Satellite Telemetry – Doppler Shift – Gpredict – SDRuno

OVERVIEW

Receiving and decoding telemetry signals from orbiting amateur satellites can be great fun but has a number of issues associated with it. One of the problems in decoding these faint signals (some satellites are only 10cm x 10cm in size) is keeping track of the signal due to Doppler shift. When satellites are approaching, the frequency is increased and as the satellite heads away, the frequency decreases. A number of satellite prediction programs offer the facility to control the receiver and keep the radio on frequency.

This article will describe how to set-up SDRuno to be controlled by the Gpredict software and alter the frequency automatically. There are a number of steps that have to been taken, some must be done EXACTLY as described here, else the set-up will not work. This advice is given after many hours of frustration in trying out the various options available.

Gpredict - https://sourceforge.net/projects/gpredict/files/Gpredict/

If not already downloaded, go to the above website and download the latest version and install the software (It's free). The installation folder is not important.

VSPE - http://www.eterlogic.com/Products.VSPE.html

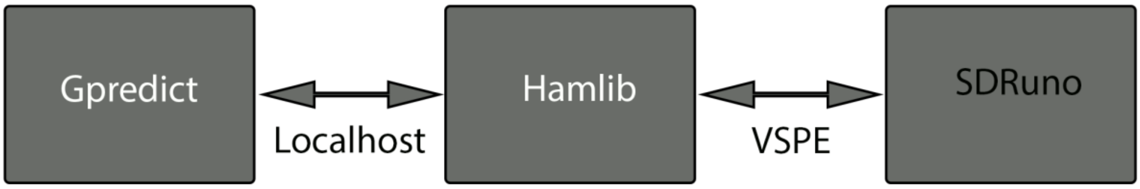
This is a "Virtual Serial Port Emulator" and is required to connect to SDRuno. There is a 32 bit version which is free and a 64 bit version that requires a licence. Download the software and install it, the folder is not important.

