

CloudSetup User Guide

Rev. 0.03

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www.rfspace.com

This specification describes the CloudSetup Program used to setup the RFSPACE Cloud-xx digital receivers. A brief description of the Cloud-xx architecture is provided along with a detailed description of the various parameters that can be setup with this CloudSetup program.

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1. CloudSetup Program Purpose

Cloud-xx is used in this document to refer to both the RFSPACE CloudIQ and CloudSDR receivers.

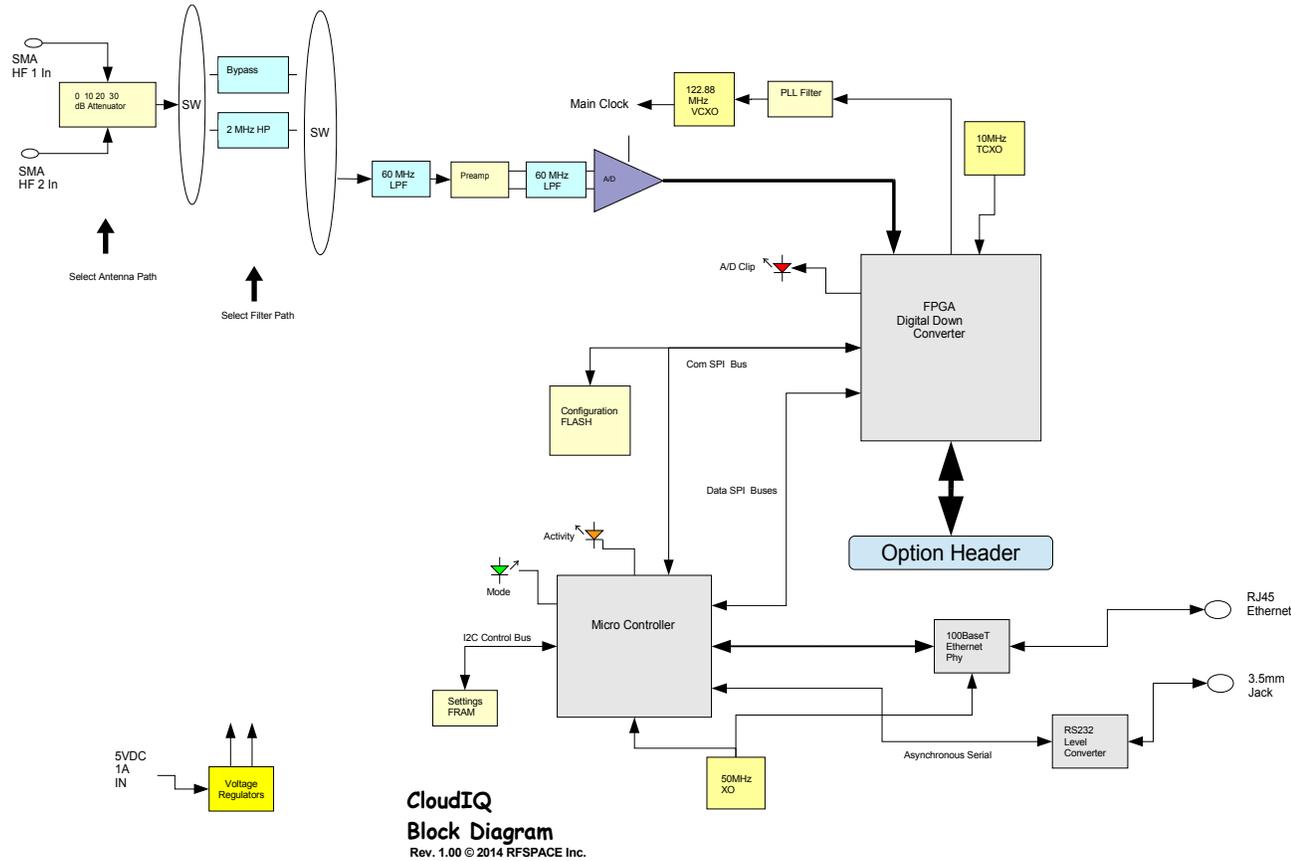
The CloudSetup program is used to setup various parameters on the RFSPACE Cloud-xx series of software defined radios. It uses UDP broadcast messages to communicate to the radios so a radio can be found even if its network parameters are not known. Various other parameters mostly relating to the stand alone Internet Cloud Mode can also be set such as text descriptions, location information, passwords, etc.

2. Cloud-xx Hardware

The Cloud-xx radio a hardware device whose basic operation is to digitize RF signals, perform various operations on the digitized data and send it back to a client application over an Ethernet network. Currently there are two different hardware models available from RFSPACE Inc.

