RemoteSDR Setup Guide

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www.rfspace.com

A quick guide to get started using the RemoteSdr Client/Server applications.

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1. RemoteSDR System

Many SDR users wish they could access their radio over the Internet but soon find it impossible due to the very high network bandwidths required to pass the raw SDR data. At 190kHz BW, the data rate of the SDR-IQ is over 6 Mbits/sec. One solution is to perform the demodulation on the server and only send the audio over the Internet. One can also send spectrum data as needed over the Internet to provide the wide band visual display SDR users are used to. By using simple data compression, a useable system can be created that drastically reduces the data bandwidth required over the Internet. Tradeoffs can be made as to audio and spectrum "video" compression and rates to match the available Internet link.

The RemoteSDR System is a means for connecting remotely over the Internet to an RFSPACE Inc. SDR-IQ receiver and operating it. The system consists of three main components.

- An RFSPACE Inc. SDR-IQ Receiver connected to a remote Windows PC.
- The RemoteSdrServer software running on the remote Windows PC.
- The RemoteSdrClient software running on the users Windows or MAC PC or an Android Client Application running on a portable device.

An example system consisting of a using a RemoteSDR Server and SDR-IQ over the Internet and Client Application is shown below.
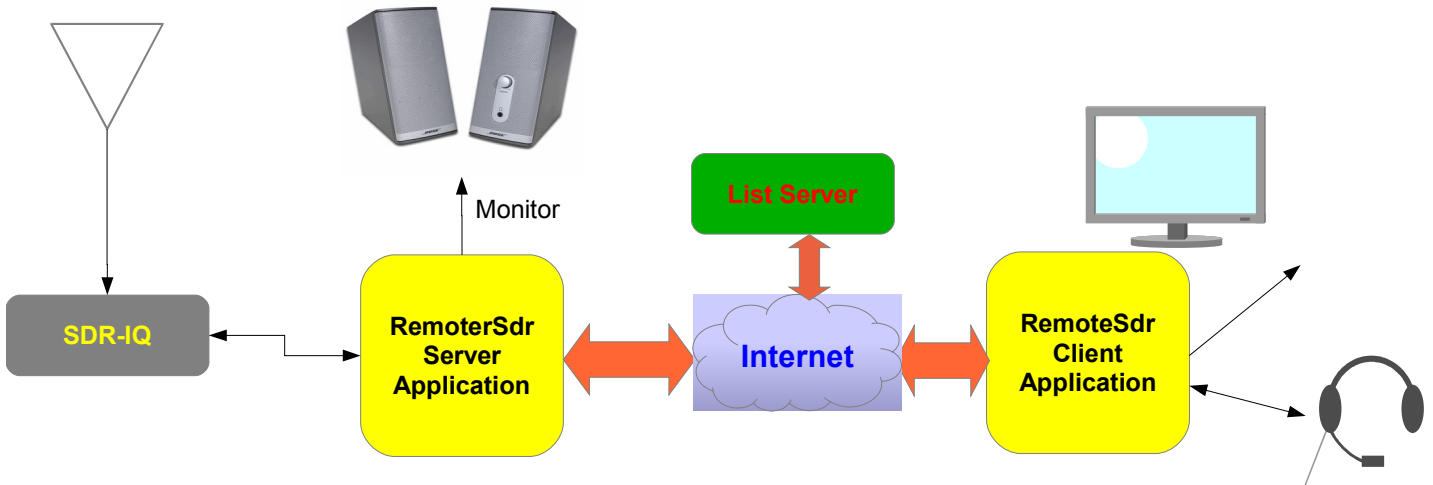
For convenience, there is a List Server service is provided on the Internet that publishes a live list of active servers that are available. This allows the Client software to easily find a radio on the Internet as well as a way to obtain its IP address and port to connect to.

1.1. Software Installation

One single Windows installation file is used to install both the Client program "RemoteSdrClient.exe" as well as the Server application "RemoteSdrServer.exe."

On a Windows PC, run the installer program "RemoteSdrClientWinSetup_xxx.exe" where xxx is the version.
This will install both applications even if you only plan to use only the client or server.

There is an Apple MAC version of the Client as well and is a separate installation. There is no MAC Server application at this time.
An Android Application is also available and is a different interface that will not be described here.

1.1.1   Client Software Setup

It is suggested to setup and use the RemoteSdrClient software first to connect to other servers on the Internet and get a feel of how it operates before tackling the more involved task of setting up your own SDR-IQ RemoteSdrServer.

Run the RemoteSdrClient by clicking on its desktop icon. Click on the "Setup" menu and setup your sound card.
The Input Sound Device is not used for normal reception use.
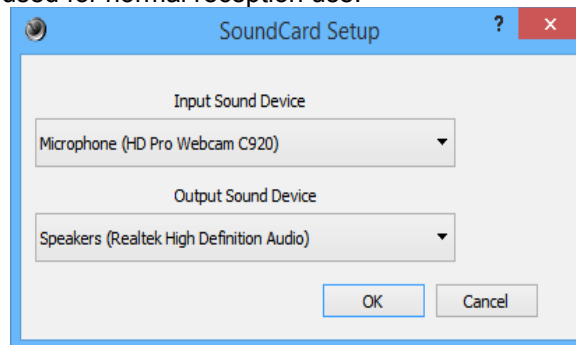
Now bring up the Network Setup menu.

Enter a brief description of your client or leave blank. This information is displayed on the server side to show who has last connected. If left blank then the last IP address is used.

