

Radio Diagnostics Basics

August 2015

RTC Manufacturing

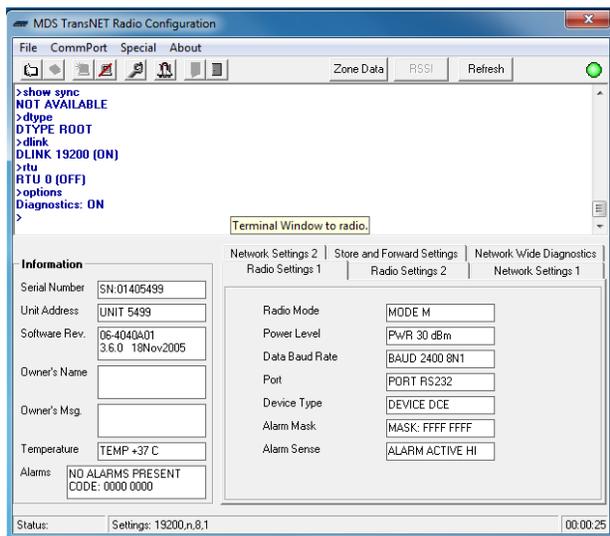
Background:

This document is intended to help a technician debug a radio network. Specifically a location that is not responding to read or write command in CPR V9

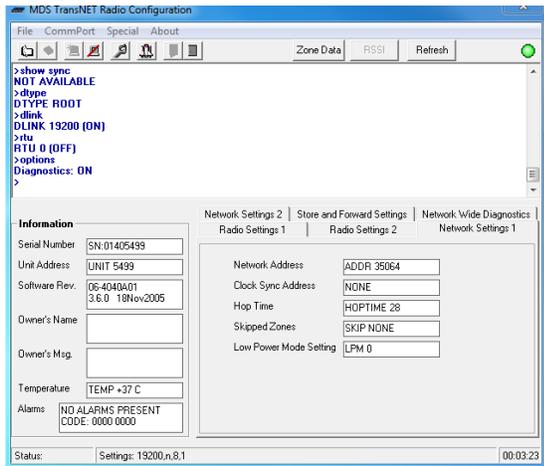
The website rtc-traffic.com has support files for MDS radio. These files show you how to setup a radio and initialize the MDS program. This document assumes you already can do these tasks. This document is to show one how to tune a radio at a location that is not working correctly.

Master Radio:

You will need to know your 'Network Address'. This is best found at the master radio. Connect to the radio using the MDS software. You will see this. Note the radio mode is set to MODE M.



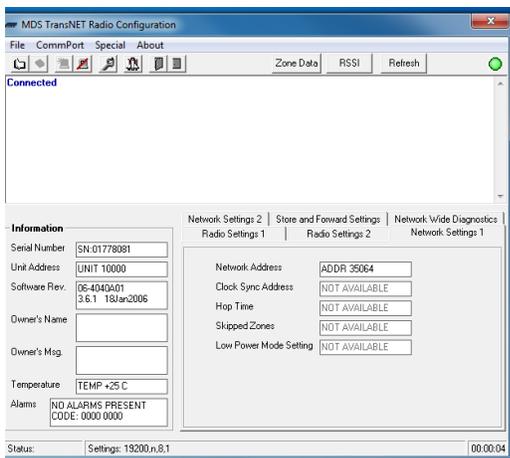
Click over to the tab 'Radio Settings 1' to see the below.



Notice in our example here the Network Address is 35064. Every single radio in the network will have to have this Network Address. There are no exceptions, so it is the first thing you check.

RSSI measuring

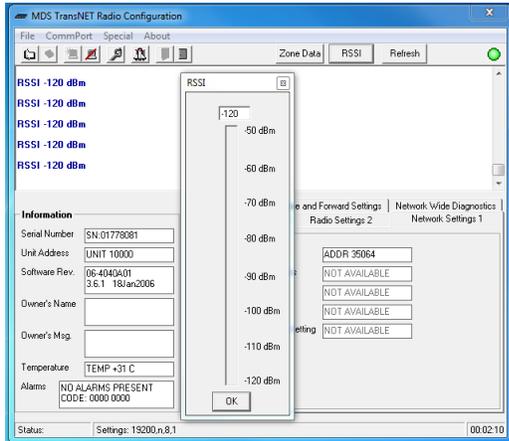
Go to the location and plug in to the radio there. Find the tab 'Network Settings 1'. Make sure the network address is the same as your master. Likely it is, but it is a good thing to check. Note in example below the Network ID is correct.