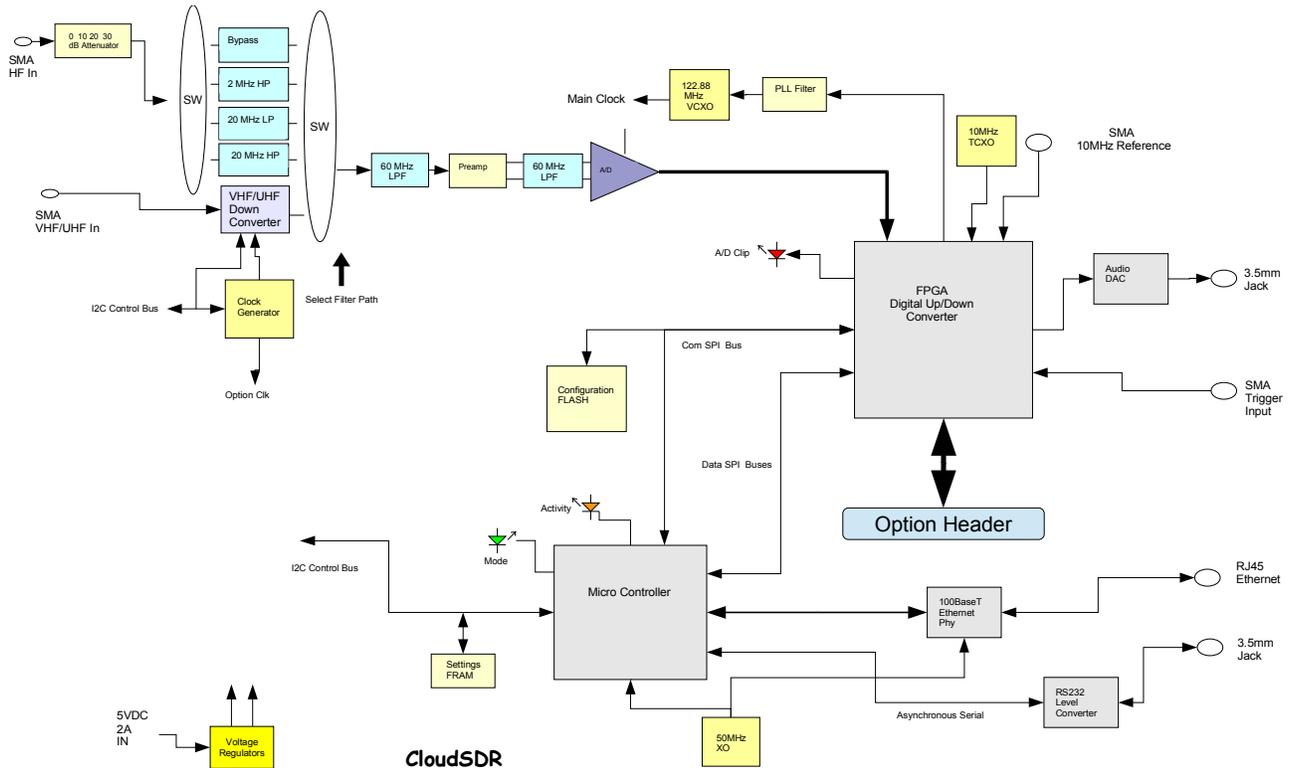
2.1. CloudIQ Model

The CloudIQ is a direct sampling Receiver with a frequency range of 0.1 to 56MHz. It has two selectable RF Input ports, and a RS232 port for controlling external devices or for monitoring. It is powered by an external 5Volt DC source and communicates using a 100base-T Ethernet connection. Three LED's indicate overload and various mode and status conditions.



2.2. CloudSDR Model

The CloudSDR has all the features of the CloudIQ plus an internal VHF/UHF down converter to extend the basic 0.1 to 56MHz frequency range to over 1GHz. It also has inputs for a 10MHz reference, a trigger input to synchronize RF capture, and an audio DAC output for local monitoring. An option header is available for a future transmit exciter option plugin.



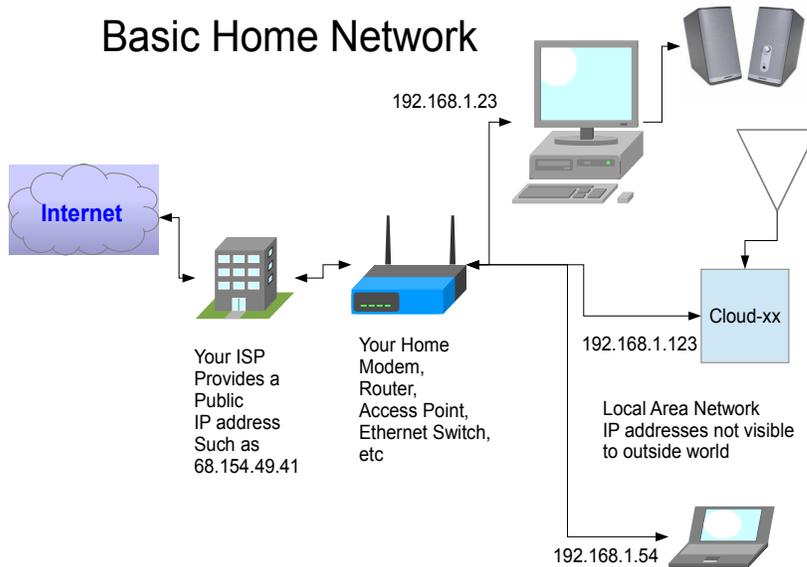
CloudSDR
Block Diagram
 Rev. 1.01 © 2014 RFSPACE Inc.

3. Cloud-xx Network Interface

The Cloud-xx runs as a TCP/IP Server allowing a single client connection and uses TCP or TCP/UDP to provide command and data interfaces back to the client.

An IPV4 100base-T Ethernet interface is used to communicate to both Cloud-xx models. While the Cloud-xx Ethernet interface can be connected directly to a PC's Ethernet port, normally it is used in conjunction with some sort of network infrastructure containing multiple devices sharing the Ethernet connections. This document does not try to explain basic networking so if one is not familiar with basic concepts there are many networking tutorials on the Web just a "Google" search away.

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.



In order to communicate with another device on the network you need to know its IP address and port number. Many networking services have implied port numbers such as web client/servers(port 80).

IP addresses can be assigned automatically by your Router using DHCP (Dynamic Host Configuration Protocol) or one can manually assign IP addresses to all your devices or a hybrid approach where some are automatic and others assigned manually. How this is done is unique to your router hardware so one must refer to its documentation for the proper procedure.

The CloudSetup program is used to set which IP address assignment method is used as well as manually assign IP addresses, port number and other networking parameters for the Cloud-xx radios.

3.1. Automatic DHCP IP assignment

Advantages:

- No worries about address conflicts
- Less understanding of networking needed.

Disadvantages:

- Have to use router setup program to find IP address number.
- IP address can change when devices are turned on and off.

3.2. Manual DHCP IP assignment

Advantages:

- IP address is fixed and will not change
- IP address is known since you assign it.

Disadvantages:

- Must manually make sure no conflicts.

When operating the Cloud-xx in the "I/Q Mode" where it is limited to devices on the local network and is not required to connect over the Internet, using automatic assignment using DHCP may be easier since the software on the PC can easily find the assigned IP address and port number. This is the cloud-xx factory default mode of operation.

When operating the Cloud-xx in the "Cloud" mode over the Internet is recommended to assign the IP address manually since it needs to remain fixed in order to forward it out to the Internet as described later in this document.

Other networking parameters that can be assigned is the subnet mask which specifies the range of IP addresses on your network and the gateway IP address which is used by the router to access other networks. Using DHCP will automatically set these parameters so normally you can use these as default.

One trick is to enable DHCP and let all the local network parameters get automatically assigned such as subnet mask and gateway address. Then turn off DHCP and manually set the desired fixed IP address and retain the other network parameters.

