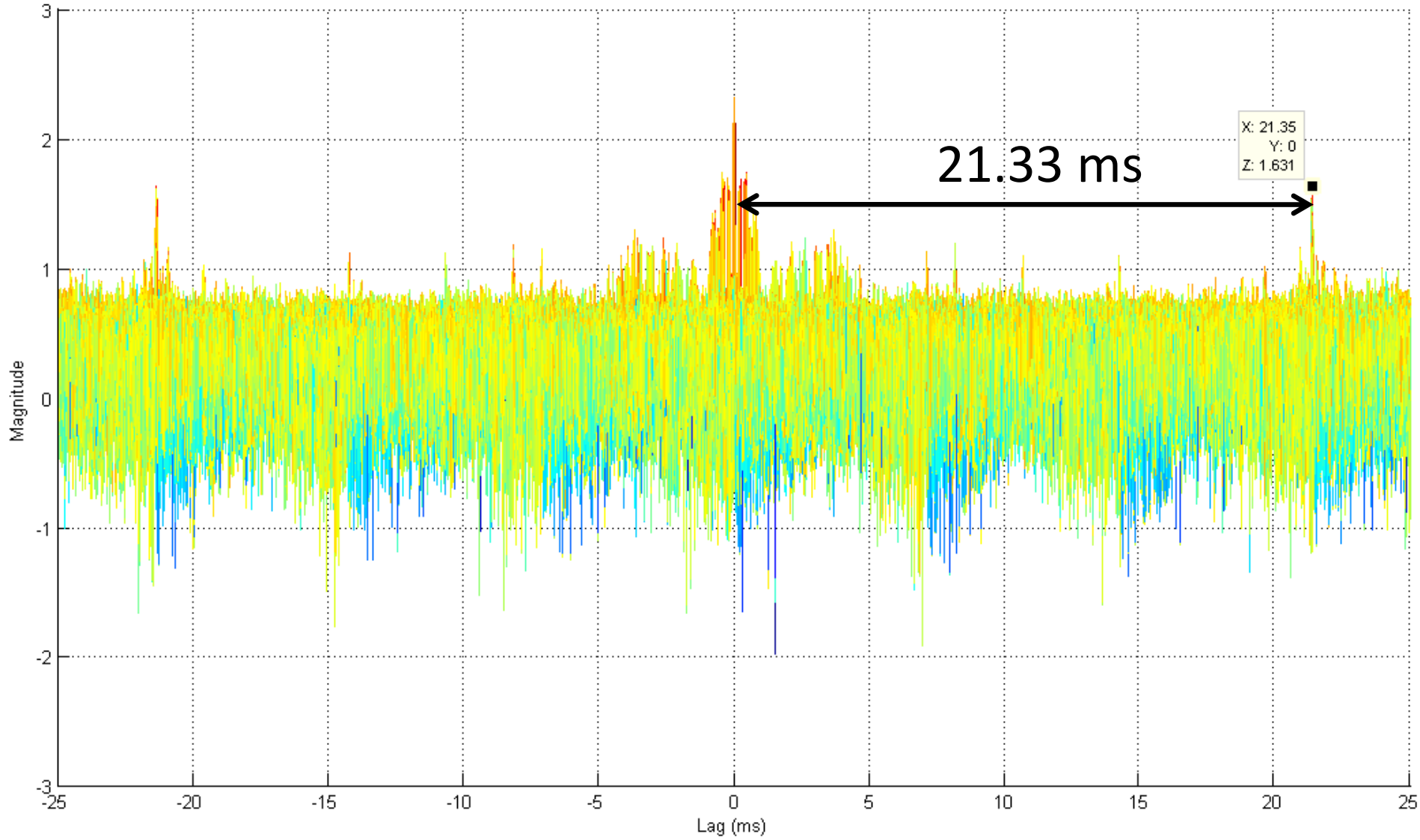


Cyclic Autocorrelation Function

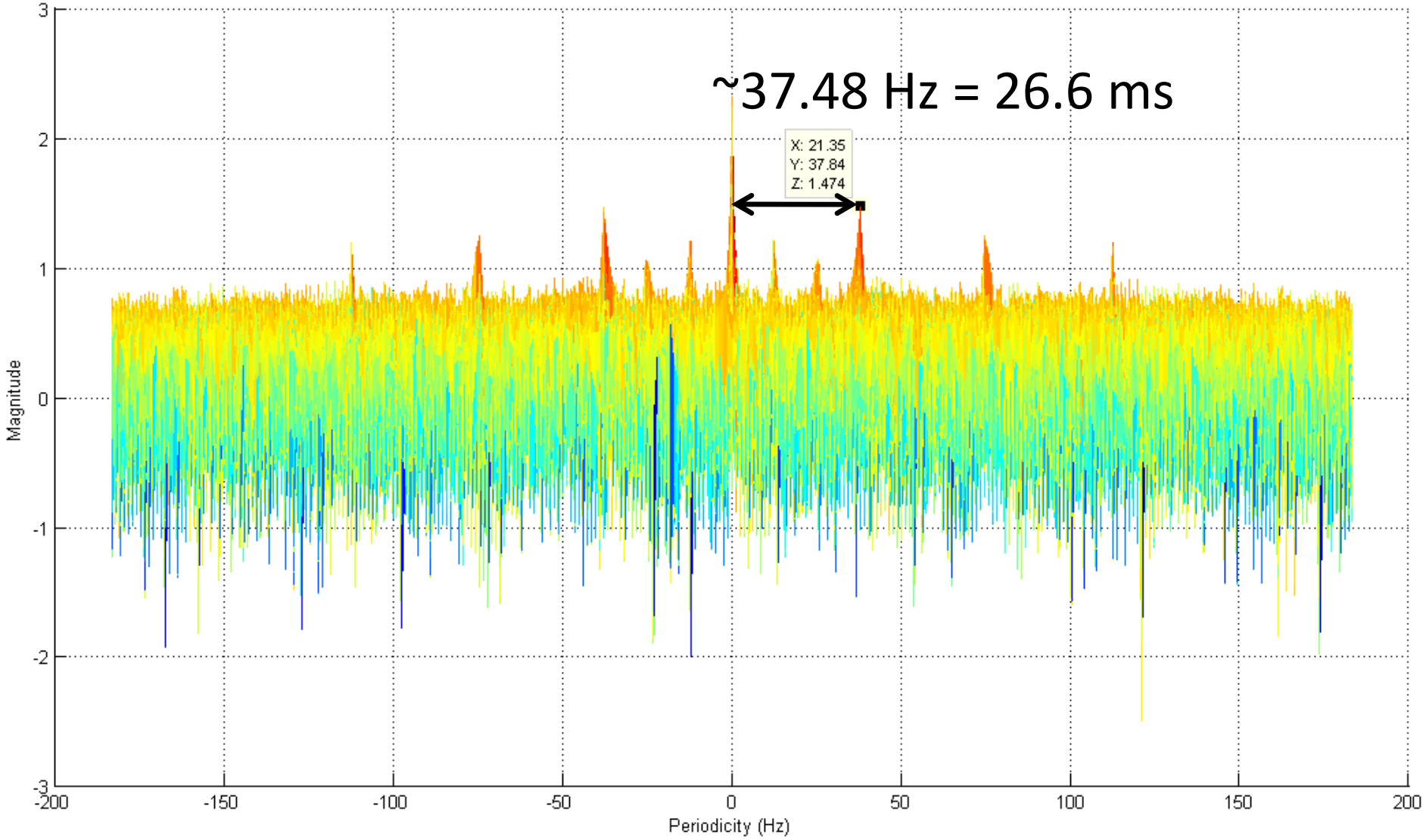
Han, Sohn & Moung,"A Blind OFDM Detection and Identification Method Based on Cyclostationarity for Cognitive Radio Application"