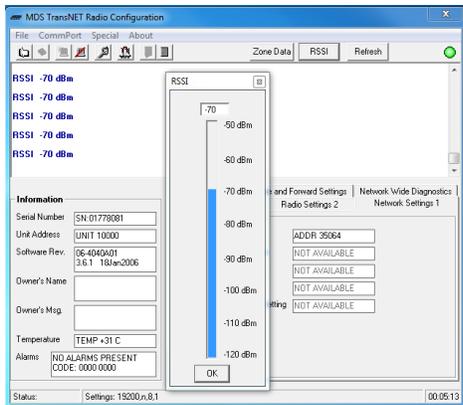
The next thing to check is the signal power to the radio. This is done by pushing the button labeled 'RSSI' at the top of the program. When you do a second window shows up indicating the signal

strength.

Notice in this example the RSSI is measured as -120. This means you have no signal. Also on this radio the sync light would not be on.



Notice in the example below the radio now has RSSI equal to -70. This is because the antenna was plugged back in before measurement.



XADDR

XADDR is the extension address of a radio.

There are three types of radios in your system

Master Radio. As the name implies the master radio of the origin of all communications, there can only be one Master radio. It typically has the XADDRESS of 0. Although this does not have to be so.

Extension Radio. Often called a repeater an extension radio is a radio that listens and repeats the message for radios further away. There can be 31 of these. Each repeater should have its own XADDR

and they are typically from 1 to 31. No duplicates allowed, and don't name it the same as the master radio.

Remote Radio. A remote radio is a radio at the end of the line so to speak, it has no extension address.

Understanding Sync Light

There is a sync radio light on your radio.

If it is the master radio it is always on and means nothing.

If it is an extension or remote radio then the sync light means the radio has a connected path back to the master radio. This path may be direct to the master, or through a series of repeater/extension radios to the master.

No radio will ever connect to an extension radio that does not have itself a connected path back to the master.

A radio cannot work without a sync light being on. Having said that, it is important to understand that the sync light being on does not guarantee the radio will work. The sync light on simply means the minimum specification of radio signal has been met. This minimum level will work for short commands, but can, and often will fail with larger commands such as programming or reading a time switch.

It is often reported for a location that someone can manual command it on and off yet it fails in reading or writing.

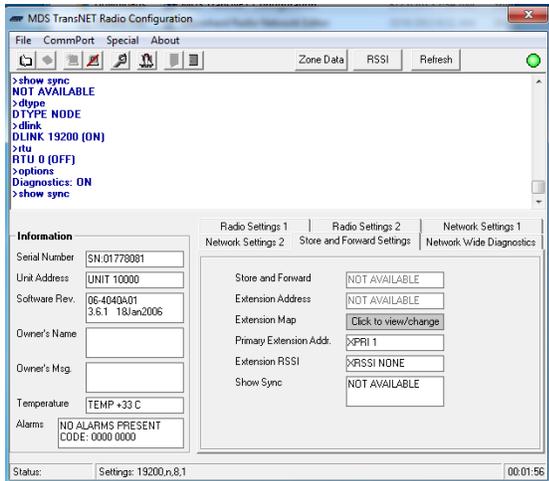
Determining connection path to Master

When synced the radio has a path back to the master radio. This is precisely what Sync means as outlined above. When the sync light is on the radio is connected to the master radio through a series of connections or possibly just to the master itself.

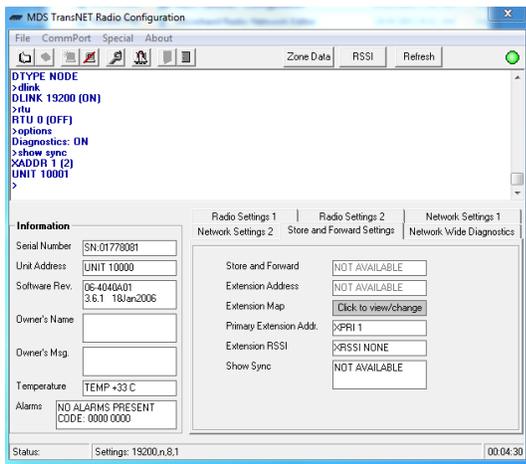
The MDS radio software gives us the ability to determine who the radio is connected to and how many connections it has to get to the master radio.

The power level it has to its connection is what we measured in the RSSI section above.

The path to the master is done using the 'Show Sync' command. This is done inside the command widow to the radio as shown below. Note in the picture the phrase 'show sync' has been typed after the > character on the screen.



After you hit enter you see the following.