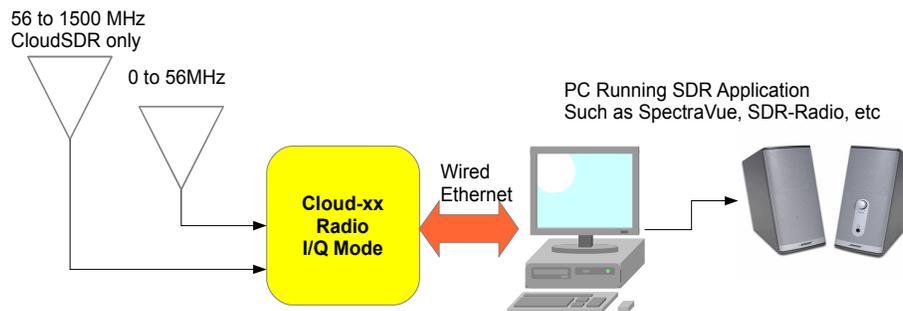
4. Cloud-xx Functionality

4.1. Operating Modes

The Cloud-xx has two independent and exclusive modes of operation that can be selected using the CloudSetup program. In order to properly use the Cloud-xx radios it is important to understand these two modes of operation and select the correct one for your application.

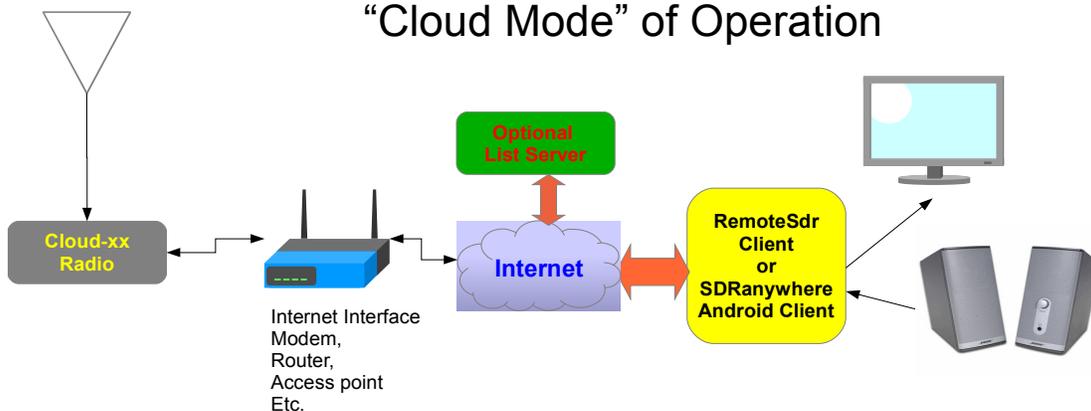
- The “I/Q Mode” of operation is where the Cloud-xx operates as a base band RF capture device and a PC is used to perform all the receiver demodulation and display functions. This is the default mode and is the way most SDR's operate using PC Software like SpectraVue to perform all the radio functions. This mode offers the most versatility and performance but is limited to working within a local Ethernet network due to the high data rates required. This mode is nearly identical the RFSPACE NetSDR mode of operation and most of the commands and data formats are identical. In this mode, TCP is used for command and status while UDP is used to send I/Q baseband sample data.

“I/Q Mode” of Operation



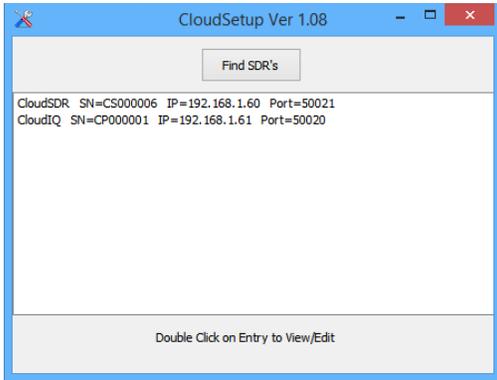
- The “CLOUD Mode” of operation is a new mode where the Cloud-xx operates as a self contained receiver and performs demodulation and spectrum calculations internally and sends just compressed audio and spectrum display data back to the host over a network connection. Because the data rates for this mode are low, it can be accessed over relatively low bandwidth Internet connections allowing for worldwide remote operation. This mode offers remote operation over the Internet but does not allow for high performance spectrum or data processing since all of the demodulation and spectral processing is done within the radio. In this mode, only a single TCP socket is used for all command, status, and data transfers. SpectraVue does not work in this mode of operation. A separate PC program called RemoteSdrClient, or an Android client SDRanywhere can be used either locally or over the Internet in this mode to display spectrum and play the demodulated audio.

“Cloud Mode” of Operation



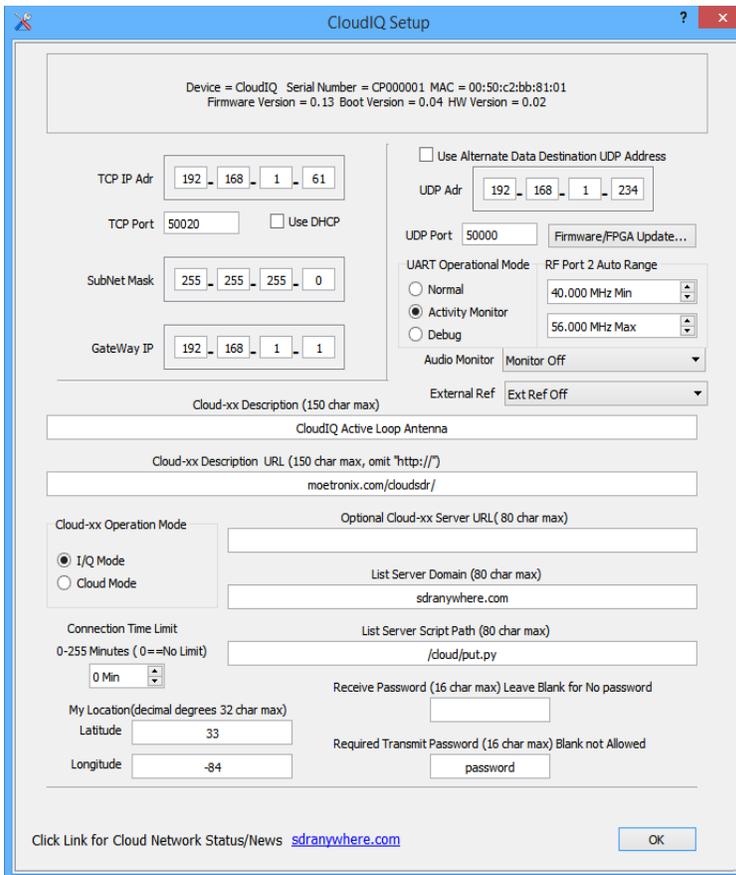
4.2. Running the CloudSetup.exe Program

When CloudSetup is first run the following screen should show up listing any Cloud-xx radios on the network. Pressing the “Find SDR’s” button will refresh the window. Double click on the desired radio to setup.

