So, you want to set up a WINDOWS/RTL based APT POLAR Weather Satellite station?

This document is for WINDOWS users. If you're using another Operation System please check the file repository for LINUX, MAC OS and RASPBERRY PI documents as they're added.

This tutorial was written for, and can be found at:

https://www.facebook.com/groups/satelliteimages/ please feel free to join.

REQUIREMENTS:

Internet access:	To get and update keplerian elements to track the satellites, AND to post into our Group your fantastic captures you'll be making soon!!
Computer:	Computer running WINDOWS, current with updates, and virus free
Ram:	As much RAM as you can, but preferably more than 2Gb
Graphics card:	A recent one. The author has used a Nvidia GTX520 but I now have a Galax Nvidia GT1030
Radio receiver:	Most of us use Software Defined Radios (SDR's) such as re-purposed TV dongles using the RTL2832u and RT820t or RT820t2 chip set or RTL SDR V3's; SDRPlay RSP units, Airspy's, or HackRF's. The bandwidth on wide-band FM (WFM) needs to be at least 38kHz for NOAA and 120kHz for Meteor 2. Most scanner type radios do NOT have the required bandwidth OR they're too wide letting in other noise.
Satellite tracking program:	Orbitron, Wxtrack, Gpredict are 3 that readily come to mind.
DDE program:	A DDE program transfers information from 1 program to another e.g. tracking information to a rotator control program. We'll be using it to get the times that the satellite rises and sets on the horizon, AND the correct frequency that we need to be listening to so we can receive it (the doppler frequency).
SDR operating program:	SDR# (pronounced SDRsharp and NOT to be mistaken for SDRSharper [another program]) HDSDR and SDR Console quickly come to mind.
Virtual cable program:	This program takes the received audio from the radio program and delivers it to the decoding program. Used instead of a real cable unless you are using a standalone radio, which in that case you'll need a lead from the radio to the line in jack on your soundcard! VB Cable and Virtual Audio Cable are two programs that I know of.
Decoding program;	NOAA; most people use WxtoImg, although there are others. METEOR; there are two different ways to decode Meteor 2. Some people prefer to record the baseband signal and then decode it. These people are usually NOT using SDR#. I use a SDR# plugin called Meteor Demodulator with a program called MeteorGis.
Coax and antenna:	COAX Buy the best coax you can, this is only the start of an addictive hobby. You'll need as much as required to go from the radio receiver ANT socket to the antenna. DUH!!

ANTENNA Well the one each person in this Group uses is THE BEST, so don't ask them!!! If you have an existing vertical for 144Mhz, a discone, or a broadband scanner vertical antenna that will start you off, however signals from the satellite are circular polarised. The cheapest next option would be the V dipole. With elements around 53cm each leg and placed in a horizontal V shape with 120 degrees between them. It's cheap and easy to make. After that you're looking at a QHA (also called QFH), a turnstile or a double cross antenna.

This instructional is based on what I use, which works well for me!! I use a computer based on a Intel i5 3330Mhz with 8Gb RAM computer running Windows X, Orbitron 3.71, SDR# v1.0.0.1666, VB Cable, WxtoImg 2.11.2 beta, MeteorGis, a SV1AFN manufactured low noise amplifier (LNA) and a home made QHA antenna (on a piece of 40mm PVC pipe) at 4 metres above the ground.

If you choose to use different program(s), I've given more explanation in some areas of what the steps are trying to achieve, so hopefully you can just amend these instructions to suit your own progam(s)

HOW LONG WILL THIS TAKE?? This instructional presumes you know your way around a computer, that you can download programs, unzip them, and install them. I also expect that you can edit a text file, and locate a directory\file. With all of that in mind allow yourself a solid 2 hours of uninterrupted time to download, install the software and configure it. Knowing your latitude and longitude in D M' S", DD MM.mmmm and DD.dddd will be a big help!

Conventions in this instructional
Bold is a folder name
Italics is a file name
Underline bold is for parameters or settings
A red background is most important.
HINT is a hint, TIP that I hope will benefit you somehow!!

