

A TR log linux port

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1 Introduction

TR log or TR was written by Tree, Larry Tyree, N6TR. It was written for PCs running DOS. It continued to work fine running versions of Windows based on DOS, i.e. Windows 95, 98, ME etc., but does not run without modifications under modern multitasking multiuser versions of Windows that are based on Windows NT, and obviously will not run natively on unix based operating systems like linux or Mac OS X.

For many years I have run TRlog under linux using dosemu, a program that runs a version of DOS in linux. While this works for the most part, the timing for sending CW requires taking care that dosemu gets high priority, and even so occasionally poor cw is sent. Getting a sound card working is difficult, and the whole thing is a ugly.

In November 2011, I asked Tree if he would be willing to let me try to port TR log to linux. He very generously sent me the complete source code to TR log version 6.76, along with the comment “I suppose I can zip up the source code – but I think you are nuts!”

TR log is written in Pascal. In particular, I learned that it is written in Borland Pascal 7.0. Happily, Free Pascal, available at <http://freepascal.org>, is an excellent multiplatform pascal compiler that supports nearly all the Borland Pascal 7.0 features. This made porting the code much less painful.

2 Goal

Please realize, that my goal was to port the code to run on modern hardware with a multitasking multiuser operating system while doing the least amount of work. Therefore I decided to run TR log in a terminal window that would look and work like the DOS version of TR.

I have added essentially no new features. I have tried to remove as few features of the DOS based TR log as possible.

3 My tests

I have tested this code only on my linux systems which all run a recent version of Slackware, mostly Slackware 13.37.0, and all run the fairly lightweight xfce desktop environment. There are many features that I have not tested. Most of these should work since I have not changed Tree’s code intentionally.

4 Quick start

1. Download the latest trlinux-rN.NN.txc, where the N.NN is the version number.
2. Untar this in a convenient location at the command line

```
tar -xJf trlinux-rN.NN.txc
```

3. In the trlinux-rN.NN/files subdirectory find the Xresources file. Include these lines in the .Xresources file in your \$HOME directory, (or create this file if it doesn't exist). You can run at the command line

```
xrdb -merge .Xresources
```

to load this the first time. It should be automatically reloaded when you log in.

4. Test that this works with the commands

```
xterm -class DosTerm
```

and

```
xterm -class BigDosTerm
```

Feel free to change the font specified in the .Xresources file for these to get a convenient size. The DosTerm should be 80 columns and 25 rows, and the BigDosTerm 80 columns and 50 rows.

5. All of the files that you need to run TRlog are in the subdirectory trlinux-r0.01/log. Place these in any convenient directory (or leave them where they are). I will call this directory path-to-trlog. The executable name is then

```
path-to-trlog/trlog
```

since **tr** is already a system utility in linux/unix. Feel free to put the directory path-to-trlog in your PATH environment variable to reduce typing.

6. Start a DosTerm with

```
xterm -class DosTerm
```

Change to a convenient empty directory, and start Trlog, for example

```
cd
mkdir trtest1
cd trtest1
path-to-trlog/trlog
```

You should get the prompt

Do you want to step through setting up a new contest? (Y/N) :

answer Y, and choose a contest – try CQWW to test things out. Give your call and choose color monitor when prompted. *Answer no to all other questions.* The ports all have different names under linux, and I have not changed the set up routines.

7. You should have a trlog screen in the xterm. Try logging a few contacts.
8. If this works you're essentially ready to go. See the later sections on how to set up serial and parallel ports, etc.

5 Setting up TR log on linux

TR under linux should be run as a normal user. I run it under my usual login account. That user/account should have permission to read from and write to any devices you use to interface to your rig.

Since linux is case sensitive, Tree wrote the file names in the source in all capitals, and all the commands in the LOGCFG.DAT file are converted to uppercase before interpreting them, all file names used by TR should be in capital letters. So, for example, the default file names will be LOGCFG.DAT, LOG.DAT, LOG.TMP, RESTART.BIN, BANDMAP.BIN etc.