Hamlib - https://github.com/Hamlib/Hamlib/releases/tag/3.3

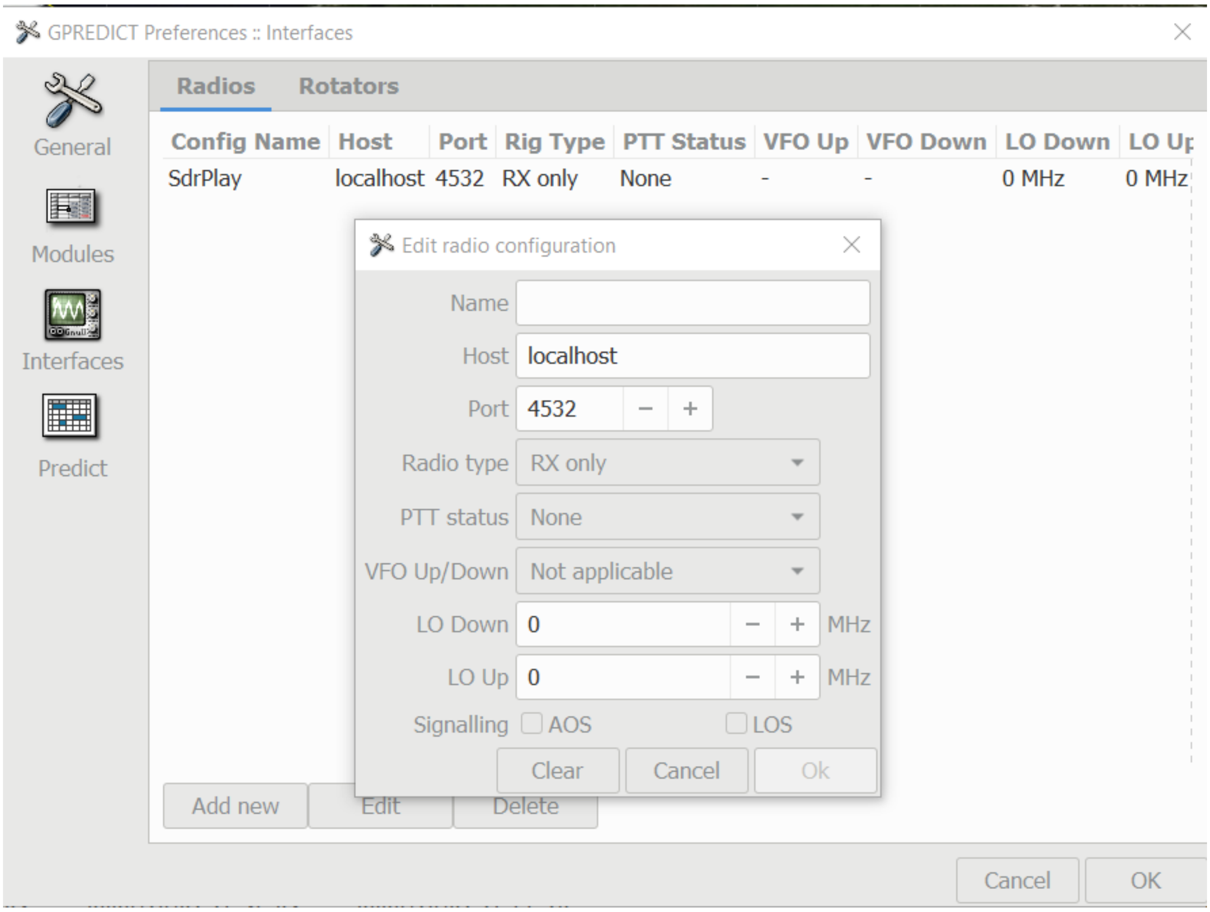
This package uses a consistent application programming interface (API) that many programs use to control radios and rotators. Download and install into the default folder (IT IS VERY IMPORTANT TO MAKE A NOTE OF THIS FOLDER).

SET-UP

It is important understand how the set-up works in theory in case some de-bugging is required.



Within Gpredict the ‘Radio Control’ function needs to know which radio to control at any given time. This is done by setting up each radio (SDRuno in this case) in the EDIT/PREFERENCES/INTERFACES/ADD tab within Gpredict. In this tab ‘localhost’ can be seen and this is the way Gpredict communicates with Hamlib.



Config Name	Host	Port	Rig Type	PTT Status	VFO Up	VFO Down	LO Down	LO Up
SdrPlay	localhost	4532	RX only	None	-	-	0 MHz	0 MHz

Name
Host localhost
Port 4532
Radio type RX only
PTT status None
VFO Up/Down Not applicable
LO Down 0 MHz
LO Up 0 MHz
Signalling □ AOS □ LOS