INSTALLING THE SOFTWARE

I STRONGLY suggest the following folder structure.

F:\Meteor
        \Images
        \Imagesfinales
        \LRPTv56
        \Meteor_Demodulator_Recorder
        \SD#v1732
        \Sharefolder
        \Thumbnails
        \WxtoImg
                \Thumbnails
                \Raw
                \Maps
                \Imagesfinales
                \Images
                \Audio

\Orbitron
                            \Config
                            \Data
                            \Help
                            \Help.plk
                            \lame_v3.99.5
                            \Lang
                            \Notes
                            \Output
                            \TLE

This way everything is in the F:\Meteor folder in it's own folder. I use an external drive F:\ but you can use any drive with a heap of space.

Newer versions of programs can be easily added (and found).

It makes changing to new versions very easy as only the version number needs amending in any paths.

It allows for retaining previous versions until confidence has been reached that the new version is performing correctly.

Now that we've got the why's and what do I need out of the way let's start getting this system set up and installed.   I recommend that you install ALL the programs (except MeteorGis) into the one new master folder under separate folders.   E.G. if you have an X:\ drive

X:\Meteor\VB Cable   ****Run as ADMINISTRATOR to install**** You may need to reboot the
                            computer!!

X:\Meteor\SDR# V1.0.0.1666 (or whatever version number you have)

             If you've NEVER had a SDR receiver plugged into your computer then you
             MUST run ZADIG.EXE with the device PLUGGED IN to install the device
             drivers to natively talk to the device. If you have, you can IGNORE this!!

X:\Meteor\MeteorGIS_v   MeteorGis you'll find will have it's own file structure.
X:\Meteor\Orbitron

X:\Meteor\WxtoImg

SDRSharpDDE.exe   save to X:\Meteor\SDR# your version number

Plugin Manager   save to desktop where you can find it
Tracking DDE V1.2 plugin   save to X:\\Meteor\SDR# version\Plugin Zip files
Meteor Demodulator   save to X:\Meteor\SDR# version\Plugin Zip files

X:\ Meteor\MMSSTV WHAT you haven't downloaded it. That's ok, I use it for receiving SSTV
               off of ISS. I just threw it in to see if you were paying attention. Good.

Download the document with the URL's from Weather Satellite Images Group (Click on FILES), download them and install them. SDR# tends to be able to be copied and *SDRSharpDriverDDE.exe* needs to be saved into the **SDR# folder.**

When the brown smelly stuff hits the spreading oscillating wind generator it's far far easier to find that **folder** or *this file* that you want in a hurry!!

Finished downloading and installing, good?? Now that you've installed/copied the files into their directories and let's configure the programs.

SDR#	Run *SDRSharp.exe* In the SOURCE plugin, select **RTL-SDR USB** as the device. Click on the arrow PLAY button. If you get an error at this point it's usually because the device is not plugged in, or ZADIG.exe needs to load the driver. In the top status bar you have 3 horizontal lines to close the side plugin display, a PLAY arrow which becomes a STOP square when running, a COG to access some settings, a speaker icon to mute the radio, a volume slider and a frequency display.

Click on the cog (sometimes called a gear), and set sampling mode to **quadrature**, the device sample rate to **0.9MSPS**, the decimation to **none** (if it's displayed) and the gain to ¾ or **maximum**. Press the arrow button and SDR# should start. Using the frequency display at the top of the screen, click on the top or bottom of the numbers to adjust the **r**eceived frequency to a nearby radio broadcast station. Open the radio plugin and select the *mode, bandwidth, filter, step size* and make sure the **CORRECT IQ** is checked. With a half decent antenna set up and connected you should be able to hear the tuned local station. Once you fully get SDR# working, you'll need to come back to the cog and adjust the **ppm setting** to "fine tune" the radio!!

SDR# Plugins	The EASIEST way to install plugins for SDR# is to install Eddie MacDonald's Plugin Manager!! Once you've downloaded and followed his instructions and installed the Plugin Manager, copy the *.zip* files into the **x:\Meteor\SDR# version #\Plugin Zip File**s folder. Run *SDRSharp.exe* and it should open.