6 Window manager hot keys

Most window managers grab various function key presses before they are sent to applications. Since TRlog uses all the combinations of function, ctrl-function, alt-function, shift-function, you should turn off the window manager hot keys (or at least the ones you want to use in TRlog). How to do this varies according to the window manager you run. For example for xfce go to Settings->window manager->Keyboard, and clear the shortcuts that you want to use under TRlog. In most window managers, you can set up different profiles so that you can have one profile for normal computing when you want the hot keys to work, and another when you want to run TRlog.

7 PC speaker

Under linux, the PC speaker is accessed through /dev/console which, for security reasons, can only be read or written by root. If you want to use the PC speaker for beeps like in DOS, you must run the linux trlog executable as the root user. As an alternative, you can use the beep soundcard enable command described later. Nothing else should require root permissions!

8 New configuration commands

The main change to the LOGCFG.DAT is that since the program now goes through the standard drivers, the serial and parallel port devices must use linux device names. Whenever a port number was given in the DOS TR configuration command, a full device path needs to be given under linux. *These are case sensitive and must match the linux device names.* Here is an example of the lines that I use for radio control and keying of my Elecraft K2 using a usb serial port adapter. The adapter comes up under linux as the device /dev/ttyUSB0.

```
keyer output port = serial /dev/ttyUSB0
radio one type = k2
radio one control port = serial /dev/ttyUSB0
radio one baud rate = 4800
```

A similar set up on my shack computer which has hardware serial and parallel ports uses:

```
keyer output port = parallel /dev/parport0
radio one type = k2
radio one control port = serial /dev/ttyS0
radio one baud rate = 4800
paddle input = parallel /dev/parport0
```

The serial port device names are those set up by the kernel. The parallel port names are the device names reported by libieee1284. Usually these will be /dev/parport0, /dev/parport1, etc.

9 Port permissions

You will need appropriate permission to read and write to the ports. The simplest way is to add the username of the account to the groups that own the ports. For example, when plugging in a USB to serial port adapter on my Slackware 13.37.0 system, the device is /dev/ttyUSB0 which has permissions from `ls -l /dev/ttyUSB0`

```
crw-rw---- 1 root dialout 188, 0 Feb 22 22:12 /dev/ttyUSB0
```

which is owned by the dialout group. I added my user name (schmidt) to that entry in /etc/group

```
dialout:x:16:uucp,schmidt
```

You must log out and log back in for this to take effect.

10 K1EL Winkeyer support

Initial limited support of the K1EL Winkeyer has been added. I have done limited testing with my Winkeyer2 v2.3 chip. It should support two radios, both with ptt, and a single sidetone if desired.

Older version 1 chips are supported, but since they have only two output pins, I have chosen to use these for keying the two radios. No PTT or sidetone is available with these chips. Since you can order a WinKeyer2 chip from K1EL for 11 US dollars, I decided it was not worth more than a few minutes of my time to support the older chips.

There is a new configuration command. Add a line like:

```
winkeyer port = serial /dev/ttyUSB0
```

to your LOGCFG.DAT file, substituting your serial port device that is connected to the Winkeyer for /dev/ttyUSB0 above.

Most of the standard TR commands should still work. Some things that are currently different or should be mentioned (there are probably others)