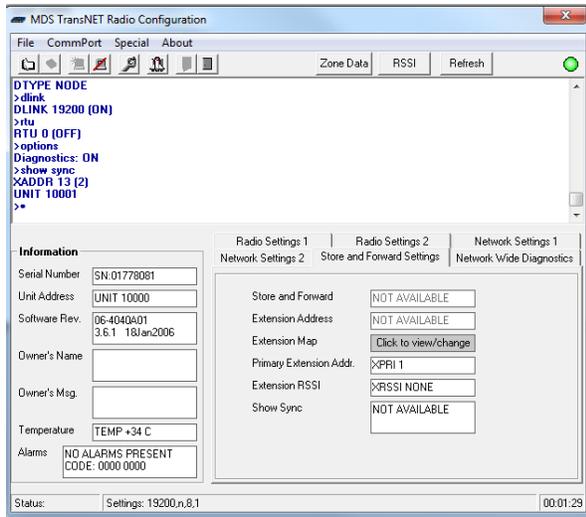


Notice the return from the show sync command was

XADDR 1 (2)

Unit 10001

This tells you that the XADDR of the radio this is connected to is has its xaddr set to 1 and there are 2 connections to the master radio. In this case, 1 connection to the extension radio and the second connection to the master radio.



Notice the one listed above the radio is connected to XADDR 13 again with 2 hops to the master.

In the test example below you see again the radio is connected to XADDR1, but this time there are 7 hops to the master. This can happen and often has bad results. See the sections below for the remedy.

XADDR 1 (7)

Unit 10001

The bottom line is that at any radio you can tell three things about its connection to the master.

- 1) The RSSI signal to the radio immediately upline.
- 2) The XADDR of the radio upline.
- 3) The number of radio hops this connection is taking to the master.

Tuning XADDR for Optimal Connection

Each radio has the ability to connect to any extension radio that has a connection to the master, or the master itself. This sounds like a good thing when in fact it is not.

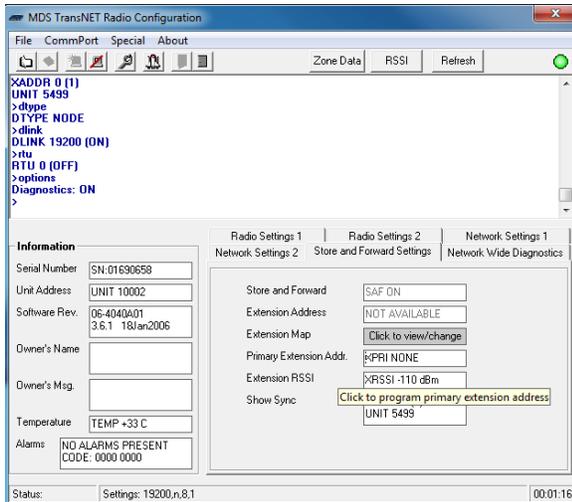
The radio will connect to the first radio it detects that has a path to the master as mentioned before. The problem arises when the radio picks a connection to an extension which has a poor signal while possibly ignoring one with a good signal.

Say you have a radio system with 2 extension radios XADDR6 and XADDR13.

You can have a radio with a -95 RSSI to XADDR6 and a -102 RSSI to XADDR13. Clearly in this case you want to make your radio go to the XADDR6 and ignore ADDR13. The good news this is easily done.

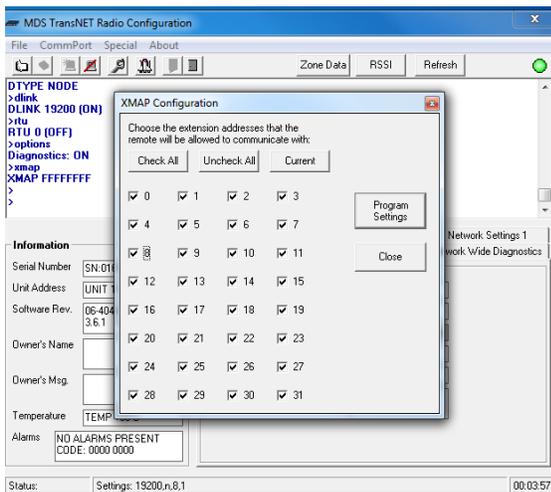
Since we know how to measure the RSSI all we need to do is learn how to force a connection to a specific XADDR. Once you have done this you can measure the RSSI and be a little more selective about who it can connect to.

After connecting to radio go to 'Store and Forward Settings' tab. You will see something that looks like this.



The setup of your radio if it is a remote radio will look like this. Notice Primary Extension Addr. Is set to NONE. This means there is no single XADDR it prefers to connect to.

Notice the Extension Map box. To the right of it is a button that says Click to View/change. Go ahead and click this, it will show you the following.