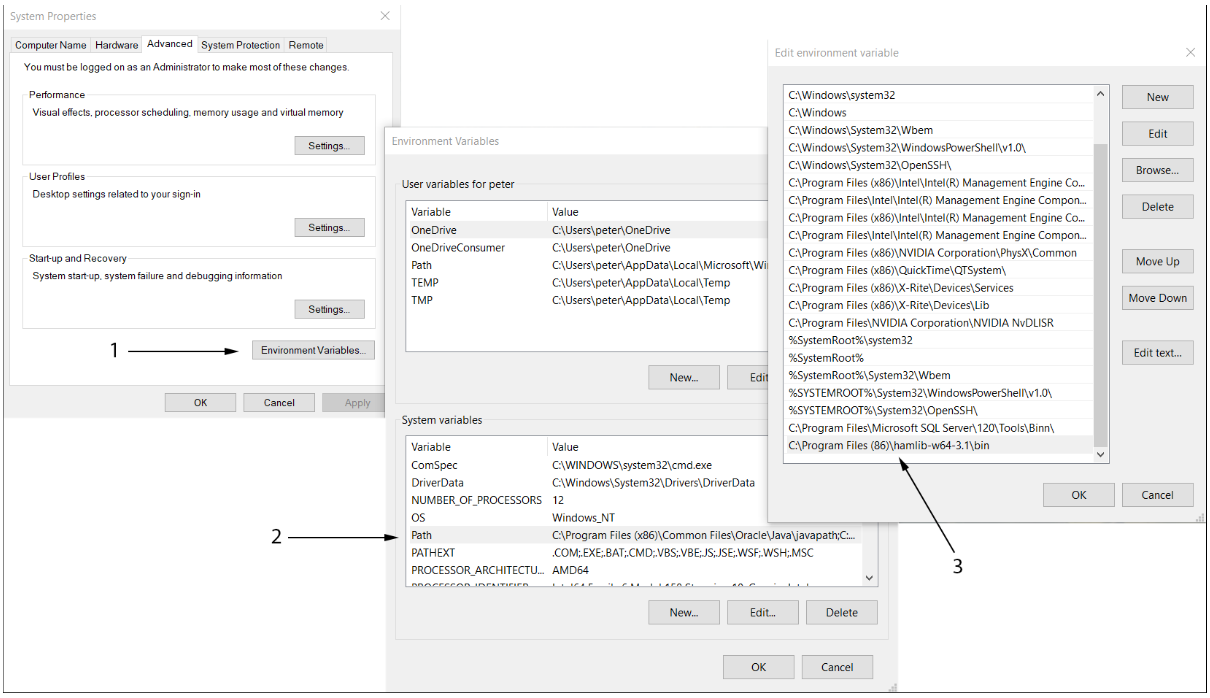
Add a new radio as shown above.

Gpredict software link to Hamlib

Now, one of the most important steps in getting this set-up working. Gpredict needs to know how to communicate with Hamlib. The way to do this is to create a new ‘System path’ which allows the commands sent from Gpredict to be seen by Hamlib.

In the windows ‘Search bar’ type “env” – this will bring up the System Properties window. Select ‘Environmental Variables’ and in the lower window ‘System Variables’ double click “path”. Add a new line as in the example shown here where hamlib is located in the Program Files (x86) folder. Make sure to get this right otherwise it just will not work ! In the case below the path is:

C:\Program Files (86)\hamlib-w64-3.1\bin



You must be logged on as an Administrator to make most of these changes.

Visual effects, processor scheduling, memory usage and virtual memory

Desktop settings related to your sign-in

System start-up, system failure and debugging information

User variables for peter

Variable	Value
OneDrive	C:\Users\peter\OneDrive
OneDriveConsumer	C:\Users\peter\OneDrive
Path	C:\Users\peter\AppData\Local\Microsoft\Wi
TEMP	C:\Users\peter\AppData\Local\Temp
TMP	C:\Users\peter\AppData\Local\Temp