- The Winkeyer paddle speed is locked to the trlog speed.
- The speed pot on the Winkeyer is ignored. (This is untested since I do not have a speed pot hooked to my Winkeyer2 v2.3 chip.)
- You cannot have a separate paddle sidetone frequency. (Actually, none of the Winkeyer sidetone stuff is tested since I do not have a speaker connected to my Winkeyer2 v2.3 chip.)
- You cannot change the weight in a message using ctrl-x, ctrl-y.
- Speed changes with ctrl-f and ctrl-s should work fine.
- None of the special length dots and dashes work. That is do not use ctrl-p, ctrl-q, ctrl-\, ctrl-v, ctrl-l, ctrl-e, ctrl-d, ctrl-k ctrl-n, ctrl-o, or - in a message.
- During CW, the Winkeyer handles PTT. It does not handle push to talk in other modes. This can be added if there is sufficient interest. The trlog PTT setting are approximately mapped to Winkeyer settings. So Paddle PTT Hold Count is converted to the nearest Winkeyer hang time. PTT Turn On Delay is converted into the nearest Winkeyer leadin.
- Footswitch CW grant does not work with the Winkeyer. This could be added if there is sufficient interest.
- Winkeyer PTT tail time has been fixed at 20 milliseconds.
- Choosing the simulator will disable the Winkeyer and use Tree's original CPU keyer to generate the simulated CW.

To add Winkeyer support, I encapsulated Tree's serial and parallel port keyer object as a class. This made adding Winkeyer support straightforward, however, be aware that this could easily have added bugs to the original serial and parallel port keyers.

11 Bug fixes and upgrades

As mentioned in the introduction, the code base is TRlog version 6.76. I have fixed one bug and added support for newer CTY.DAT with specific call signs.

- I have fixed the 160m bandmap bug – see http://lists.contesting.com/_trlog/2003-10/msg00092.html.
- You should use the CTY.DAT file for TRlog version 6.90 and later which flags individual calls with an equal sign. For example the entry =W9CF(3)[6] shows that I am in CQ zone 3 and ITU zone 6 rather than the default W9 zones 4 and 8. This same entry in the CTY.DAT file for earlier versions is W9CF(3)[6] without the equal sign. The problem with this older version is that W9CF is treated as a prefix and W9CFA through W9CFZ would be flagged as being in zones 3 and 6 too. With the equal sign in front of my call there has to be an exact match.
- The dvp commands can be used to play files. Currently these must be at 44100 Hz stereo, i.e. cd quality audio. They can be wave files, or, if your distribution has compiled ogg support into libsndfile, they can be ogg files. (You can take your wave file temp.wav and encode it with oggenc temp.wav then rename it to CQF1.DVP etc., or just rename temp.wav to CQF1.DVP.) The sound uses the ALSA (advanced linux sound architecture) libraries so the kernel must have ALSA support. By default it opens the hw:0,0 device so the first soundcard will be used. It must support 44100 Hz stereo. You can change the device with the configuration file command like

```
SOUNDCARD DEVICE = plughw:0,0
```

which would open the alsa software plugin for the same device. *Push to talk does not yet work with the dvp commands.*

- If you are not using the dvp files, you can give the command

```
beep soundcard enable = true
```

which will play the pc speaker beeps through the sound card. Again this requires ALSA and 44100 Hz stereo support. Note that, just like the original pc speaker, no shaping is done, so the clicks when using this as a sidetone or with the simulator get annoying quickly.

- Since parallel ports are getting rare, and USB to parallel adaptors don't work very well for non printer applications, I added paddle input on serial ports. This violates the RS-232 standard which defines the two logic levels as positive and negative voltages, while the paddle will only key a positive voltage to ground. But, according to the ARRL handbook, none of the serial port chips used actually require a negative voltage on their inputs to get the correct logic level. Therefore, I have set up the clear to send (CTS) input as the left paddle (normally dot) input, and data set ready (DSR) input as the right paddle (normally dash) input. I pull these inputs to +12 volts through a 10K ohm resistor (the RS-232 standard requires between 3 and 25 volts), and the paddle keys those inputs to

ground. On a DB9 connector they are pins 6 (DSR) and 8 (CTS). Ground is pin 5. It is then possible to have radio control, radio keying, push to talk, and paddle input on a single serial port. I use a USB serial port with the line

```
paddle port = serial /dev/ttyUSB0
```

in LOGCFG.DAT. Probably the two easiest places to get the pull-up voltage are from the rig power supply or use the +5 volt output of a USB port.