SDR# Plugins   Now click on the arrow in Plugin Manager Suite to open the plugin. Click on Plugin Editor to see the installed plugins. Click on the + button and navigate to the **Plugin Zip files** folder and select the *Tracking DDE Client V1.2* (if it's NOT there, copy the zip file from where you downloaded it into here, along with *Meteor Demodulator*)and click open. Once that's installed select the Meteor Demodulator file and install that the same way.

SCHEDULE	Select the *minimum elevation* that suits your location. This determines WHEN SDR# starts.

Under the options button, make sure that DDE Options **ORBITRON**

<div align="right">

Application Name **ORBITRON**

Link topic **TRACKING**

Link Item **TRACKING DATA**

</div>

Open Audio plugin and set VB Cable Input as the audio device.

Under the config button of the Tracking DDE Client enter the satellites and add the AOS and LOS fields from the table on the next page. The data under NOAA is for NOAA 15, so don't forget to change the radio frequency to suit:-

NOAA 15	137620000
NOAA 18	137912500
NOAA 19	137100000

Sat Name	NOAA Satellites (Just change frequency)	Meteor 2
AOS	radio_Start radio_modulation_type<**wfm**> radio_frequency_Hz<**137620000**> radio_bandwidth_Hz<**38000**> radio_tracking_frequency_On	radio_Start radio_modulation_type<**wfm**> radio_center_frequency_Hz<**137700000**> radio_frequency_Hz<**137900000**> radio_bandwidth_Hz<**120000**> send_tracking_frequency_On PSK_set_SymbolRate<**72000**> QPSK_demodulator_Start start_programm_Path<X**:\Meteor\MeteorGIS_v2.2 4\MeteorGIS.exe**>
LOS	radio_Stop	radio_Stop send_tracking_frequency_Off QPSK_demodulator_Stop

NOTE: The sat name must match the syntax (upper or lower case, spelling.) as it is shown in Orbitron AND the TLE source IE: Noaa 18 Satellite should be entered as NOAA_18 , Meteor as METEOR-M_2, etc. If your using a different source for TLE's or different Sat tracking software, check the verbiage as well, they'll have to match that.

ORBITRON:	Run it and open setup from the main screen (the crossed tools icon 5th from the left on the main tab)
General tab:	I've selected **every check box**, the radio button for **decimal degrees** and a **date format** that suits me!!! Make sure that the local time box is showing the correct UTC +/- for your timezone!!
World Map tab	Click on the "LOCK" icon to unlock the setting and adjust to suit your preference. Once you have finished click on the LOCK again to lock them.
TLE Updater tab	Select www.celestrak.com-all in the drop down box and tick the **check box** to mark the group for **update** and change the days to **7**. FORCE IT TO UPDATE NOW by clicking on the **world and lightning icon**.
HINT	I've added http://www.amsat.org/amsat/ftp/keps/current/nasabare.txt to my celestrak-all list. This gets me some satellites that Celestrak doesn't contain e.g. AO-85!!
Time Synch tab	**Select a time server close to your location** and note the comment regarding firewall ports below it. Select **Synchronise PC Clock when Orbitron starts** and click on the earth and lightning icon to reset your PC clock!! Software we'll install later places a map where it thinks the satellite should be based on the keps and the PC time!! With the satellites travelling around 17000km/hr (around 10560 miles per hour) every 2 seconds they've travelled 19 kilometres or around 12 miles!!
HINT	This works until you forget to synch the time manually! As I leave these programs running I now run a NTP synch program that every 2-12 hours resets the PC clock.
Miscellaneous tab	Set **AOS notification** (when the satellite rises above the horizon) **to what you prefer.**
HINT	As I'm sometimes using this copy of SDR# for other things, I set it at 0 to give me time to reset the settings for satellites. Click show **notice and play sound**.
Extra tab	I have **check boxes 1,2,3,4,6,9,10,12 (if you're in the southern hemisphere), 17 and 18 all ticked;** counting down the first column as 1-9 and the 2nd column as 10-18. Check boxes 17 and 18 are what make it work for us.
	Now back on the main program page, open the main tab.
Main tab weather	In the top right, click **LOAD TLE** and load *weather.tle* That will load satellites into the program, now scroll through them and select **NOAA 15, 18 and 19 and MeteorM2**. These selected satellites are the ones Orbitron will now track.
HINT	If like me you want to chase weather, Fox, Cubesats and the ISS; it's possible to make your own hybrid .tle file. Just open a text document and copy and paste the 2 line data into it maintaining the format. I save my files in YYYYMMDD format where Y=year, M=month and D is day.
Visualisation tab.	I find it easier to have **sat on track with beginning ticked, terminator and night** **shadow and sat captions** ticked with the others at your preference.
HINT	Orbitron is an easy way to roughly see the time in another country, Just use the Main tab screen!!
Location tab	**Set your location into the system**.
Prediction Setup	I have **automatic** ticked, looking **1** day ahead, sun elevation **-5**, sat elevation **3** (as I have a house and trees nearby) and **search passes for tracked **