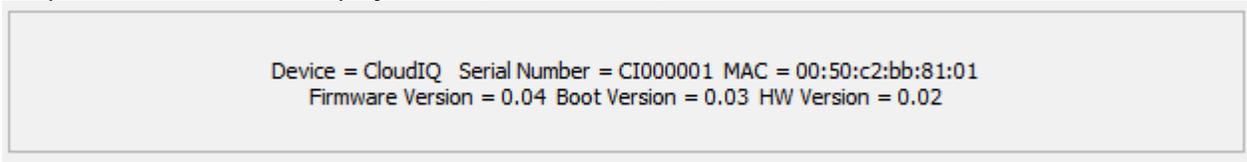


4.2.1 CloudIQ Setup

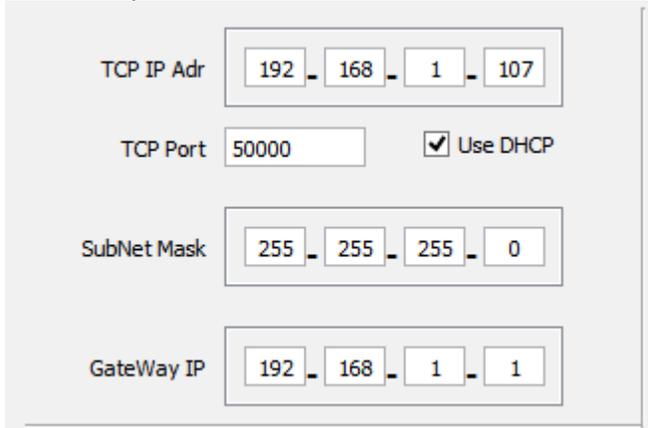
The following menu is displayed after selecting a CloudIQ radio. Press “OK” to make your changes take affect or cancel to abort any changes. After changing some of the parameters, the Cloud-xx will recycle so it may take several seconds before it is back on line.



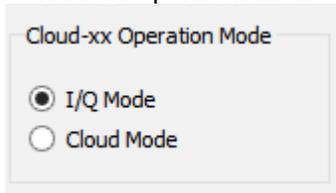
The top information window displays model, serial number, MAC address, and version information.



The Network parameter area of the menu is used to select DHCP or manually enter the network parameters.



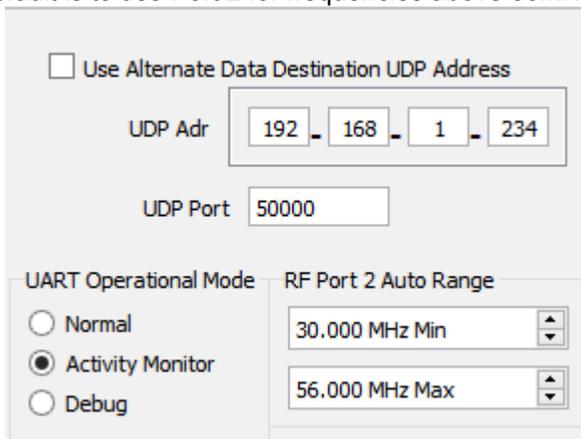
The Cloud-xx Operation mode section is used to select one of the two basic operation modes of the Cloud-xx.



This area of the menu is used to select an alternate UDP data address for the I/Q Mode. This is not very common so should be left non-selected. The UART Operational mode allows selection of the use of the RS232 port on the CloudIQ.

Normal mode should be selected if used as an interface to an external radio in panadapter applications. Activity Monitor mode is used when in Cloud mode to monitor remote activity. Debug mode is useful for software developers debugging interface issues.

The CloudIQ radio has two RF input connectors and one can choose the frequency range that RF Input Port 2 is active. Default is to use Port 2 for frequencies above 30MHz.



The following section of the menu are settings used for the Cloud-IQ external 10MHz reference and audio board options. If you do not have this board leave these settings as off.

Use Alternate Data Destination UDP Address
 UDP Adr: 192 - 168 - 1 - 234
 UDP Port: 50000 Firmware/FPGA Update...
 UART Operational Mode: RF Port 2 Auto Range
 Normal 40.000 MHz Min
 Activity Monitor 56.000 MHz Max
 Debug
 Audio Monitor: Monitor Off
 External Ref: Ext Ref Off

The audio monitor function is only for the cloud mode and allows the user to select to use the audio monitor on or off or only when someone connects to the radio.

Audio Monitor: Monitor Off
 External Ref: Only When Connected
 Always On

The rest of the parameters are used when the CloudIQ is in the Cloud Mode.

Cloud-xx Description (150 char max): CloudIQ Active Loop Antenna
 Cloud-xx Description URL (150 char max, omit "http://"): moetronix.com/cloudsdr/
 Cloud-xx Operation Mode: I/Q Mode, Cloud Mode
 Optional Cloud-xx Server URL (80 char max):
 List Server Domain (80 char max): sdranywhere.com
 List Server Script Path (80 char max): /cloud/put.py
 Connection Time Limit (0-255 Minutes (0==No Limit)): 0 Min
 My Location (decimal degrees 32 char max): Latitude: 33, Longitude: -84
 Receive Password (16 char max) Leave Blank for No password:
 Required Transmit Password (16 char max) Blank not Allowed: password
 Click Link for Cloud Network Status/News: sdranywhere.com OK

One can set a text string to describe your Cloud-xx that can be seen by remote clients.

An optional URL can also be entered that points to a personal web page for further information on your radio.