If connecting through the Internet, Click on the "Find SDR's" button and it should display a list of RemoteSdrServers that are active on the Internet. If nothing shows up in the list, click the "Refresh List" button to try again. If still no joy, make sure your computer is connected to the Internet by connecting to a web page somewhere.
One can also get a list of SDR servers from a web page at:
http://moetronix.com/cgi-bin/sdrweb.py

Double click on an SDR that is not "In Use", and the IP and port information should automatically be selected. Some servers may require a password if it is a private users server.
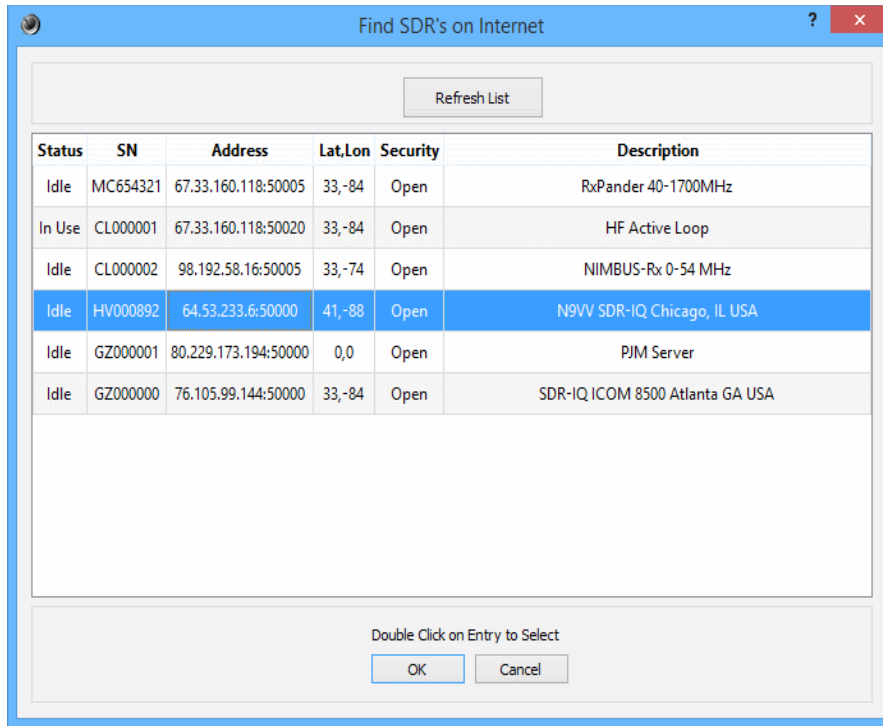
If you are trying to connect to a server on your local network and not the Internet, then manually enter the server's TCP IP address and TCP Port number.

1.2. Using Client Software

Exit the setup menus to return to main screen after selecting a Server to connect to.
Press "Start" to connect to the RemoteSdrServer.
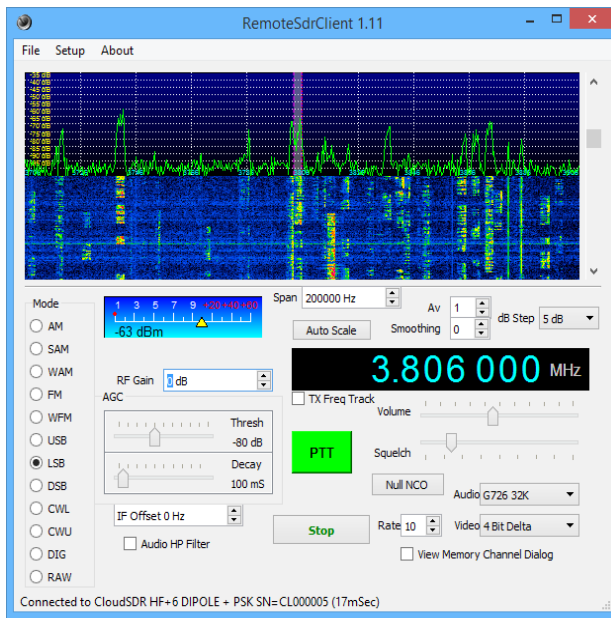
All of the receiver controls are located on the main screen.

1.2.1 Screen Spectrum Controls
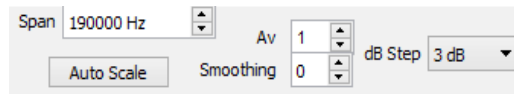
The Span box is used to specify the frequency range of the spectrum display. It acts as a "Zoom" in and out around the center frequency.

The Auto Scale Button control can be used to place the signal baseline in view.

The Average control can be used to smooth the signals on the display at the expense of blurring the waterfall.

The Smoothing control can be used to smooth the spectrum at the expense of frequency resolution. The waterfall is not affected.

The dB Step specifies the vertical screen step size. This acts as a zoom in the vertical amplitude direction.

1.2.2 Main Frequency Control

The center frequency control is used to specify the display and demodulation center frequency.

The frequency control can be set in several ways.

Place the mouse cursor on the digit you wish to change. The digit background will change color. Use the mouse or left or right arrow keys to change digit positions within the control.

- Type the desired numeric digit using the keyboard. The selected digit will move to the right so that an entire frequency value can simply be entered from the keyboard.

- Click the mouse on the top of the selected digit to increment that digit value or on the bottom of the digit to decrement it.

- Use the mouse scroll wheel to increment/decrement the digit value.

- Use the up or down arrows to increment or to decrement that digit value and zero all following digits.

An alternative method is to move the mouse cursor on the desired signal on the spectrum display and click the left mouse button. The spectrum will re-center itself to the new frequency.

A better way is to press and hold the left mouse button on the spectrum screen then drag the demodulation bar exactly to the signal you wish then release the left mouse button. When the button is released, the spectrum will then center itself around the new signal.

Hint: If you hover the mouse cursor over the spectrum display, then you can use the mouse scroll wheel to fine tune the frequency in 100Hz steps. This is useful for fine tuning in an SSB signal.

1.2.3 RF Gain

The RF Gain control is used to prevent overload on strong signals. The best setting is to use the highest gain without overload, indicated by the S-Meter turning red.

1.2.4   Demodulation Filter Bandwidth Adjustment

The demodulation filter high and low cut frequency can be adjusted using the right button of the mouse.

Steps to Adjust High Cut filter value:

• Zoom in so that the gray demod rectangle is wide enough to view easily.

• Move the mouse to the edge of the rectangle until the cursor changes to a double arrow and the High Cut Filter value is displayed.

• Right click on the mouse and either drag the edge to the value you wish or while holding down the right button, use the scroll wheel to adjust.
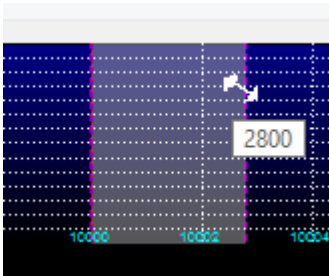
Adjusting the Low Cut filter is the same so just move the mouse to the left edge of the demod rectangle. Note the WFM demoulation mode has fixed high and low cut frequencies.