System variables

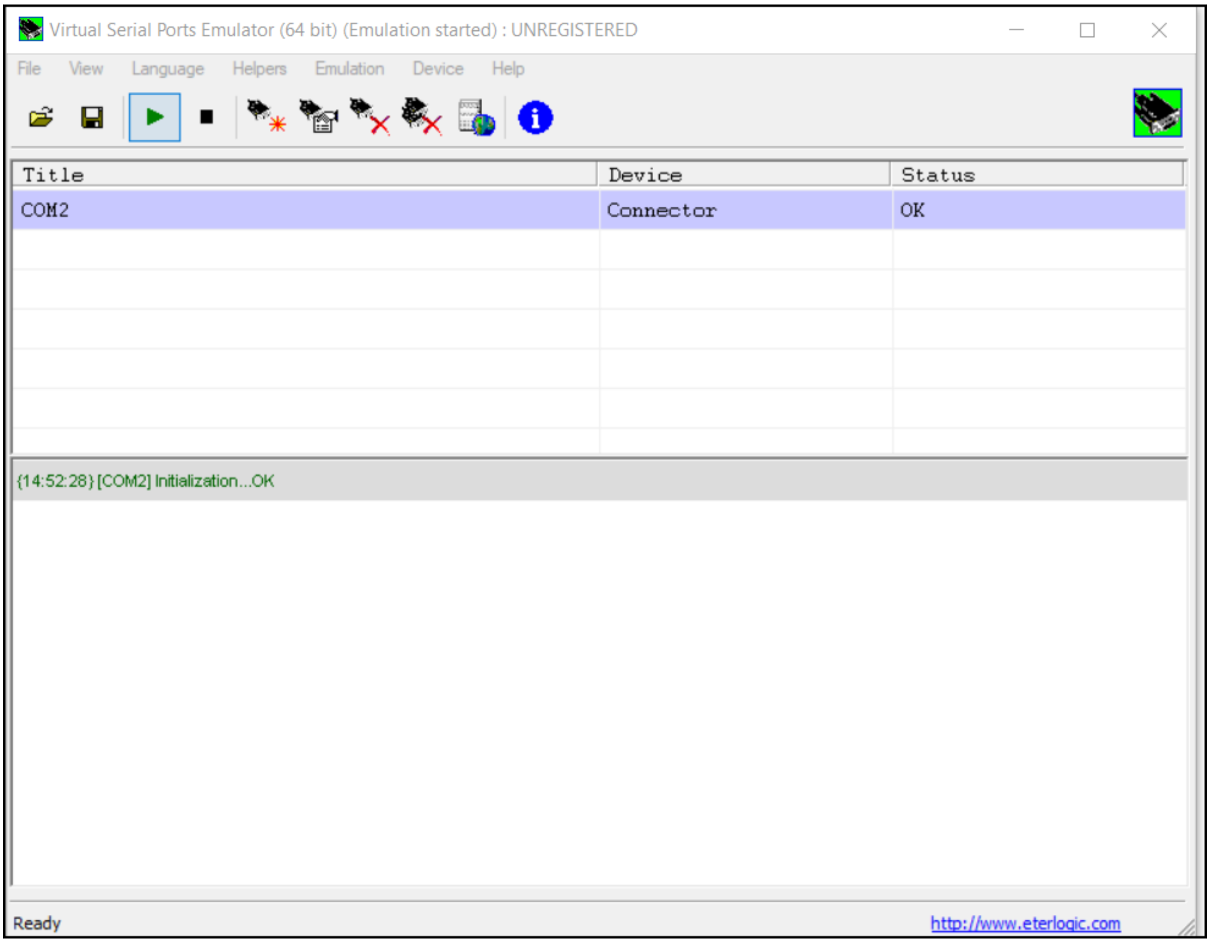
Variable	Value
ComSpec	C:\WINDOWS\system32\cmd.exe
DriverData	C:\Windows\System32\Drivers\DriverData
NUMBER_OF_PROCESSORS	12
OS	Windows_NT
Path	C:\Program Files (x86)\Common Files\Oracle\Java\javapath;C:...
PATHEXT	.COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC
PROCESSOR_ARCHITECTU...	AMD64

```
C:\Windows\system32
C:\Windows
C:\Windows\System32\Wbem
C:\Windows\System32\WindowsPowerShell\v1.0\
C:\Windows\System32\OpenSSH\
C:\Program Files (x86)\Intel\Intel(R) Management Engine Co...
C:\Program Files\Intel\Intel(R) Management Engine Compon...
C:\Program Files (x86)\Intel\Intel(R) Management Engine Co...
C:\Program Files\Intel\Intel(R) Management Engine Compon...
C:\Program Files (x86)\NVIDIA Corporation\PhysX\Common
C:\Program Files (x86)\QuickTime\QTSystem\
C:\Program Files (x86)\X-Rite\Devices\Services
C:\Program Files (x86)\X-Rite\Devices\Lib
C:\Program Files\NVIDIA Corporation\NVIDIA NvDLISR
%SystemRoot%\system32
%SystemRoot%
%SystemRoot%\System32\Wbem
%SYSTEMROOT%\System32\WindowsPowerShell\v1.0\
%SYSTEMROOT%\System32\OpenSSH\
C:\Program Files\Microsoft SQL Server\120\Tools\Binn\
C:\Program Files (86)\hamlib-w64-3.1\bin
```

Hamlib software link to SDRuno

The next step is to create a communication link between hamlib and SDRuno. This is done by using the VSPE package and creating a ‘Virtual’ comport for both packages to use.