The List server Domain and Script Path is specified that will post this Cloud-xx's External IP address and other information to a central List server that Remote client software can use to create lists of available Cloud-xx radios.

Passwords can be specified if you want to limit access to your radio.

Location information can also be entered if desired. By limiting the precision of your coordinates, you can protect the privacy of your exact location.

A connection time limit can be specified for the Cloud mode to limit user connect times.

The "Optional Cloud-xx Server URL" can be specified if your network can be reached using a URL instead of an IP address. This field MUST be left blank in order to use the numeric xxx.xxx.xxx.xxx style IP addressing.

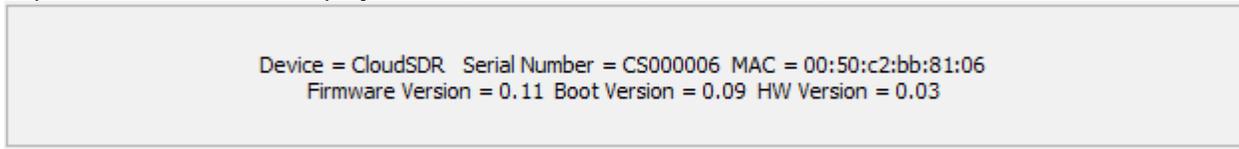
4.2.2 CloudSDR Setup

The following menu is displayed after selecting the CloudSDR radio. Press “OK” to make your changes take effect or cancel to abort any changes. After changing some of the parameters, the Cloud-xx will recycle so it may take several seconds before it is back on line.

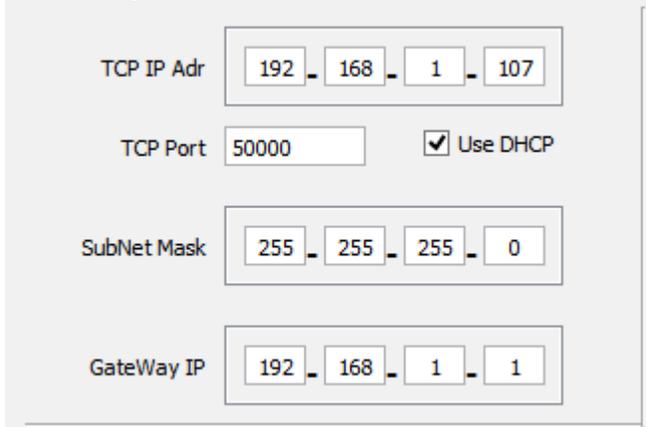
The screenshot shows the 'CloudSDR Setup' window with the following configuration details:

- Device Information:** Device = CloudSDR, Serial Number = CS000006, MAC = 00:50:c2:bb:81:06, Firmware Version = 0.29, Boot Version = 0.09, HW Version = 0.03.
- Network Settings:** TCP IP Adr (192, 168, 1, 60), TCP Port (50021), SubNet Mask (255, 255, 255, 0), GateWay IP (192, 168, 1, 1). Includes checkboxes for 'Use DHCP' and 'Use Alternate Data Destination UDP Address'.
- UDP Settings:** UDP Adr (192, 168, 1, 234), UDP Port (50000), and a 'Firmware/FPGA Update...' button.
- UART Operational Mode:** Radio buttons for Normal, Activity Monitor, and Debug (selected).
- Audio Monitor:** Monitor Off (dropdown).
- External Ref:** Ext Ref Off (dropdown).
- Cloud-xx Description:** Cloud SDR HF and VHF.
- Cloud-xx Description URL:** (Empty field).
- Cloud-xx Operation Mode:** Radio buttons for I/Q Mode and Cloud Mode (selected).
- Optional Cloud-xx Server URL:** (Empty field).
- List Server Domain:** sdranywhere.com.
- List Server Script Path:** /cloud/put.py.
- Connection Time Limit:** 0-255 Minutes (0=No Limit), currently set to 0 Min.
- My Location (decimal degrees 32 char max):** Latitude (33), Longitude (-84).
- Receive Password:** (Empty field, note: Leave Blank for No password).
- Required Transmit Password:** password.
- Footer:** Click Link for Cloud Network Status/News sdranywhere.com and an OK button.

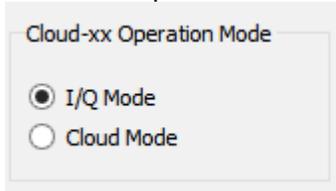
The top information window displays model, serial number, MAC address, and version information.



The Network parameter area of the menu is used to select DHCP or manually enter the network parameters.

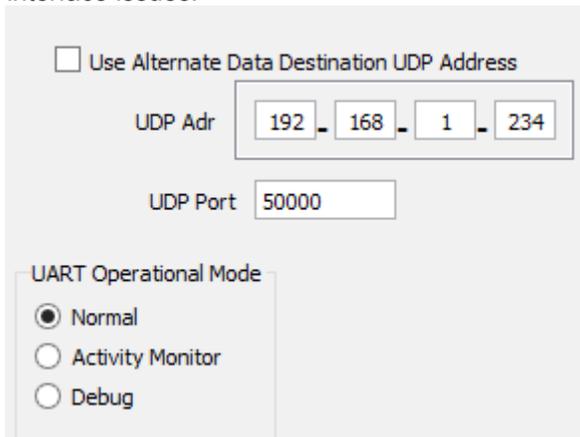


The Cloud-xx Operation mode section is used to select one of the two basic operation modes of the Cloud-xx.

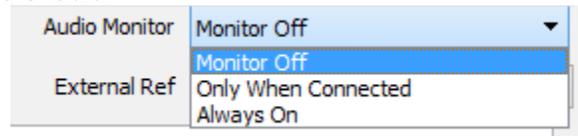


This area of the menu is used to select an alternate UDP data address for the I/Q Mode. This is not very common so should be left non-selected. The UART Operational mode allows selection of the use of the RS232 port on the CloudSDR.

Normal mode should be selected if used as an interface to an external radio in panadapter applications. Activity Monitor mode is used when in Cloud mode to monitor remote connections. Debug mode is useful for software developers debugging interface issues.



The audio monitor function is only for the cloud mode and allows the user to select to use the audio monitor on or off or only when someone connects to the radio.



The External 10MHz reference can be enabled or disabled from this menu.

The rest of the parameters are used when the CloudSDR is in the Cloud Mode.