1.2.5   Modulation Modes

Eelven modulation modes are currently supported and are selected using the list of radio buttons on the left of the screen. For each mode, the following parameters can be independently set:

High and Low Cut filter frequencies.

IF Offset Frequency (used for CW tone offsets)

Squelch threshold

AGC threshold and decay settings

HF audio filter selection.

1.2.6 Digital Mode

If the "DIG" demod mode is selected, then a basic BPSK decoder is activated. A new pop-up window shows up that will display all the decoded text. Only Two speeds are supported, 31.25 and 62.5bps. For best results use a span less than about 5kHz for easier tuning. You can set the squelch to turn off the audio and reduce the Video Rate and very little Internet BW is used since only text is being sent. Make sure AGC threshold is minimum and no IF Offset.
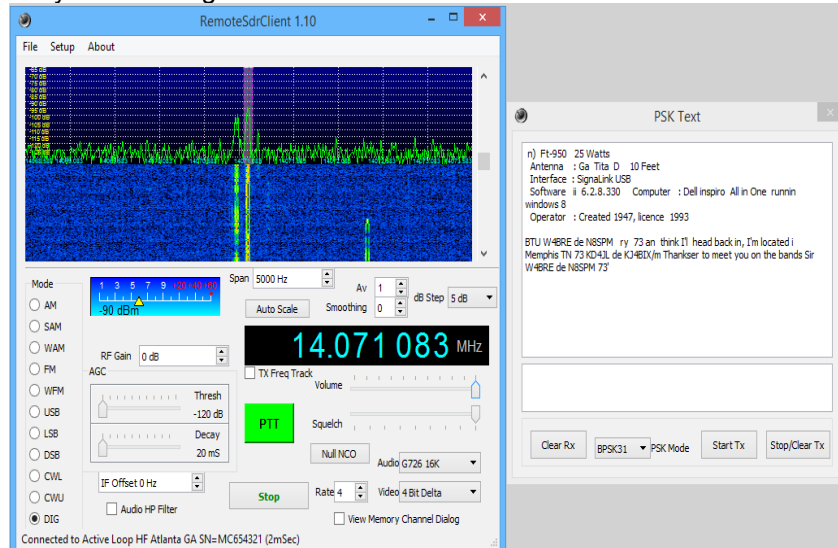
1.2.7 RAW I/Q Mode

When the "RAW" demodulation mode is selected, the server sends back its raw base band I/Q sample data without demodulation. The data is formatted as 8 bit I/Q samples and the sample rate can be selected as 16,8,4,2,1 and .5 ksps.

The data is after the main demodulation filter and so it must be selected to be less than the selected sample rate or aliasing will occur. It is also after the AGC so those controls are active on the data and also allow the data to fit in 8 bit samples. For now the client just plots the I/Q samples as an X-Y plot to verify that it is working. The more normal use would be to feed these samples into digital mode decoders for further processing. One idea is for the client to send these samples out a specified IP address and Port as UDP packets so an external 3rd party program could easily grab for its own use.

Note that the raw mode can use more Internet BW than the normal demodulation modes. The 16ksps rate uses more than 256kbps and whatever the spectrum video uses.   The 500 sps rate is only 8000bps.
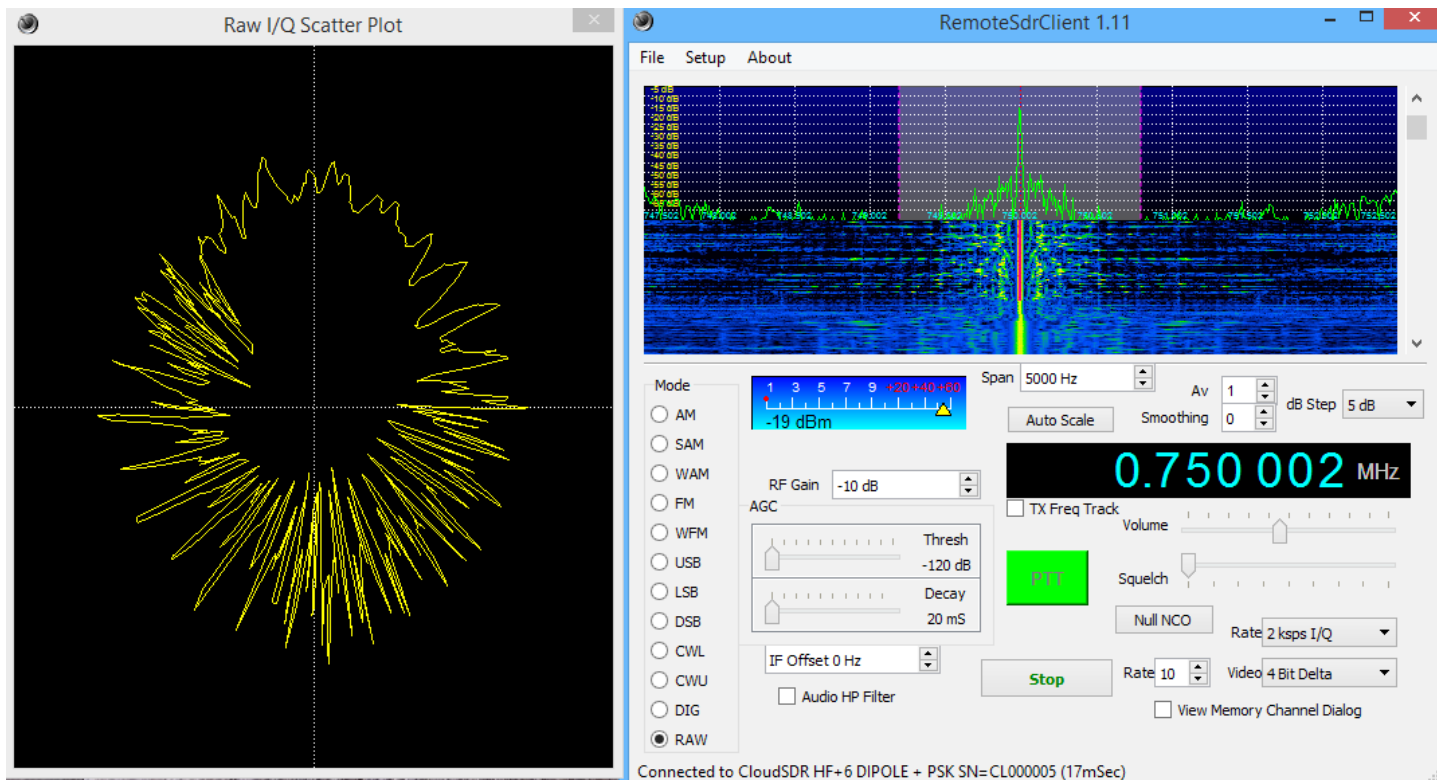
The above plot is just an AM station slightly off tuned so the I/Q vector is rotating in a circle and the length of the vector is varying with the AM modulation.