Open VSPE and set-up a new ‘connector’, this is a single com port that BOTH applications use. There are other options available to set-up a pair, both in this software and other packages. The option that works in this case is the one described here. In the example shown below com port 2 was use – remember what port you allocate as you will need it later.


Virtual Serial Ports Emulator (64 bit) (Emulation started) : UNREGISTERED
File
View
Language
Helpers
Emulation
Device
Help
Ready
http://www.eterlogic.com

Title	Device	Status
COM2	Connector	OK

```
{14:52:28} [COM2] Initialization...OK
```

It is important to run this application first.

<u>The last step</u>

Hamlib needs to be ‘instructed’ as to what com port to use for SDRuno and what baud rate, also what localhost port number to use for Gpredict. This is achieved by generating a batch file.

Open Notepad and if you have followed the examples in this article, paste the following text.

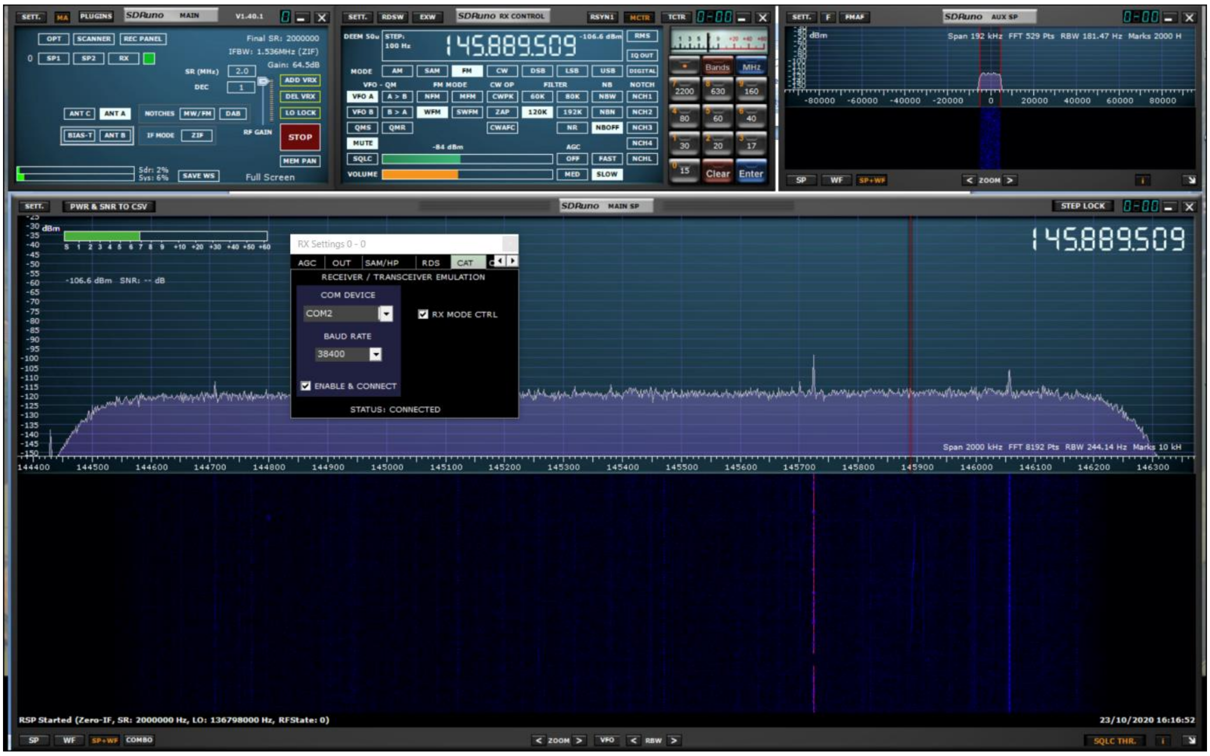
```
cd C:\Program Files (x86)\hamlib-w64-3.1\bin\
rigctld.exe -vvvvv -r \\.\com2 -m 228 -s 38400 -t 4532
```