The image shows a configuration dialog box for CloudSDR. It has several fields and options:

- 'Cloud-xx Description (150 char max)' with the value 'Cloud SDR HF and VHF'.
- 'External Ref' dropdown set to 'Ext Ref Off'.
- 'Cloud-xx Description URL (150 char max, omit "http://")' field.
- 'Cloud-xx Operation Mode' with radio buttons for 'I/Q Mode' and 'Cloud Mode' (selected).
- 'Optional Cloud-xx Server URL (80 char max)' field.
- 'List Server Domain (80 char max)' with the value 'sdranywhere.com'.
- 'List Server Script Path (80 char max)' with the value '/cloud/put.py'.
- 'Connection Time Limit' with a spinner set to '0 Min'.
- 'My Location(decimal degrees 32 char max)' with 'Latitude' set to '33' and 'Longitude' set to '-84'.
- 'Receive Password (16 char max) Leave Blank for No password' field.
- 'Required Transmit Password (16 char max) Blank not Allowed' with the value 'password'.
- 'Click Link for Cloud Network Status/News sdranywhere.com'.
- 'OK' button.

One can set a text string to describe your Cloud-xx that can be seen by remote clients.

An optional URL can also be entered that points to a personal web page for further information on your radio.

The List server Domain and Script Path is specified that will post this Cloud-xx's External IP address and other information to a central List server that Remote client software can use to create lists of available Cloud-xx radios.

Passwords can be specified if you want to limit access to your radio.

Location information can also be entered if desired. By limiting the precision of your coordinates, you can protect the privacy of your exact location.

A connection time limit can be specified for the Cloud mode to limit user connect times.

The "Optional Cloud-xx Server URL" can be specified if your network can be reached using a URL instead of an IP address. This field MUST be left blank in order to use the numeric xxx.xxx.xxx.xxx style IP addressing.

4.2.3 Cloud-xx Firmware Update

The CloudSetup Program can be used to check the versions of and update the firmware code that resides within the Cloud-xx radios.

The Cloud-xx radios contain several different sets of microprocessor firmware and FPGA code and each set can be updated individually as new features are made available.

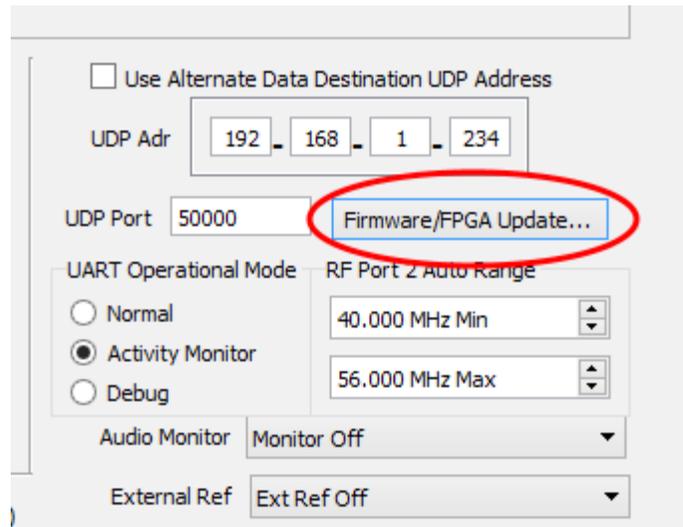
Currently there are two firmware images for the Cloud-xx. One is for the IQ mode of operation and another is for the Cloud remote mode of operation.

These images are referenced as App Firm 0(or rom0) and App Firm 1(or rom1) respectively.

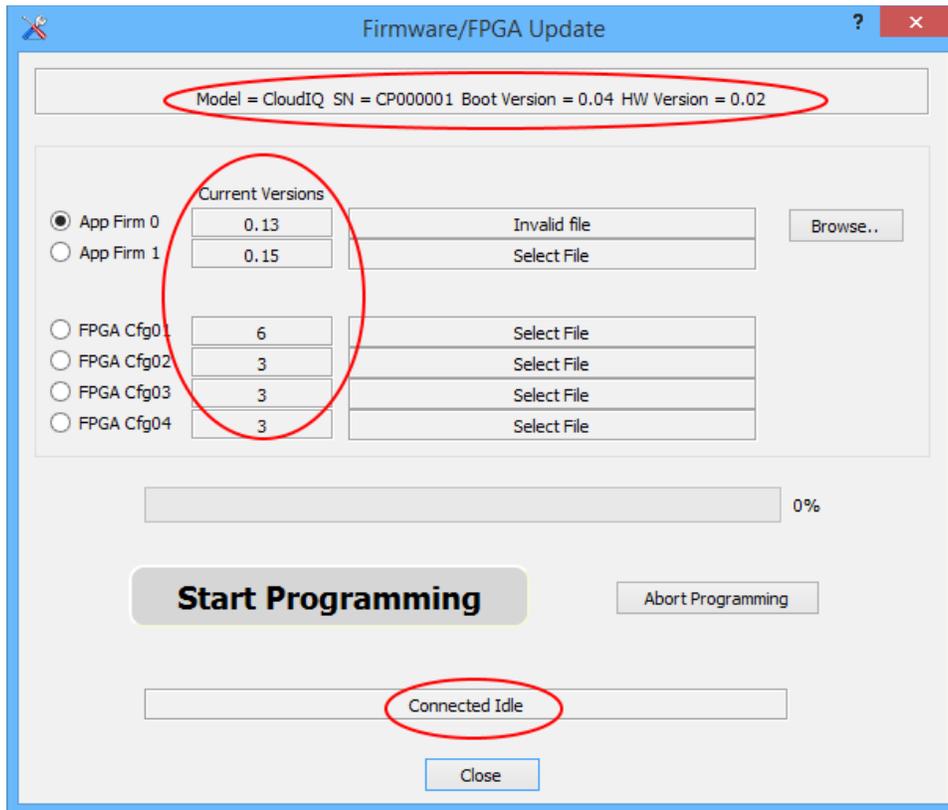
The FGPA has four different loads and are described as follows:

- Config 01 is used in the IQ mode for continuous data streaming up to 1.5MHz BW data.
- Config 02 is used for spectrum display only IQ mode from 2.5 to 15MSPS
- Config 03 is used for the Remote Cloud Mode
- Config 04 is used for the RAW 16 bit A/D Capture mode to display 61MHz of spectrum

To invoke the Cloud-xx code update menu, select your Cloud radio using the CloudSetup program then press the “Firmware/FPGA Update...” button shown below.