1.2.8   AGC Settings
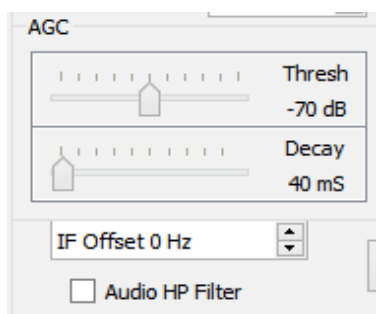
The AGC threshold is used to set the threshold where the AGC begins to act.   This is useful to reduce the background noise level if the desired signals are fairly strong compared to the noise floor. The decay setting can be used to specify how long the AGC takes to recover.

1.2.9   IF Offset

This controls a shift frequency that is applied to the demodulation filters and allows CW signals to be centered in the filter with a tone frequency equal to the offset frequency. For lower sideband CW use a negative offset frequency.

1.2.10   Audio HP Filter

This check box enables an audio high pass filter that is useful when listening to FM signals that contain CTCSS tones that are audible.

1.2.11   Audio and Video Compression Controls
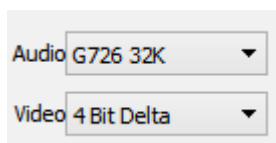
These controls allow selecting compression methods to reduce Internet bandwidth. The smaller the Audio Rate, the less bandwidth that is used at the expense of audio quality. The video compression has only two selections 8 bit(no compression) and 4 bit delta compression which reduces the rate by 50%. These controls can also be used to completely turn of either the audio or video streams.

1.2.12   S-Meter and Squelch Control

The S-Meter indicates signal strength as well as the position of the Squelch threshold. The small red dot moves according to the Squelch level setting.

During an overload condition the S-Meter background turns red indicating the need to reduce the RF Gain level.

Note that for FM demodulation, the squelch level is not the same as the signal level since it is a noise based squelch. It should be adjusted by setting the level so that no background noise is heard with no FM signal.

1.2.13 Misc Controls
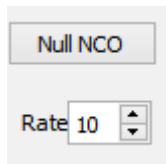
The "Null NCO" button is used to null out the NCO "Spur" that may appear to always appear at the center of the screen regardless of the center frequency setting. If it is visible, just click on the button and wait several seconds to let it automatically reduce. Make sure no other real signals are at the center frequency which can prohibit the function from working.

The "Rate" control specifies how often the screen is updated. Slowing down the display update rate will reduce Internet bandwidth usage.

1.3. Memory Dialog

☐ View Memory Channel Dialog

Setting the "View Memory Channel Dialog" box brings up a new separate window that can be used to save and recall the client program settings as memory channels for easily changing the frequency and all demodulation and screen settings by just double clicking on an entry.

The data is stored in .ini text files in the users Documents folder. One can group various channels into separate .ini files to keep the table from getting too long and complicated.

Note! The .ini file is only saved on program exit so it is important to exit the RemoteSdrClient program before turning off your PC to make sure the data in the table is saved.

This dialog window consists of two columns. The first column displays the frequency and demodulation mode for the memory channel. It is automatically set from the current Client settings when a "New Entry" is created or if the "Update Selected" button is pressed.

The second column is a user specified text description of the channel. Right clicking on the entry allows the user to edit the text description. Labeling the channels in some sort of alphanumeric order will allow the colums to be sorted by

double clicking on the "Description" header at the top of the column. Double Clicking again will sort in the opposite direction.

At the top of the window screen are two buttons used to read in a different memory file or create a new name to save the current table into. They bring up a file dialog box to select the file or file name.

1.3.1 Procedure for adding a new entry into the table.

1. First set the RemoteSdrClient's frequency and all settings to the ones you wish to save.
2. If not already visible, click on the "View Memory Memory Channel Dialog" box to bring up the memory dialog.
3. Click on the "New Entry" button at the bottom left of the screen. This creates a new entry with all the internal settings as a new line in the table and automatically places you in the text edit mode to enter a new name for the channel.
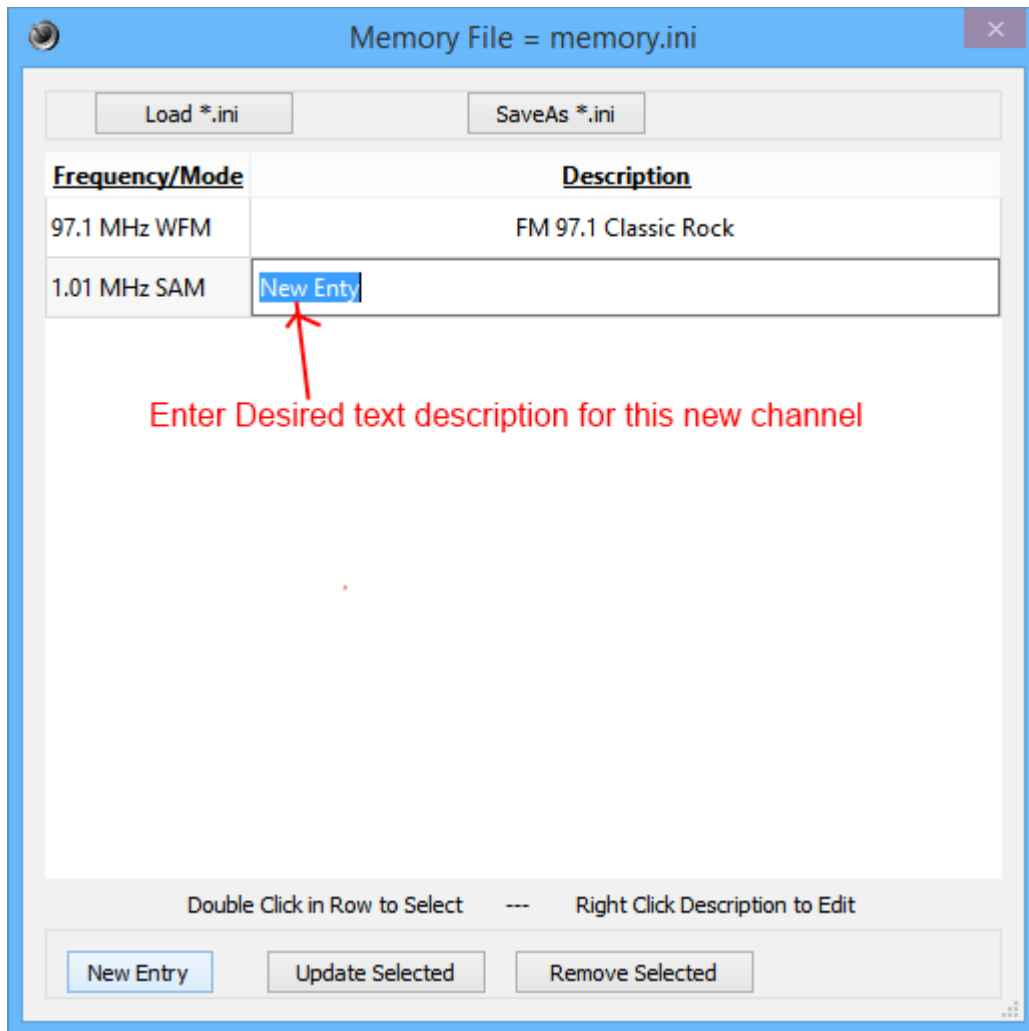
1.3.2   Procedure for Modifying an existing entry in the table.