	satellites. The flare and minimum pass magnitude shouldn't matter as long as sun elevation is negative.
Prediction tab	Make sure that "**passes**" is selected in the top right, and click the predict button. Once it finishes click OK in the small box, remember the name of the satellite at the top of the list and you can change to the Rotor/Radio tab.
Rotor/Radio tab	Click on the name of a satellite either on the map or in the satellite list box. This will cause the page to display the tracking details for your satellite. You will need to enter the **downlink** (sat –> earth freq) and the **downlink mode** for each satellite you wish to track from the list below.

NOAA 15   137.620000   FM-W
NOAA 18   137.912500   FM-W
NOAA 19   137.100000   FM-W
Meteor 2   137.900000   FM-W

We now need to finish setting up the DDE link between Orbitron and SDR#. Now we have to add the following text to the setup.cfg file in the Orbitron\ config folder.

[Drivers]
SDRSharp=X:\Meteor\SDR# 1666\SDRSharp.exe WHERE X IS YOUR DRIVE AND SDR# v1666 is your SDR version!!

Now close down Orbitron and SDR# and reopen Orbitron. Go to the Main tab and navigate to the Rotor/Rado tab. This tab and the Prediction tab will become your friend from now on!! Click on a satellite to select it for tracking, and check that the downlink and mode is correct. Now open the driver drop down box and **SDRSharp** should now be an option. Select it. Repeat this for each satellite you wish to receive.

Click on the **small box** to the right of the driver dropdown box. It looks like 2 task pages or monitors. If everything's good SDR# will load!! One more thing to check, and you can take a break!!! If it didn't, don't despair, manually run SDR# and start it. Open up the plugin Tracking DDE Client V1.2 plugin.   Click on the scheduler check box to start it.

After a few seconds it should now show that Orbitron is connected!! You should also see the name of the satellite that Orbitron is tracking, the "doppler corrected" downlink frequency, the azimuth and elevation. If the satellite is ABOVE the horizon the frequency at the top of the program should start following the frequency given by Orbitron in the Schedule plugin.

Excellent work. Take a break, grab a coffee- **no beer or alcoholic drinks** as you're not finished yet. When you're ready to proceed come back and let's continue.

WxtoImg	The following represent the settings I use in the PROFESSIONAL version and some may not be relevant at the moment.
Direction	Select **AUTODETECT**
Satellite	Select **AUTODETECT**
Enhancements	To begin I'd recommend selecting **MSA** with precipitation or **HVCT**. This displays a daylight image with rainfall in the IMAGE tab once a pass has been received and decoded.