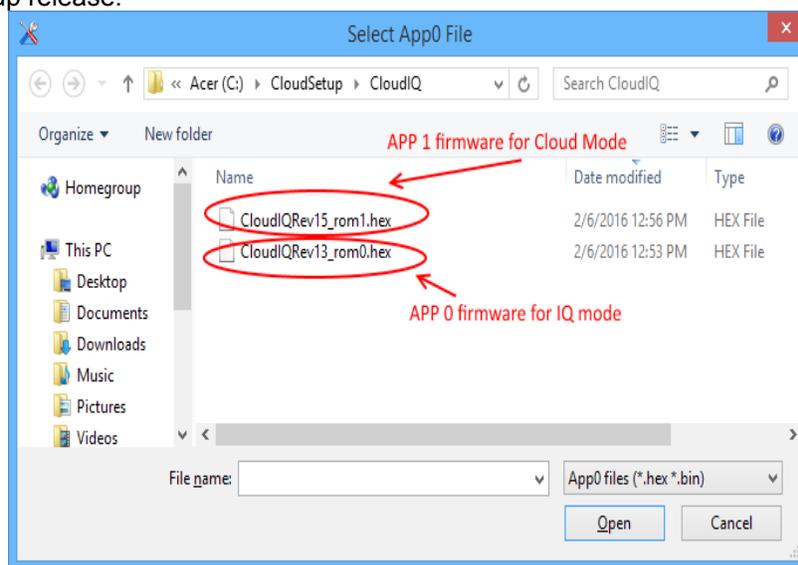


The following menu should appear. It may take 10 -20 seconds for the menu items to fill in as the radio may reset itself to the IQ mode of operation in order to obtain the all current code versions and allow for code updating.

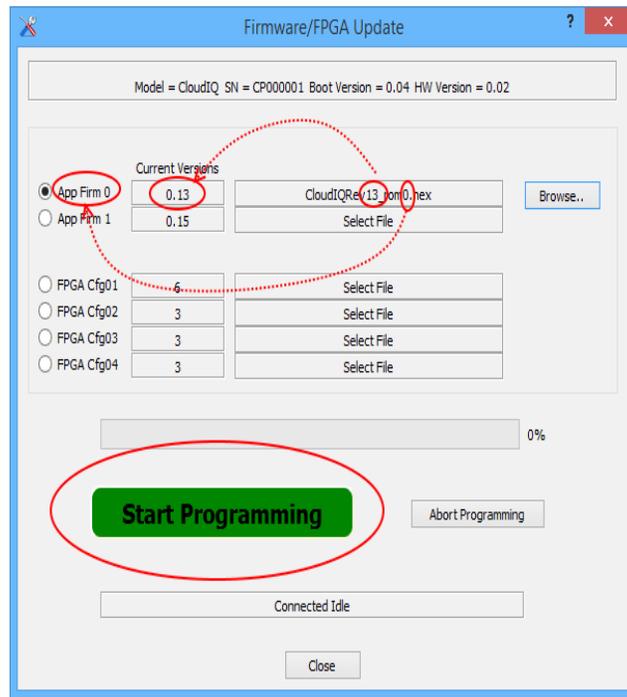


It should display the connected cloud-xx model, serial number etc. at the top. Along the left side it should display all the current revisions of firmware and fpga code. At the bottom should show the connection status.

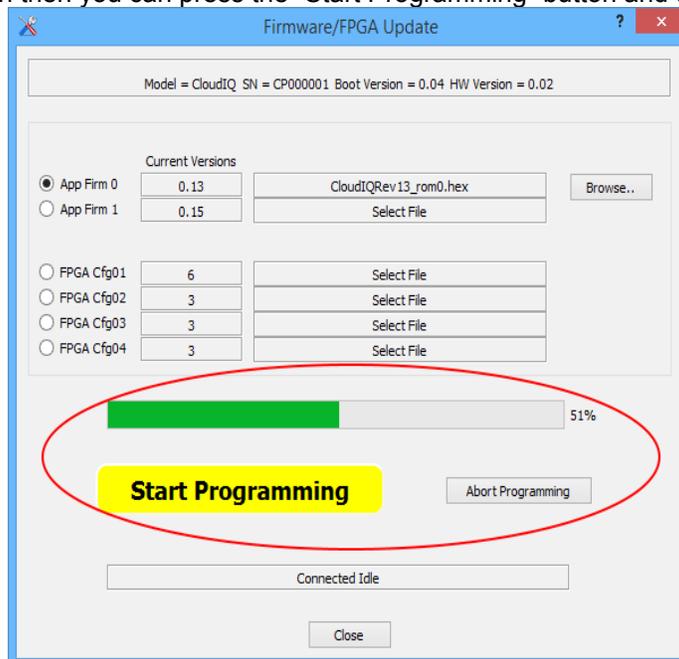
Initially there are probably not any files selected for updating the various code images. By selecting each code item then pressing the "Browse" button, the file menu should open up and allow you to select the latest firmware or fpga code available in this CloudSetup release.



After selecting the correct file for the App firmware the file should show up in the menu and the “Start Programming” button should turn green. If the versions match there is no need to update that particular code.

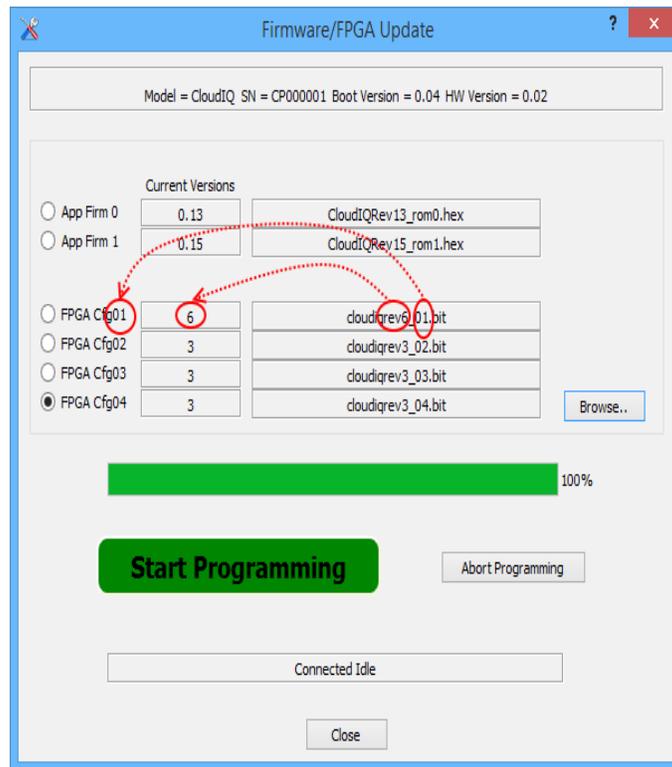


If the file is a newer version then you can press the “Start Programming” button and update that code.