Don’t worry about the syntax (unless you want to read the Hamlib manual) – what this file does is to tell Hamlib to use Com port 2 for SDRuno, set it 38400 baud rate, and use localhost 4532. The –m 228 means that any instructions sent from Hamlib will be sent to SDRuno as an TS480 radio, which is the command set it understands.

Save the file as ‘Gpredict.bat’ to the desktop.

Set-up SDRuno

SDRuno will be run in the CAT mode.



RX Settings 0 - 0

AGC | OUT | SAM/HP | RDS | CAT

RECEIVER / TRANSCEIVER EMULATION

COM DEVICE: COM2

BAUD RATE: 38400

☑ RX MODE CTRL

☑ ENABLE & CONNECT

STATUS: CONNECTED

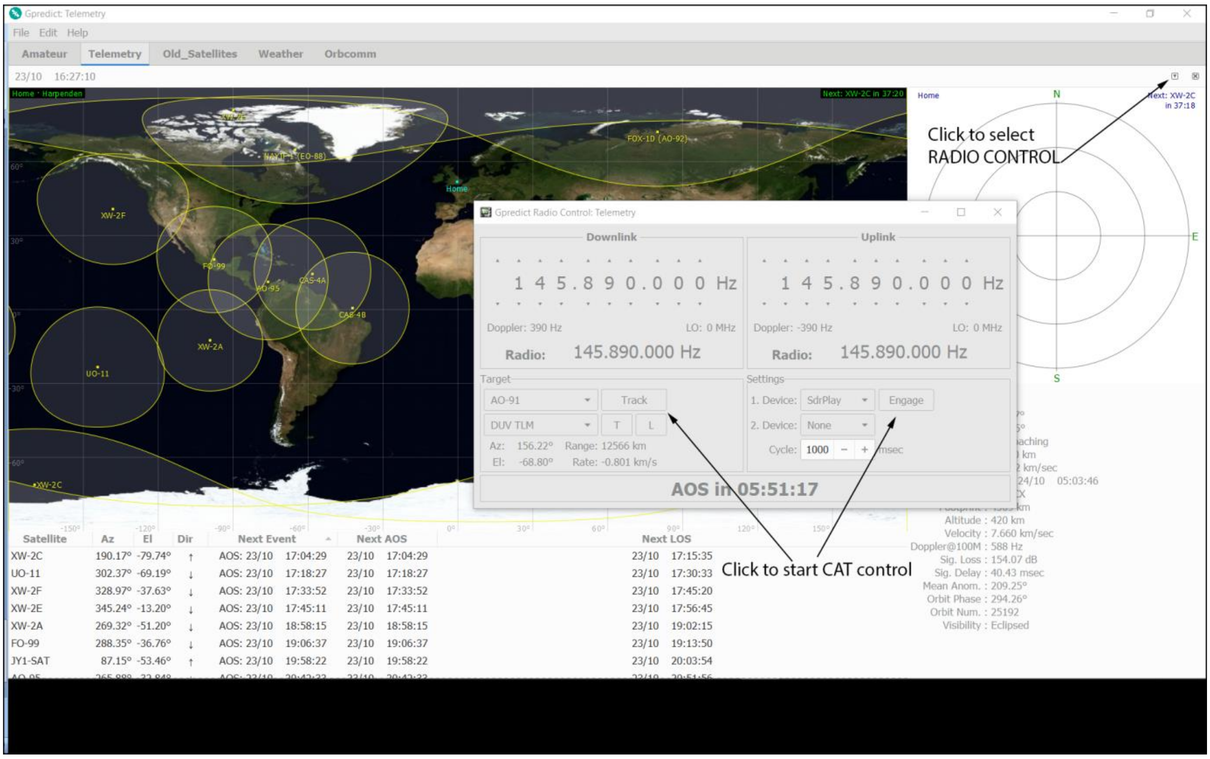
Set the com port and the baud rate the same as the batch file, in our case com2 and 38400 Baud. Remember to tick ‘Rx MODE CTRL’ & ‘ENABLE & CONNECT’.