Options	Any option that I don't mention is at default!!
	Select **INTERPOLATE** unless you get memory issue style warnings from WxtoImg.
	Select **SHOW ALL**
	Select **CROP TELEMETRY**
	Select **RESYNC**
	Active Satellites Select **NOAA 15, 18** and **19**. <mark>Click the check box at the bottom of the page also.</mark>
	Ground Station Location **Please enter where you live!**!
	Recording Options I have **Record only when active APT satellites are overhead** selected. I have a W:E elevation of **3:3** and an N:S of **2:2** due to trees and a neighbouring house to the South of me.
	    Select **VB Cable Output** as the sound card option. This is where the program gets it's audio from the radio (program). You can (if you want to) select the type of antenna that you're using.
	Auto Processing Options Select Record and **AUTO PROCESS**.
	Click on Image selections and select the top 2 **MCIR and MSA** options for now. Click on **White background on projection**s.
	    Select **CREATE COMPOSITE IMAGES** then click on Composite Image Settings. To avoid getting many images and files, I've selected just **MCIR and MSA with precipitation**. I've chosen a **minimum elevation of 10, Orthographic projection**, clicked **Easy Set Defaults** and **Disable Text Overlay**.
	    I've selected a **0.1** minimum % of projection filled, **5.0** solar elevation for visible images, **480** scan lines as the minimum image size to be considered, **show MCIR when MSA fails on screen** (this way you always get an image on the image tab and I remove all files after **30 days** EXCEPT images which is **2 months,**
	Map Overlay Options. You can set these later after you have successfully received an image.
	Text options. Tick **show temperature scale**. Some people add their station details but you can set these later after you've successfully received an image.
	File Names and Locations. I save into a folder a level under all my weather folders. Select **use for audio recording/maps too** and browse and **select appropriate folders** for yourself.
	GUI Options Select what's appropriate for yourself.
	
	<mark>YOU MUST CLICK ON THE SAVE BEFORE CLOSING THE OPTIONS TAB, OR REDO ALL THE SETTINGS.</mark>

Projection	Select **the projection** you want the image to have.
Image	These ALL help you "correct" an image after reception and decoding. I use **COLDER COLOURS** and **HISTOGRAM EQUALISE IMAGE** a lot!!
Help	Really!!! REALLY !!!!!! No it is a great resource as I've really only covered the basics.

MeteorGis	ALL of the configuration for MeteorGis is done in the *default.ini* file. The author Christophe has made a Meteor Configurator program (since around version 2.20) which now makes it VERY easy to configure.

A HELP menu has been included for MeteorGIS explaining the format for the command line options. I've only been able to display it by making a bat(ch) file containing "MeteorGIS.exe /help" WITHOUT THE QUOTES.

Things to check:-

The MeteorGIS INPUT directory (or a sub folder of it) is where it FINDS the files to action. This is the SAME DIRECTORY where the LRPT program SAVES IT'S FILES (or a subfolder of it).

If you have a map full of cities, then set shapes=3. This will turn off the populated areas (cities) and mountains. Read the configurator section for those shapes, make a change, and then change shapes back to shapes=(either 4 or 5). 4 adds populated areas and 5 adds populated areas and the mountains.

Finally, open Orbitron PREDICTION tab, find an satellite but preferably a MeteorM2 or Mn2-2 entry and double click on the max elevation line.

This puts Orbitron into SIMulated time mode, triggers SDR# to start up, should change SDR# parameters to that of the tracked satellite, and if it's a Meteor satellite, then a MeteorGIS command box should open. It will display several lines of text, getting Meteor tle, etc and then the LRPT program should open and the programs sit waiting for received data. If they close almost immediately once LRPT has opened, check that you have the TCP option checked in SDR# meteor Demodulator plugin.

If this works, click on the red SIM in Orbitron (near the clock). This will reset Orbitron back to real time, and close down MeteorGIS and LRPT.

If it doesn't, check your program paths in the Tracking DDE Client plugin, correct and try again.

CONGRATULATIONS!!! Grab a cold alcoholic drink of your preference or a hot drink, sit back and enjoy the hard work of the last 2 hours. With a suitable antenna you now should have a WINDOWS based AUTOMATIC APT/METEOR WEATHER RECEIVING and PROCESSING STATION.

A V-dipole is the quickest and easiest to make, a set of adjustable telescopic rabbits ears mounted horizontally onto a post will get you started, or a QHA, crossed dipole or turnstile antenna gives a far better reception.

My suggestion is check out the posted images on the Weather Satellite Images Facebook Group, find a person who regularly has great captures, and ask them what they use!

Now your next task is to post your first capture for us...we can't wait.

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