Wait for it to finish and then wait for the Cloud to reset and reconnect. After about 10-20 seconds or so it should reconnect and display the new current version. Be patient and wait for it to finish resetting and reconnecting before exiting this menu. If you are using DHCP to get an IP address, this could take a while.

Repeat this procedure for each code item until all of them are at the same revision level.



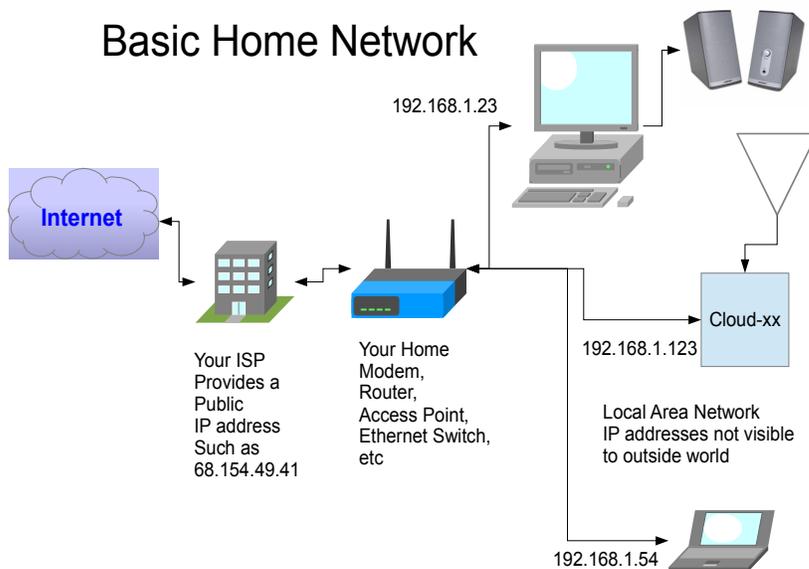
When finished and the radio is reconnected, press the Close button and exit the menu. If you were initially in the Cloud mode then the radio should reset back to this mode automatically. If not you may have to manually set it back to the mode you wish.

5. Network Setup for Remote SDR Internet Access

In order to connect to a Cloud-xx radio remotely over the Internet, a better understanding of your particular network is required.

5.1. Network components

- The Internet is the 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, Firewall, 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.



There are several problems to get an outside Client to be able to connect and use your Cloud-xx that is located on your local network.

5.1.1 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.

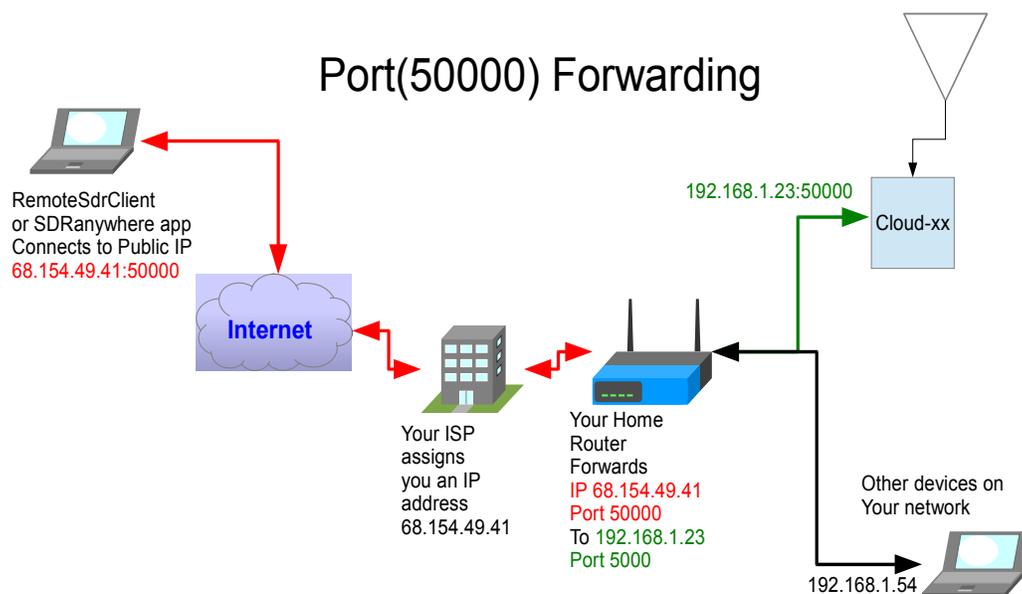
- Manually find your public IP address by opening up your router's web setup program.
- Bring up one of the Web sites that tell you what it is such as [Find My Public IP Address](#)
- Sign up for one of the free Dynamic DNS services that register a unique Domain Name to you and it is mapped to your Public IP address. This requires running a simple client that is supplied by the service on a PC 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 RemoteSdrClient or SDRanywhere client 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.

5.1.2 Accessing a PC From Internet

The next problem is how to give the client access to the particular Cloud-xx radio.

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 Cloud-xx radio. 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 Cloud-xx based only on the port number. It is important to assign a unique port number to the Cloud-xx radio so the router will be able to route to correctly.



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 Cloud-xx to the local IP address Cloud-xx. For example, say your Cloud-xx is on IP address 192.168.1.23 and port number 50000. You will need to forward port 50000 to IP address

192.168.1.23. You only need to 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/>

5.1.3 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 Cloud-xx radio 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.

5.1.4 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.

6. Change Log

0.01 Initial Release

0.02 Updated screen shots

0.03 Added firmware/fpga code update action