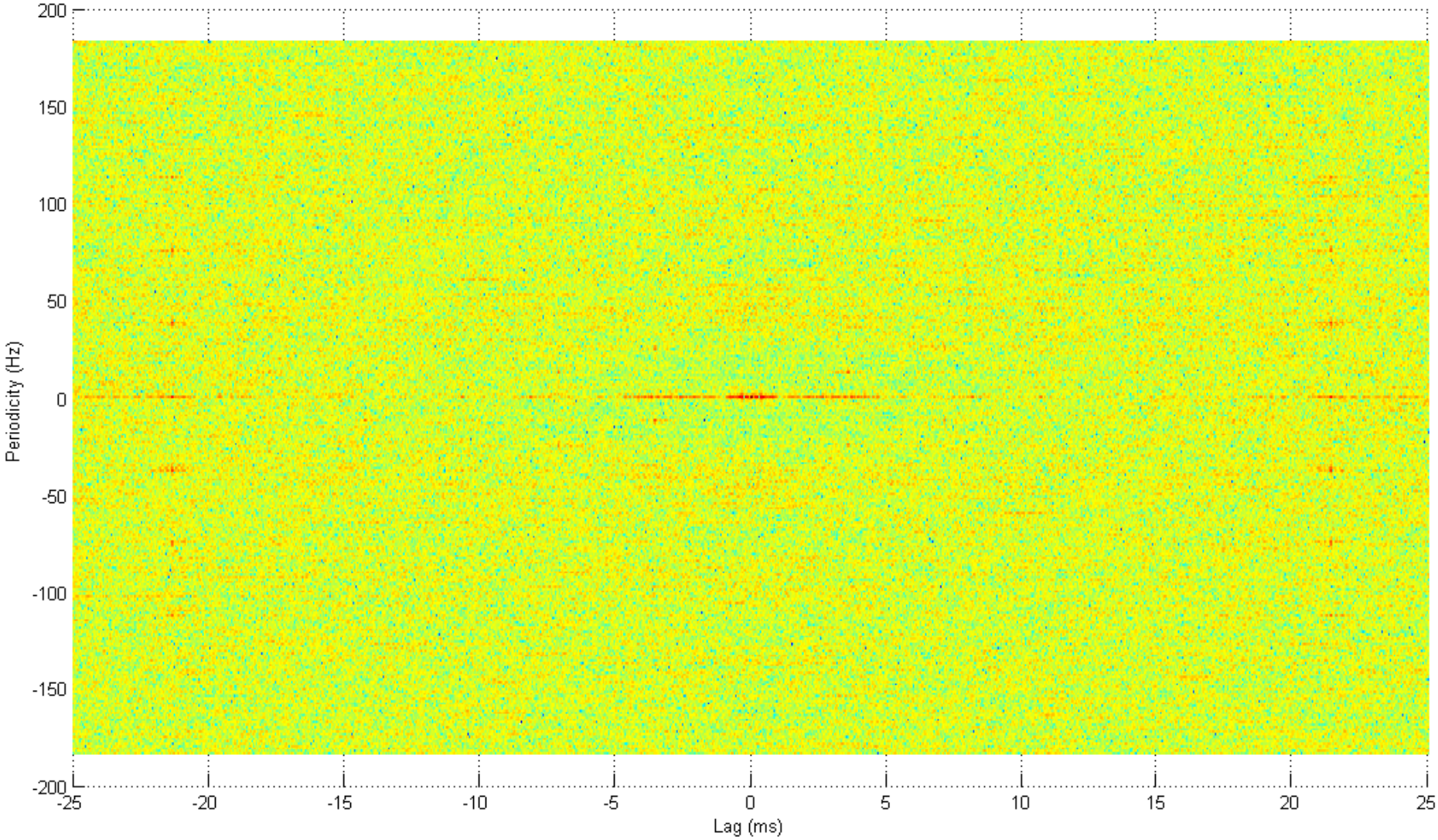
Un-guarded Symbol Time



Total Symbol Duration



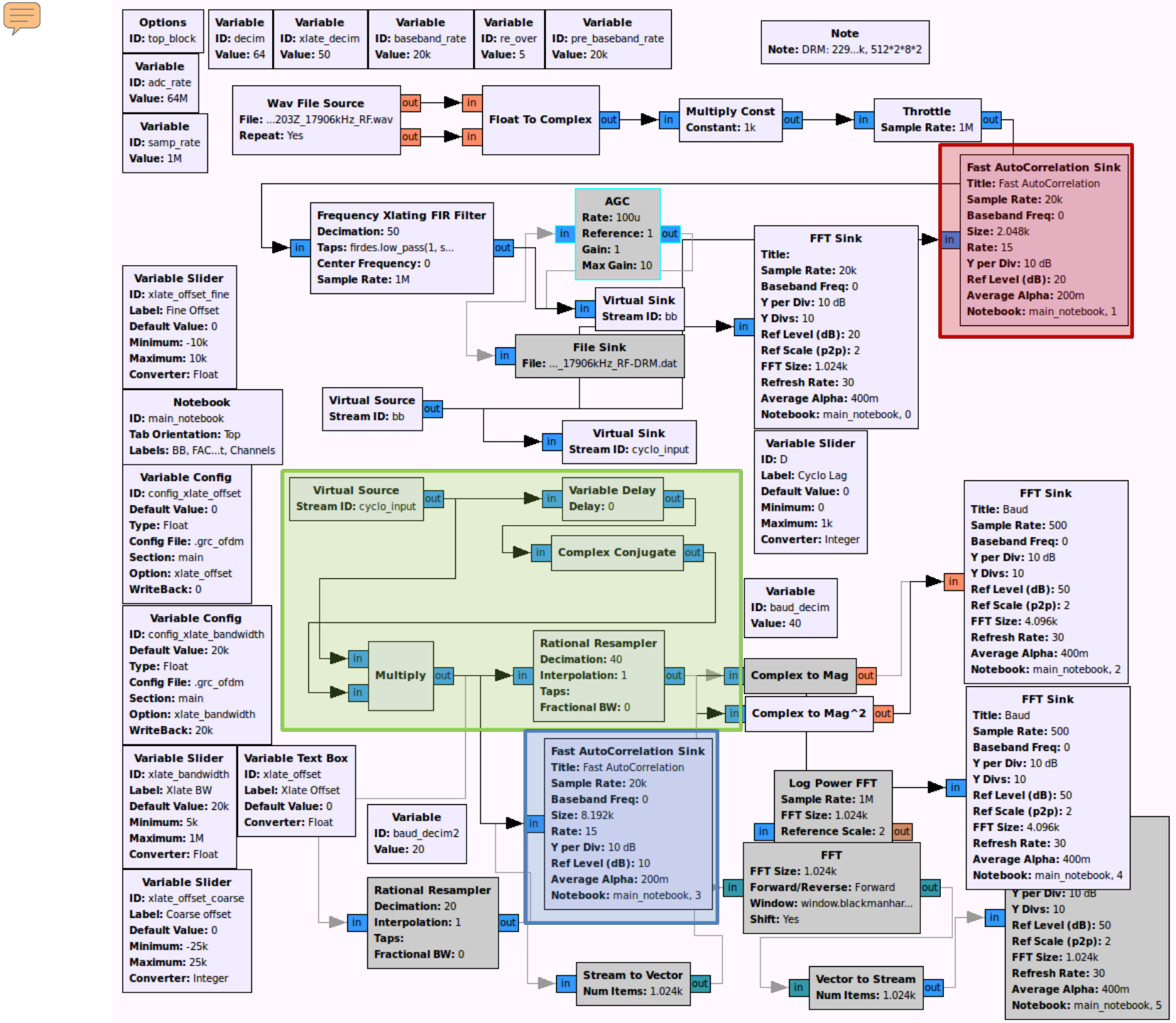