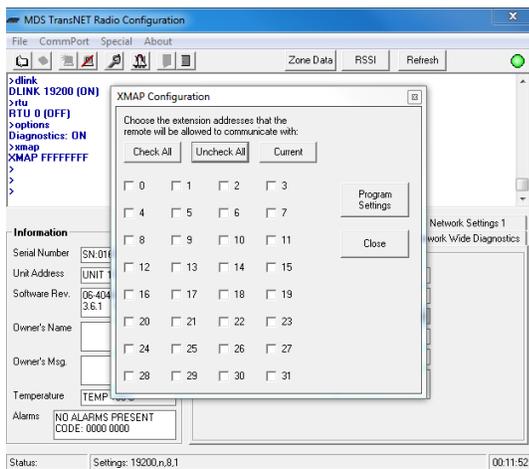
Notice there are 32 checkboxes. One for each XADDR possible.

Notice they are all checked in this example. This means the radio can connect to anyone it wants to.

The radio it connects to is totally random and has absolutely nothing to do with signal quality. The only requirement is that it can see the master. Whether or not it sees it through a series of poor connections is a matter of luck.

The purpose of this section is to take the luck out of it and tune the radio to only talk to good XADDR's.

Click the button uncheck all. This will do as it is labeled. It will then look like this.



Then click the button 'Program Settings'. This will write them down to the radio. As soon as you push this button the form closes. I typically reopen it to see if it really did it.

In my example here there are three XADDR that can be connected to. The procedure is to enable each one and measure the RSSI. Write down the RSSI for each XADDR for your records and for use in this procedure.

So for this example I want to know the RSSI for XADDR = 0, XADDR = 6, and XADDR = 13.

The procedure is to:

- 1) Change the Primary Extension Addr field to 0. Wait one minute and measure the RSSI. Write the number down.
- 2) Change the Primary Extension Addr field to 6. Wait one minute and measure the RSSI. Write the number down.
- 3) Change the Primary Extension Addr field to 13. Wait one minute and measure the RSSI. Write the number down.

Once you have the three RSSI you know where to plug the radio to.

So breaking down each step.

- 1) Change Primary Extension Addr. To 0. This is done by clicking in the field that now says XPRI NONE and changing this to 0. You don't have to type the XPRI part, just type 0.
- 2) Now click the RSSI button and look at the DB level. It will likely read -120 for sometimes as long as a minute. If it still reading -120 after a minute then you may need to cycle power to the radio and check again. It is best before shutting the radio off to exit the MDS code, otherwise it will annoy you with errors for a long time.
- 3) Click OK on the RSSI form .
- 4) Repeat 1 – 3 for XADDR = 6.
- 5) Repeat 1 – 3 for XADDR = 13.

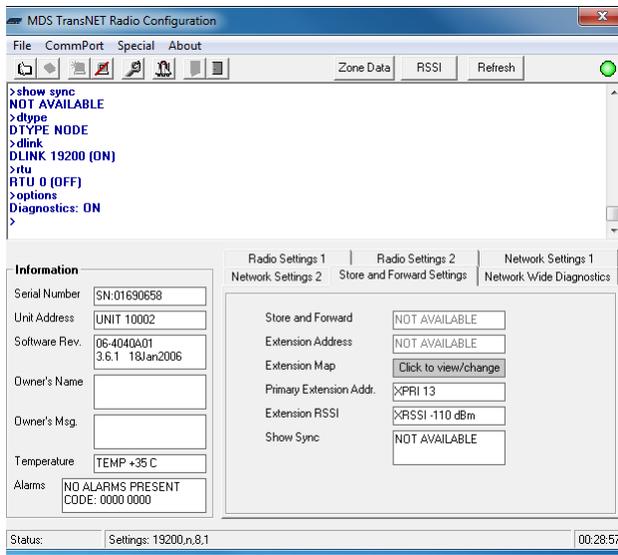
You will end up with a signal level for each XADDR in your system. The tuning of the radio is simply making it ignore any radios that the signal level is worse than -95. Mind you -96 is worse than -95.

Say for our example I had the following table created.

XADDR	RSSI
0	-101
6	-94
13	-78

I would want the Primary Extension Addr. Set to 13. I would want XADDR = 6 to be able to be spoken to if 13 was not available. I would not want it to connect to XADDR0 under any circumstance.