- Since the serial ports are using the linux drivers, you should be able to use any baud rate supported by your hardware (up to at least 115200 baud for modern serial ports). Since the linux kernel can buffer up to 4096 bytes, the only caveat is that trlog will have a maximum throughput on the serial ports set by the emulated DOS interrupt which occurs about every 1.7 milliseconds. I believe this should be adequate for any rig.
- Winkeyer support has been added.
- Ultimatic mode has been added. This is free with Winkeyer, it now also works with the original CPU keyer. Add

```
curtis keyer mode = u
```

to your LOGCFG.DAT or use the control-j menu.

12 Things that no longer work

- DVP record/backtrace etc. These can be added, but they are low priority for me.
- DVP PATH has not been implemented. Place the audio files in the current directory with LOGCFG.DAT.

13 Packet using the shell device

The preferred way to use packet is now with the shell device. Use the lines

```
PACKET PORT = SERIAL shell  
EIGHT BIT PACKET PORT = TRUE
```

If you now hit control-b, you will get the usual packet window, but it will now show a shell prompt. You can simply type a command like

```
telnet n7az.net
```

login with your call sign, and type sh/dx or just wait for spots. If you have other software that provides packet filtering, etc., you can use that.

14 Networking with the ncat device

My Slackware distribution comes with ncat installed as a part of the nmap package, (<http://nmap.org/ncat/>). I assume, therefore, that most other distributions will have ncat available. The network is set up so each trlog instance talks to the next, forming a loop just like the original serial port network. That way most of Tree's code can be used without change.

Security disclaimer: I implemented this without any encryption. You should therefore trust the other users on your local network, and the port(s) you choose for the communication should be behind a firewall that does not expose them to the rest of the internet. If you have a real need to use secure sockets, because of networking between distant stations, let me know and I can try to get that set up.

To use ncat networking, the ncat command should be in your PATH. Add a line like:

```
MULTI PORT = SERIAL ncat;12002;shack.myhouse.org:12001
```

or

```
MULTI PORT = SERIAL ncat;12001;192.168.14.27:12001
```

The form is

```
MULTI PORT = SERIAL ncat;localport;nextmachine_ip_address:nextmachine_port
```

If all the trlog instances are running on different computers, then all the ports can be the same number. This should be an unused port number greater than 1024 (since ports below 1024 are privileged). You can check the file /etc/services for the well known port numbers and make sure you are not using any of those.

Trlog will listen on the localport and will send to nextmachine.port on the machine with ip address nextmachine_ip_address. Be sure to notice the use of both semicolons (to separate the different parts of the command string) and a colon (to separate the machine address from the port.)

As an example, if you have 3 computers with IP addresses, shack1.myhouse.org, shack2.myhouse.org, shack3.myhouse.org. You could decide to run ncat on port 12001 on all of them.

The trlog version on shack1.myhouse.org would have the line

```
MULTI PORT = SERIAL ncat;12001;shack2.myhouse.org:12001
```

The trlog version on shack2.myhouse.org would have the line

```
MULTI PORT = SERIAL ncat;12001;shack3.myhouse.org:12001
```

The trlog version on shack3.myhouse.org would have the line

```
MULTI PORT = SERIAL ncat;12001;shack1.myhouse.org:12001
```

15 xterm setup

The xterm terminal emulator for X is distributed with every linux system, so I decided to run TRlog inside an xterm. You can also run it on the linux console, but I have done only minimal testing. TRlog expects VGA sized screens, so you need to set up the xterm with the correct options. These are most easily set in the .Xresources file in your home directory (notice the “.” at the beginning of the file name!). Here is an example which is included in the distribution in trlinux-rN.NN/files/Xresources:

!Use:

```
!xterm -class DosTerm
DosTerm*VT100*background: black
DosTerm*VT100*foreground: white
DosTerm*VT100*font: vga
DosTerm*VT100*geometry: 80x25
DosTerm*eightBitInput: false
```

!Use:

```
!xterm -class BigDosTerm
BigDosTerm*VT100*background: black
BigDosTerm*VT100*foreground: white
BigDosTerm*VT100*font: lucidasanstypewriter-12
BigDosTerm*VT100*geometry: 80x50
BigDosTerm*eightBitInput: false
```

You can then start these with the commands

```
xterm -class DosTerm
```

or

```
xterm -class BigDosTerm
```

You will want to use the BigDosTerm class if you have a band map or visible dupe sheet.