Top-down DRM Symmetry

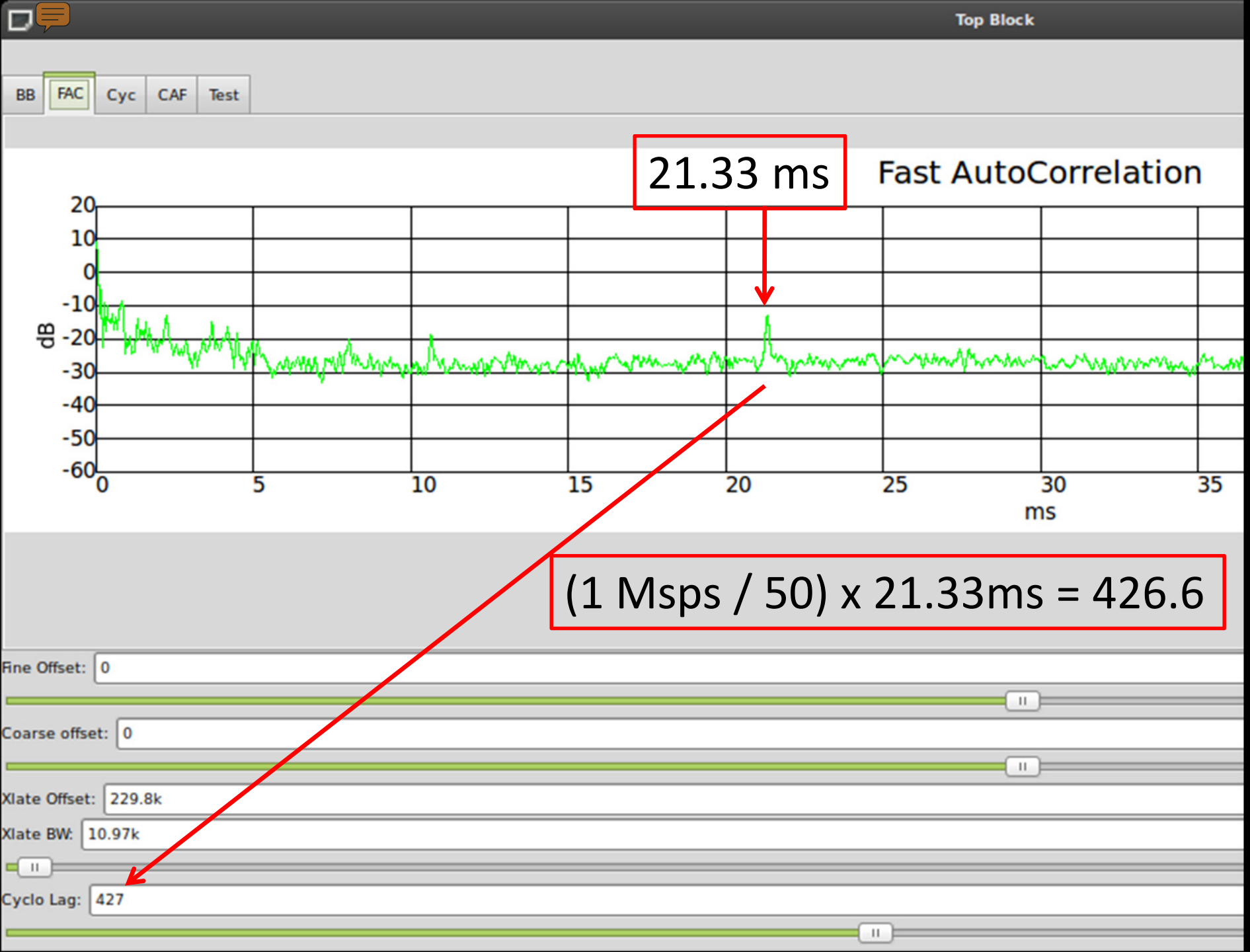


DRM Class B

Modulation property	Value
Un-guarded symbol time	**21.33 ms**
Sub-carrier spacing	46 7/8 Hz
Guard interval	5.33 ms
Total symbol duration	**26.66 ms**
Guard interval ratio	1/4
Symbols per frame	15