1. First set the RemoteSdrClient's frequency and all settings to the new ones you wish to save in an existing channel entry.
2. If not already visible, click on the "View Memory Memory Channel Dialog" box to bring up the memory dialog.
3. Click on the table entry row that you wish to update. Either the description or frequency cell should be highlighted indicating that it is selected.
4. Click on the "Update Selected" button at the bottom of the screen to update the channel to all the current settings.
5. Right click on the Description and edit if you wish to modify it as well.

1.3.3   Using the Channels.

To use a channel, simply double click the desired channel in the table and all the settings associated with that channel get transferred to the main program.

1.3.4   Advanced Editing.

The .ini files are just text files in a certain format containing the settings data. If one is careful, the entries can be edited using a text editor such as changing frequency or the text description. If the .ini file is incorrectly edited, then it may not work correctly so its editing is not recommended except where perhaps it is easier to edit the descriptions using a text editor than editing each item line by line.

An example of an ini file:

```
[Channels]
1\MemName=Atlanta AM 1010 Funk
1\RxCenterFrequency=1010000
1\dBStepIndex=1
1\dBMaxIndex=9
1\FftAve=1
1\FftRate=10
1\DemodMode=7
1\Volume=100
1\RfGain=0
1\AudioCompressionIndex=2
1\VideoCompressionIndex=2
1\RxSpanFreq=250000
1\Offset=0
1\SquelchValue=-160
1\AgcThresh=-120
1\AgcDecay=500
1\HiCut=3900
1\LowCut=-3900
1\Symetric=false
1\AudioFilter=false
2\MemName=Atlanta AM 680 Sports Talk
2\RxCenterFrequency=680000
2\dBStepIndex=0
2\dBMaxIndex=-1
2\FftAve=1
2\FftRate=10
2\DemodMode=7
2\Volume=100
2\RfGain=0
2\AudioCompressionIndex=4
2\VideoCompressionIndex=2
2\RxSpanFreq=250000
2\Offset=0
2\SquelchValue=-160
2\AgcThresh=-120
2\AgcDecay=500
2\HiCut=3900
2\LowCut=-3900
2\Symetric=false
2\AudioFilter=false
size=2
```

1.4. Experimental Transmit Features

Even though the SDR-IQ is only a receiver, the RemoteSdrClient has hooks to be able to transmit remotely as well. Currently this is an experimental mode so is not complete.

When the "PTT" button is pressed, the RemoteSdrClient goes into transmit mode where the sound card audio input is compressed and sent to the RemoteSdrServer. Currently all the Server does is generate a modulation signal and output it to the soundcard as a stereo I/Q baseband signal. The Transmitter spectrum is sent back to the RemoteSdrClient and displayed instead of the receiver spectrum.

If while in transmit mode, you select the Setup Transmitter menu, an audio test generator can be enabled that generates Gaussian noise or a single tone. A 3 band equalizer can be adjusted to modify the audio spectrum.
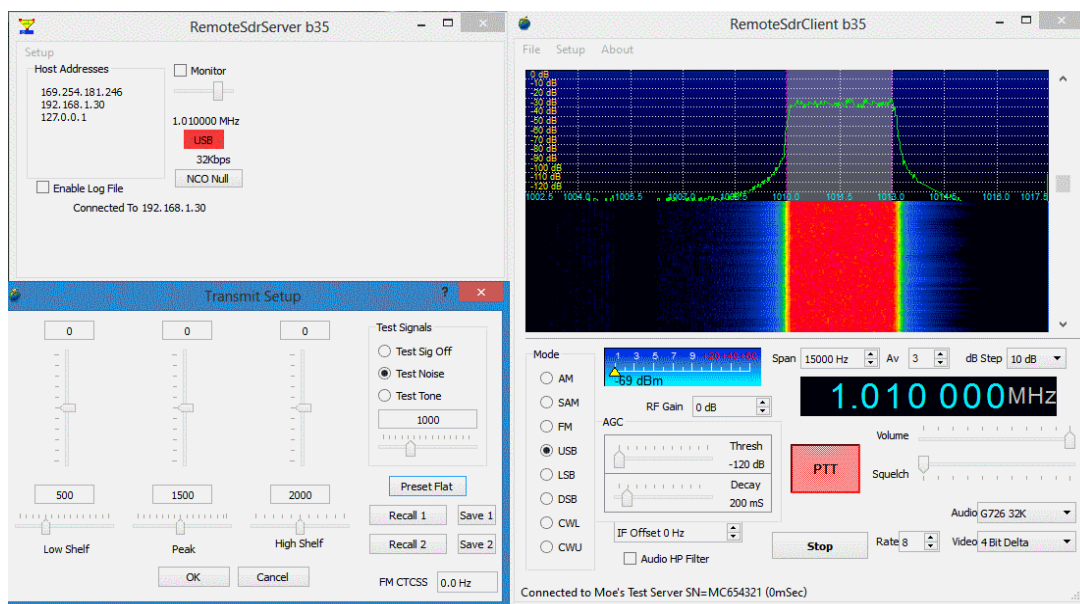
There has been little testing done with the transmit mode and it is more for experimenting than actually using to drive an actual transmitter. Any such experimenting should not be done over the Internet since there are no protection timeouts etc. if things go awry.