Hooking it all together

As each package relies on the other to work correctly, it is important to run them in the correct order.

1) Run VSPE – set up com port as a connector.
2) Run SDRuno making sure that CAT mode is selected. Also, make sure the Band Select is for the frequency your are expecting – or ‘Clear’ the band select all together.
3) Run the batch file.

4) Run Gpredict – wait for your selected satellite – open the RADIO CONTROL panel – click TRACK & ENGAGE to start CAT control.



Click to select RADIO CONTROL

Click to start CAT control

Downlink: 1 4 5 . 8 9 0 . 0 0 0 Hz
Doppler: 390 Hz LO: 0 MHz
Radio: 145.890.000 Hz

Uplink: 1 4 5 . 8 9 0 . 0 0 0 Hz
Doppler: -390 Hz LO: 0 MHz
Radio: 145.890.000 Hz

Target: AO-91, DUV TLM
Az: 156.22° Range: 12566 km
El: -68.80° Rate: -0.801 km/s

Settings:
1. Device: SdrPlay
2. Device: None
Cycle: 1000 msec

AOS in 05:51:17

Satellite	Az	El	Dir	Next Event	Next AOS	Next LOS
XW-2C	190.17°	-79.74°	↑	AOS: 23/10 17:04:29	23/10 17:04:29	23/10 17:15:35
UO-11	302.37°	-69.19°	↓	AOS: 23/10 17:18:27	23/10 17:18:27	23/10 17:30:33
XW-2F	328.97°	-37.63°	↓	AOS: 23/10 17:33:52	23/10 17:33:52	23/10 17:45:20
XW-2E	345.24°	-13.20°	↓	AOS: 23/10 17:45:11	23/10 17:45:11	23/10 17:56:45
XW-2A	269.32°	-51.20°	↓	AOS: 23/10 18:58:15	23/10 18:58:15	23/10 19:02:15
FO-99	288.35°	-36.76°	↓	AOS: 23/10 19:06:37	23/10 19:06:37	23/10 19:13:50
JY1-SAT	87.15°	-53.46°	↑	AOS: 23/10 19:58:22	23/10 19:58:22	23/10 20:03:54

24/10 05:03:46
Altitude : 420 km
Velocity : 7.660 km/sec
Doppler@100M : 588 Hz
Sig. Loss : 154.07 dB
Sig. Delay : 40.43 msec
Mean Anom. : 209.25°
Orbit Phase : 294.26°
Orbit Num. : 25192
Visibility : Eclipsed

Whilst you may encounter some frustrations setting this up – it does work, it's probably one of the settings. Check, double check and check again.

My thanks go to Ed Barley in the USA for much of the information contained in these instructions.

Peter Wilson

Ooo OOO ooo

SDRplay is very grateful to both Peter and Ed for their work. Rather than contacting the authors directly if you have questions, we encourage discussion around this topic on one of the popular SDRplay forums such as:

https://groups.io/g/SDRPlayUsers

https://www.facebook.com/groups/SDRplay

https://www.facebook.com/groups/SDRuno

(and starting in November, a forum for teaching radio comms around satellite reception: https://uni.sdrplay.com/forum/) *October 2020*