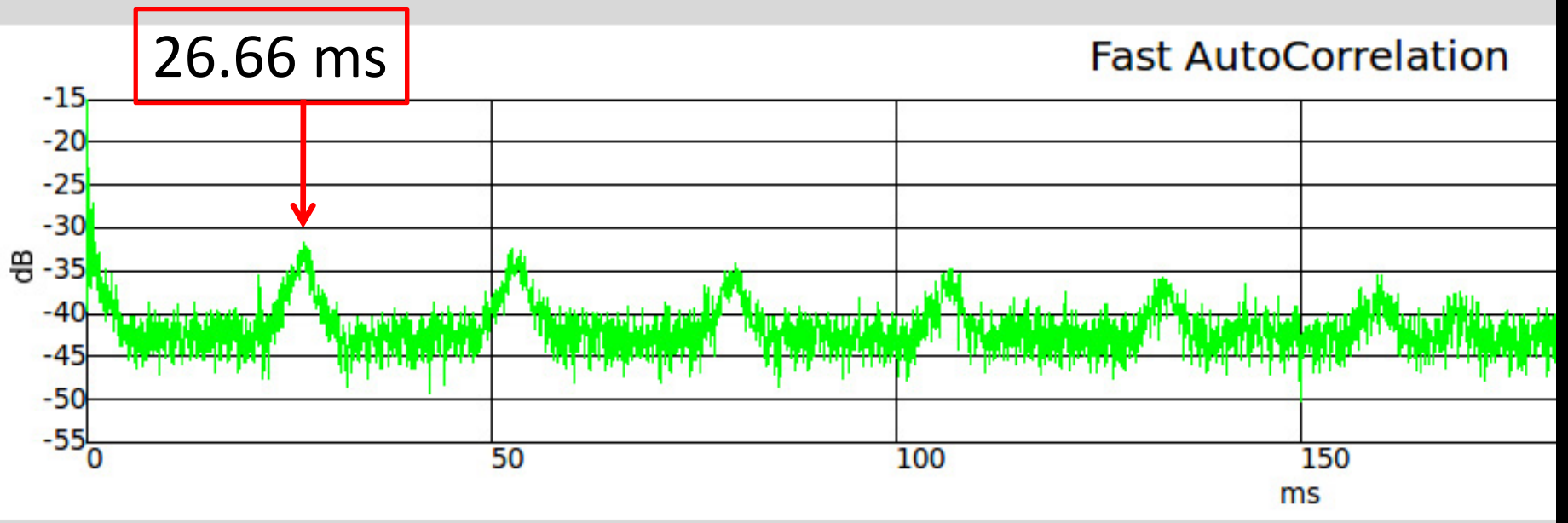
1 / (21.33 ms)