1.5. RemoteSdrServer Software Setup

Note!! If you are only going to use the Client software to connect to remote receivers, you do not have to run or setup the Server software.

This section describes how to setup your own server using the RFSPACE Inc. SDR-IQ receiver.

Unlike setting up the Client software, setting up the server software will require some basic knowledge of networking such as IP addresses, Port Forwarding, etc. While some of this will be described briefly here, feel free to use Google to find better explanations for some of the the concepts used here.

1.5.1   Software Installation

First install the application if not already installed as described in section 1.1.

Run the RemoteSdrServer.exe application by clicking on the icon that should have been placed on your desktop. An RFSPACE SDR-IQ radio must be connected to the PC using the USB cable and its driver installed. The driver installation should be automatic with Windows or already installed if you have been using the SDR-IQ before on your PC.

1.5.2   Software Installation

The following shows the basic controls and status areas of the main program.
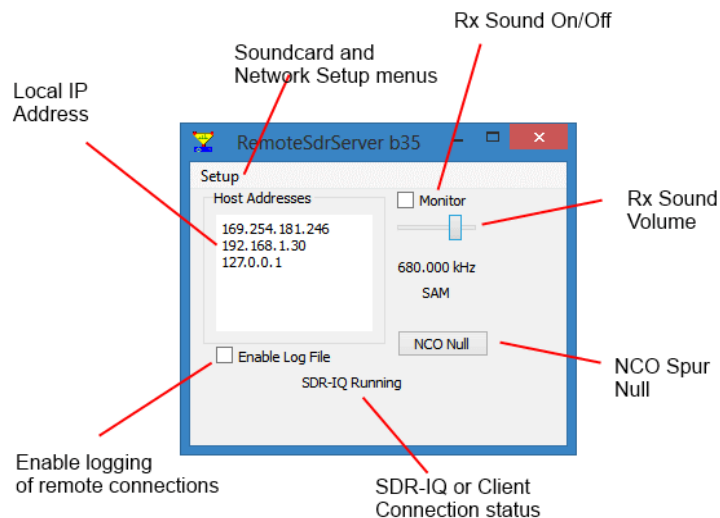
1.5.3   Sound Card Setup

Click on the "Setup" menu then to select the SoundCard setup menu.
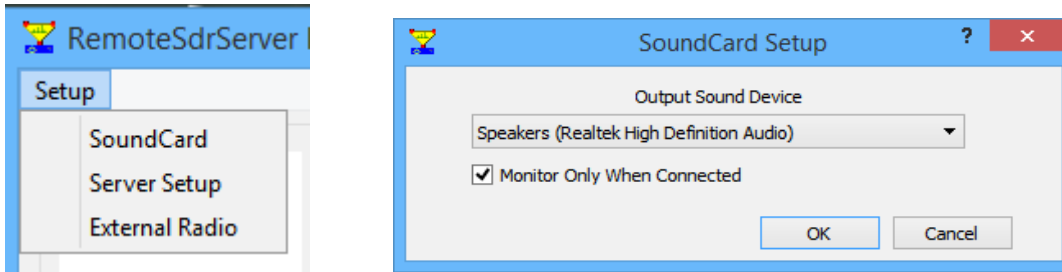
Select the sound card if any that you wish to use as a monitor. Checking the "Monitor Only When Connected" box will only activate the monitor when someone is connected to the server otherwise it will always be on as long as the main Monitor checkbox is on.

1.5.4   Server Setup

The Server Setup menu provides a means to set various settings of the SDR Server.
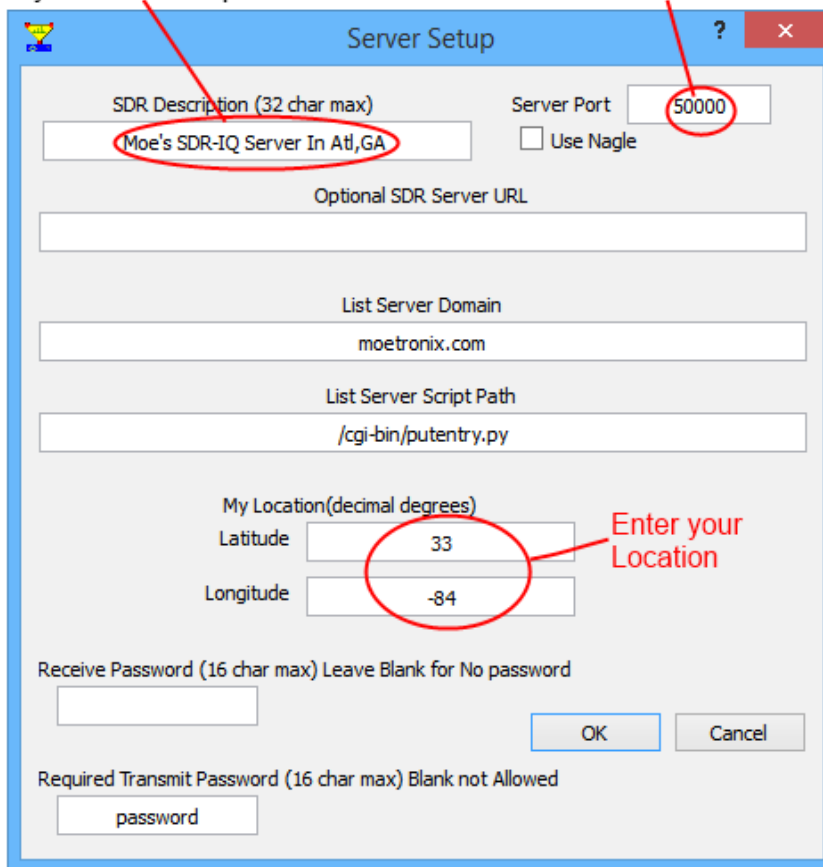
Leave the "Optional SDR Server" URL blank if you do not have your own domain name. Entering anything in this field prohibits the use of an IP address.