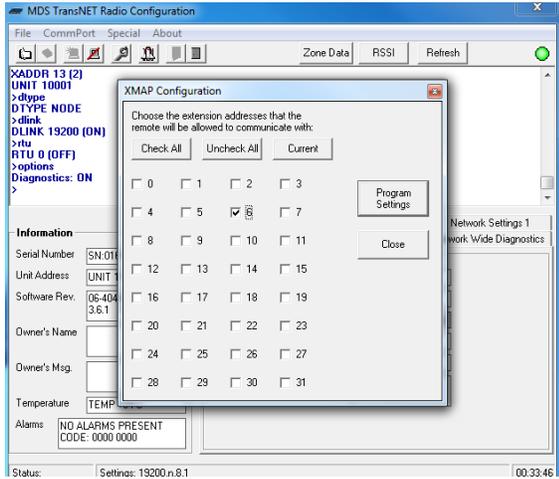
To do this you do the following. Put the number 13 in the text box opposite Primary Extension Addr. It will look like this. This tells our radio that it should first look for the radio with XADDR 13 ignoring all other radios on the network. If it finds it, it will connect, if not it will look elsewhere.



So now we tell the radio which other radios it can try to connect to. This is done in the Extension map. Push the button opposite the Extension Map. Text. You see the same map we saw earlier.

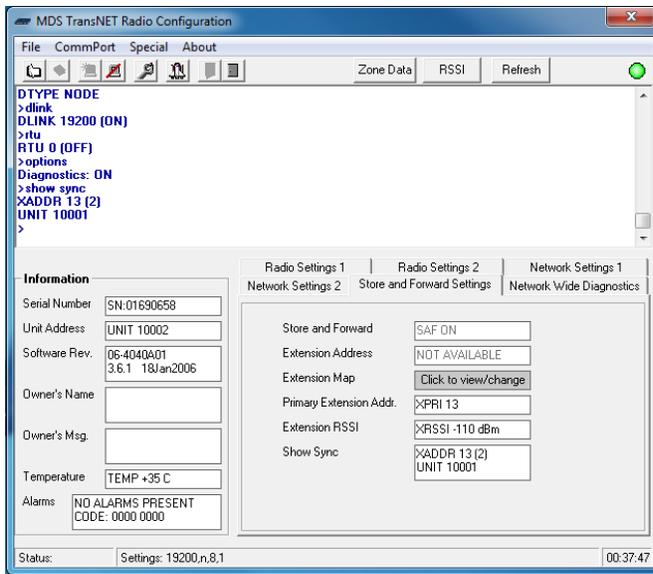
Notice in our example nothing is checked this is because earlier we unchecked them all. If the radio were left like this it would try the XPRI, if it cannot find it, it would give up. We want our radio to try to connect to 6 as we see this RSSI is alright. We do not want it to connect to 0 as the signal is no good.

To do this we check the box with a 6 next to it and leave all the others unchecked. See below.



At this time the radio does not have this information; to send it to the radio you push the Program Settings button. MDS decided as soon as you push this button you close the form. So I open it back up to assure I got the right value. Go ahead; if it worked you will see just what you have above.

So in our example case I have told it to first try 13, and then if it is not there go ahead and connect to 6. I did a show sync command to see the result. It is below.



Notice the result from the show sync command is

XADDR 13(2)
UNIT 10001

In our example here the radio it is attached to is XADDR 13 and it has two hops to the master.

If I unplug XADDR 13 then our radio will try to connect to XADDR6. It just did after I unplugged XADDR13.

Extension Radio Strategy

Typically in a radio system there are a few extension radios that make geographic sense. Often times they have time switches associated with them sometimes they do not.

In our example imagine two extension radios XADDR6 and XADDR13 both being on hills on the opposite sides of town. Lets us further say the master sits right in the middle.

Typically you would not want repeater XADDR6 to connect to the master through XADDR13 as the master is much closer in our example.

Same things for XADDR13, you would not want it to connect through XADDR6.

For this contrived example you set XPRI = 0 for radio at XADDR6. You also uncheck all XADDR in the Extension map. It forces this repeater to only talk to master ignoring all other repeaters.

You do the same setup for XADDR13.

In most situations once you have constrained each repeater to only connect to radios with signals better than -95 radio problems disappear.

You may have to fine tune other minor repeaters in the system the same way. There also may be a few remote radios you have to tune a bit as well.

In General this procedure works.

- 1) Tune each repeater/extension to only connect to master or other repeaters that have the best signal. I set XPRI to the best signal and only allow in extension map those with the best signals.
- 2) Do the above for all major repeaters in the system. Mind you major repeaters is not an MDS term, I use it to mean the repeaters you have throughout town on hills, water towers or other geographic places.

- 3) Read all the clocks and denote the ones that do not communicate. Do this over a few days time to get a pattern of those not talking well.
- 4) Once you have this table made up visit the problem locations and tune them as you did the repeaters above.