Options
ID: top_block
Variable
ID: decim
Value: 64
Variable
ID: xlate_decim
Value: 50
Variable
ID: baseband_rate
Value: 20k
Variable
ID: re_over
Value: 5
Variable
ID: pre_baseband_rate
Value: 20k
Note
Note: DRM: 229...k, 512*2*8*2
Variable
ID: adc_rate
Value: 64M
Variable
ID: samp_rate
Value: 1M
Wav File Source
File: ...203Z_17906kHz_RF.wav
Repeat: Yes
out
out
in
in
Float To Complex
out
in
Multiply Const
Constant: 1k
out
in
Throttle
Sample Rate: 1M
out
Fast AutoCorrelation Sink
Title: Fast AutoCorrelation
Sample Rate: 20k
Baseband Freq: 0
Size: 2.048k
Rate: 15
Y per Div: 10 dB
Ref Level (dB): 20
Average Alpha: 200m
Notebook: main_notebook, 1
Frequency Xlating FIR Filter
Decimation: 50
Taps: firdes.low_pass(1, s...
Center Frequency: 0
Sample Rate: 1M
AGC
Rate: 100u
Reference: 1
Gain: 1
Max Gain: 10
Virtual Sink
Stream ID: bb
File Sink
File: ..._17906kHz_RF-DRM.dat
FFT Sink
Title:
Sample Rate: 20k
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 20
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 30
Average Alpha: 400m
Notebook: main_notebook, 0
Variable Slider
ID: xlate_offset_fine
Label: Fine Offset
Default Value: 0
Minimum: -10k
Maximum: 10k
Converter: Float
Notebook
ID: main_notebook
Tab Orientation: Top
Labels: BB, FAC...t, Channels
Virtual Source
Stream ID: bb
Virtual Sink
Stream ID: cyclo_input
Variable Slider
ID: D
Label: Cyclo Lag
Default Value: 0
Minimum: 0
Maximum: 1k
Converter: Integer
Variable Config
ID: config_xlate_offset
Default Value: 0
Type: Float
Config File: .grc_ofdm
Section: main
Option: xlate_offset
WriteBack: 0
Virtual Source
Stream ID: cyclo_input
Variable Delay
Delay: 0
Complex Conjugate
Variable
ID: baud_decim
Value: 40
FFT Sink
Title: Baud
Sample Rate: 500
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 4.096k
Refresh Rate: 30
Average Alpha: 400m
Notebook: main_notebook, 2
Variable Config
ID: config_xlate_bandwidth
Default Value: 20k
Type: Float
Config File: .grc_ofdm
Section: main
Option: xlate_bandwidth
WriteBack: 20k
Multiply
Rational Resampler
Decimation: 40
Interpolation: 1
Taps:
Fractional BW: 0
Complex to Mag
Complex to Mag^2
Variable Slider
ID: xlate_bandwidth
Label: Xlate BW
Default Value: 20k
Minimum: 5k
Maximum: 1M
Converter: Float
Variable Text Box
ID: xlate_offset
Label: Xlate Offset
Default Value: 0
Converter: Float
Fast AutoCorrelation Sink
Title: Fast AutoCorrelation
Sample Rate: 20k
Baseband Freq: 0
Size: 8.192k
Rate: 15
Y per Div: 10 dB
Ref Level (dB): 10
Average Alpha: 200m
Notebook: main_notebook, 3
Log Power FFT
Sample Rate: 1M
FFT Size: 1.024k
Reference Scale: 2
FFT Sink
Title: Baud
Sample Rate: 500
Baseband Freq: 0
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 4.096k
Refresh Rate: 30
Average Alpha: 400m
Notebook: main_notebook, 4
Variable
ID: baud_decim2
Value: 20
FFT
FFT Size: 1.024k
Forward/Reverse: Forward
Window: window.blackmanhar...
Shift: Yes
Variable Slider
ID: xlate_offset_coarse
Label: Coarse offset
Default Value: 0
Minimum: -25k
Maximum: 25k
Converter: Integer
Rational Resampler
Decimation: 20
Interpolation: 1
Taps:
Fractional BW: 0
Stream to Vector
Num Items: 1.024k
Vector to Stream
Num Items: 1.024k
Y per Div: 10 dB
Y Divs: 10
Ref Level (dB): 50
Ref Scale (p2p): 2
FFT Size: 1.024k
Refresh Rate: 30
Average Alpha: 400m
Notebook: main_notebook, 5


Top Block
BB
FAC
Cyc
CAF
Test
21.33 ms
Fast AutoCorrelation
dB
20
10
0
-10
-20
-30
-40
-50
-60
0
5
10
15
20
25
30
35
ms
(1 Msps / 50) x 21.33ms = 426.6
Fine Offset:
0
Coarse offset:
0
Xlate Offset:
229.8k
Xlate BW:
10.97k
Cyclo Lag:
427