You should now see your Server listed here:
http://moetronix.com/cgi-bin/sdrweb.py

Note!! In order for the Server to be accessed from the Internet, most likely you will have to forward the chosen port number from your router to the IP address of the PC you are running on. This is done in your routers setup and will depend on its brand, model, etc.   See section 3 for details on setting up your network to work with the server.

If you are uncomfortable with forwarding a port you can still use the client server on your local network but will have to to enter the local IP and port address from the RemoteSdrServer manually into the Client Application.

2. Optional Use of External IF Radio

The RemoteSdrServer application has an option to connect an AOR AR5000 or IC-8500(other radios as they are added) in order to extend the frequency range of the receiver. The IF output of the external radio is connected to the RF input of the SDR-IQ and an RS232 serial port cable is connected between the External Radio and the PC that the Server software is running on. The Server commands the SDR-IQ to stay tuned to the IF frequency of 10.7MHz and the external radio is commanded to tune to the desired frequency.

Set the external radio's mode to AM or FM in order to center the frequency in the IF bandpass.

2.1. System Description

Example Usage of External IF Radio
To Extend Frequency Range
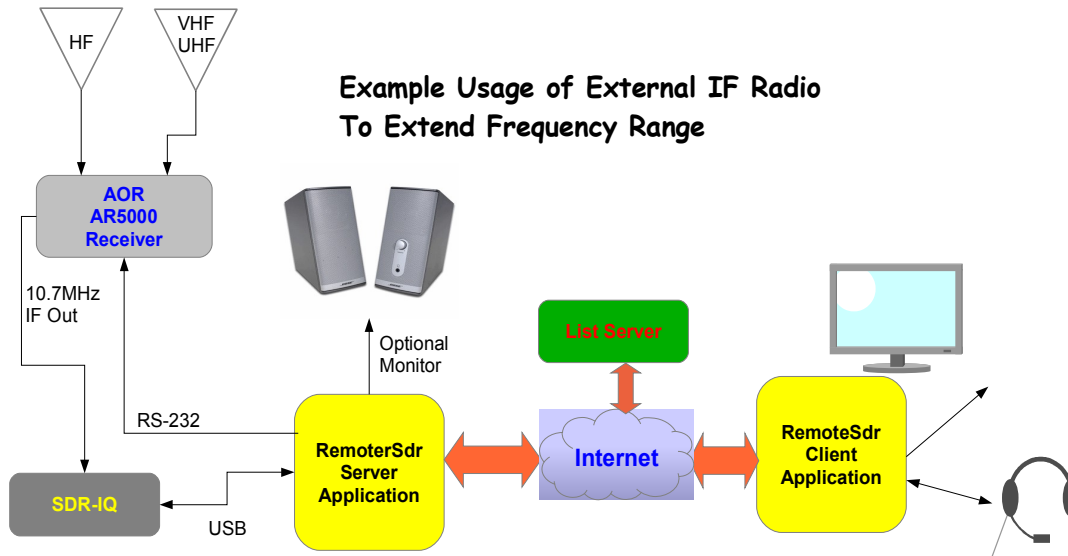
The AOR AR5000 has two antenna connectors that can be automatically selected based on frequency ranges so for example an HF antenna can be connected to one connector and a wideband VHF/UHF antenna connected to the othere connector. Refer to the AR5000 manual for instructions on setting up the menu to do this.

2.2. Software Setup

Bring up the Setup/External Radio Menu and select the radio, COM port, and port settings to match your radio.
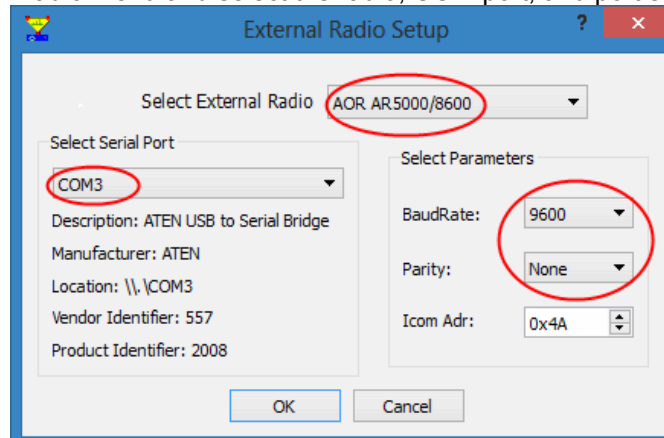
3. Network Configuration

3.1. Networking Basics

All networks are different but for most home networks the same basic architecture is used and is shown below. In commercial networks things can get very complicated and trying to place an SDR behind all the security walls and getting administrator help may be difficult.

Network components:
- The Internet is the vast worldwide network that we are trying to communicate over.
- Your Internet Service Provider(ISP) provides your home a unique IP address that is visible on the Internet. It normally is not static and can and does change.
- Modem, Router, Access Point, Ethernet switch are unique to your home but provide the translation between your assigned Public IP address and all the networked devices within your home.
- All your network devices are assigned their own IP addresses on a Local Area Network (LAN). These addresses are not visible to the outside world and cannot be routed outside your home. All Internet traffic must go through your router and be translated to your Public IP address.

Basic Home Network
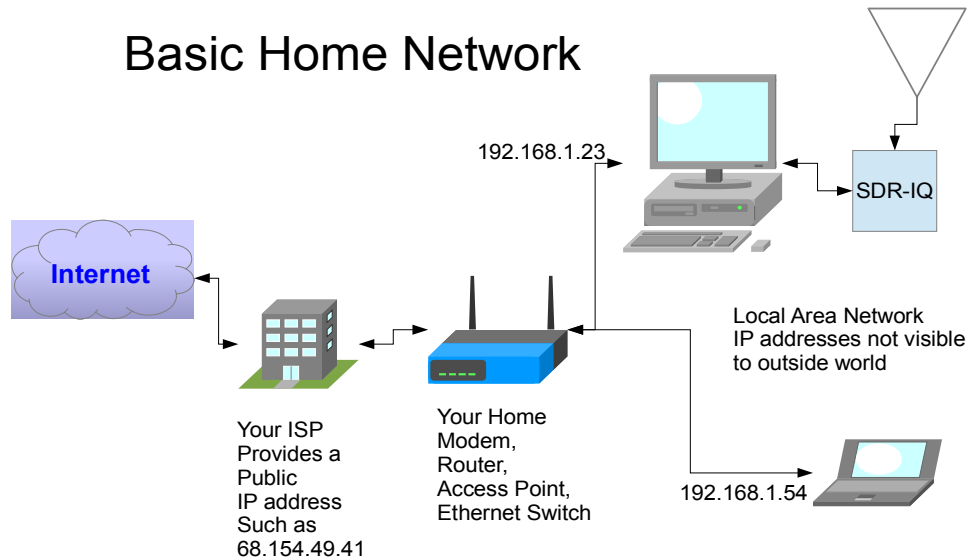
There are several problems to get an outside Client to be able to connect and use your SDR-IQ that is located on your local network.