Top Block

BB | FAC | Cyc | CAF | Test | Channels



Fine Offset: 0

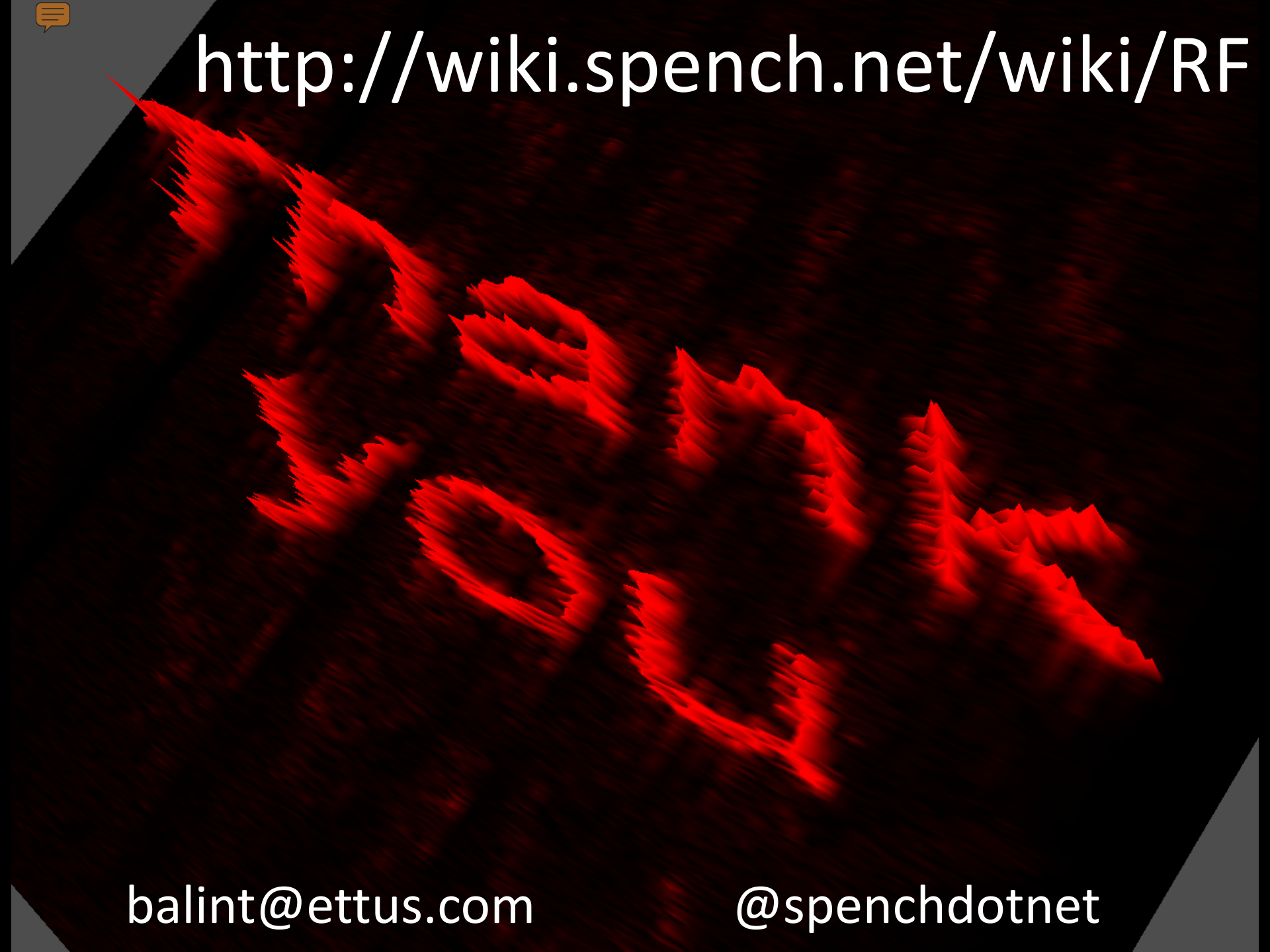
Coarse offset: 0

Xlate Offset: 229.8k

Xlate BW: 10.97k

Cyclo Lag: 427

http://wiki.spench.net/wiki/RF



balint@ettus.com @spenchdotnet