3.1.1 Finding your Public IP Address

The first problem is finding your Public IP address that is assigned and changed by your ISP. Here are several ways to do it.
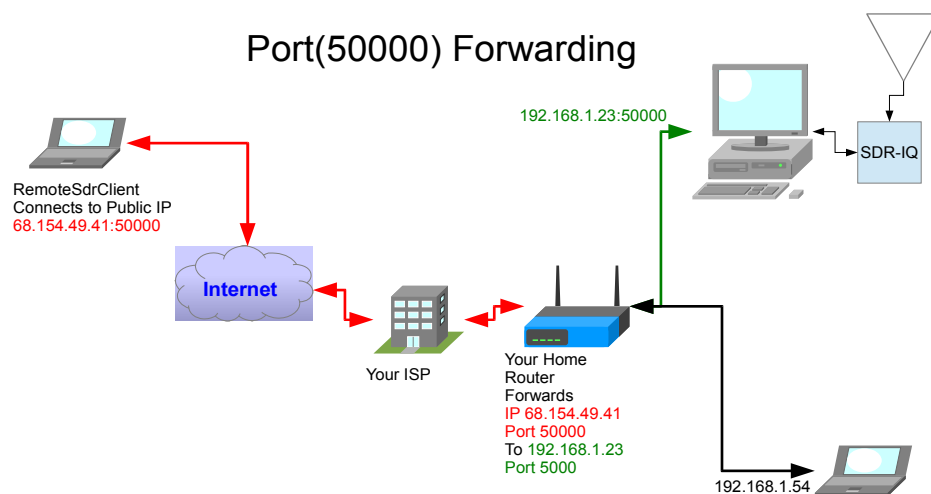
- Manually find your public IP address by opening up your router's web setup program.
- Bring up one of the Web sites that tell you what it is such as Find My Public IP Address
- Sign up for one of the free Dynamic DNS services that register a unique Domain Name to you and it is mapped to your Public IP address. This requires running a simple client(might as well use the same PC that the RemoteSdrServer.exe server is running on) that is supplied by the service that periodically sends your Public IP address to the domain name server. One such free service is dynu.com. These services are also useful for connecting to your web cams etc. over the web when you have a changing dynamic public IP address.
- Use the custom List Server for the RemoteSdrClients which provides a simple way to see a list of SDR's on the Internet and just click on the entry which automatically fills in the Public address and other information to connect.

3.1.2 Accessing a PC From Internet

The next problem is how to give the client access to the particular PC that is connected to the SDR-IQ.

Note that there is only one IP address assigned to your entire home by your ISP so how can the client know how to connect to one of many PC's and other devices on your home network.

The answer is to setup Port Forwarding in your router. This works by setting up your router to forward a unique user specified Port Number to the local IP address of the PC running the SDR-IQ server software. Now a client will connect to your Public ISP assigned IP address with the same user specified Port Number. Your router will then forward this connection to the PC running the SDR-IQ server software based only on the port number.

Port(50000) Forwarding

192.168.1.23:50000

RemoteSdrClient
Connects to Public IP
68.154.49.41:50000

Internet

Your ISP

Your Home
Router
Forwards
IP 68.154.49.41
Port 50000
To 192.168.1.23
Port 5000

192.168.1.54

SDR-IQ

Most Access Points/routers can be setup to forward a port or range of ports to a specific internal local IP address. This is normally done using its web based setup facility. Depending on the brand/model you will have to dig out the manual or Google for directions on forwarding ports. Sometimes it is under an obscure heading like "Gaming" or other odd name.

The forwarding procedure is:
Forward the TCP Port Number you assigned to the RemoteSdrServer to the local IP address of the PC you are running the RemoteSdrServer on.
For example, say your host server PC is on IP address 192.168.1.23 and you picked port number 50000 for the RemoteSdrServer. You will need to forward port 50000 to IP address 192.168.1.23. Forward TCP data. TCP is used for command, control, and carries the audio and video data streams.

Here is a link to a web page that allows you to test your port forwarding:
http://www.yougetsignal.com/tools/open-ports/

3.1.3   The DHCP Problem

Another problem that can occur is that if DHCP(Dynamic Host Configuration Protocol) is used by your local router, the local IP address assigned to the PC that is hosting the RemoteSdrServer can and will change as all your network devices are turned on and off or moved around. This means you would have to change your port forwarding to this new IP address every time it changes.

One suggestion is to setup the server PC to use a manually assigned IP address. I setup my router to have a range of local IP addresses that are manually assigned and another range that allows DHCP assignment so there is no chance of overlap. You still have to be careful not to manually assign the same IP addresses to different devices or kaboom.

Also choose the port number such that it doesn't conflict with something else. There are several Port numbers that are common to various services and should not be used. Anything under 1024 is not a good idea as they are already assigned. The maximum number is 65535 so there are plenty to choose from.

3.1.4   Other Network Problems

All networks are different and some have varying degrees of security that can inhibit connections over the internet.

One may have to experiment with security levels to get things to work. If you have no control over the network then you may just be out of luck.

4. Change Log

Initial Release Rev 1.00   2013-10-4
Release Rev 1.01 2013-10-16   Added description to use external radio.
Release Rev 1.02 2014-04-15   Added descriptions to match latest software.
Release Rev 1.03 2014-06-24   Added descriptions to match latest software. Rewrote some sections.
Release Rev 1.05 2014-10-31   Added descriptions to match latest software.
Release Rev 1.06 2015-03-10   Added digital mode description to match latest software.