16 Troubleshooting

16.1 Some keys or key combinations don't work

This is likely either some program like a window manager or helper is intercepting the key presses before reaching the xterm, or your xterm version is not sending the standard function key strings.

You can test these as follows:

- It will be convenient to copy the Xresources and xinitrc files from the files subdirectory of the trlog distribution to your home directory.
- Exit X. If you are running a display manager (i.e. you logon through a pretty X display rather than the console login prompt:

login:

you need to do something like:

```
telinit 3
```

as root to enter run level 3 which often is the console login. However, some distributions make run levels 3 through 5 identical – see your distributions documentation and/or check the comments in `/etc/inittab` if this doesn't work.

- Log in at the console prompt. Type

```
ls -l Xresources
ls -l xinitrc
```

to make sure those files are available. Now run a minimal X.

```
xinit xinitrc
```

which is X with no window manager and only a single xterm. In this xterm you can try running `trlog` and see if the function keys work.

- You can also simply type

```
cat
```

in the xterm and press the key combinations that aren't working in `trlog`. The strings that the xterm sends will be displayed (escape is `^[`). Compare these to the expected strings in `xterm.txt` in the `files` subdirectory.

- If `trlog` works in this minimal xterm, then some part of your X installation is capturing the keystrokes before handing them to the xterm. You will have to figure out what this is, and turn it off when running `trlog`. Usually it is the window manager, but other helper programs can capture keystrokes too.
- If your version of xterm is not sending the correct strings expected by `trlog`, you can use the xterm translations property to change them.

16.2 Shared libraries not found

Since this is Tree's source code, he makes the rules. I therefore am only distributing a binary version.

To legally distribute a binary only version of `trlog`, some libraries (e.g. `libsndfile`) can only be dynamically linked. Here is the output of `ldd trlog`:

```

linux-gate.so.1 => (0xffffe000)
libasound.so.2 => /usr/lib/libasound.so.2 (0xb777d000)
libieee1284.so.3 => /usr/lib/libieee1284.so.3 (0xb7773000)
libpthread.so.0 => /lib/libpthread.so.0 (0xb775a000)
libsndfile.so.1 => /usr/lib/libsndfile.so.1 (0xb76f4000)
libdl.so.2 => /lib/libdl.so.2 (0xb76ef000)
libc.so.6 => /lib/libc.so.6 (0xb758c000)
libm.so.6 => /lib/libm.so.6 (0xb7566000)
librt.so.1 => /lib/librt.so.1 (0xb755d000)
/lib/ld-linux.so.2 (0xb7875000)
libFLAC.so.8 => /usr/lib/libFLAC.so.8 (0xb750e000)
libvorbisenc.so.2 => /usr/lib/libvorbisenc.so.2 (0xb7397000)
libvorbis.so.0 => /usr/lib/libvorbis.so.0 (0xb7370000)
libogg.so.0 => /usr/lib/libogg.so.0 (0xb736a000)

```

Check your versions of these libraries if there are problems on your system. These libraries are mostly used for parallel port and sound card access. The trlog executable is linked with an RPATH that points to the lib subdirectory in the same directory as the trlog executable. If your system uses default libraries that differ from the ones above and do not work, you can put alternative libraries in the lib subdirectory. You should then see them dynamically linked if you run `ldd trlog`. The Slackware 13.37.0 libraries work on my system.

17 Using pseudoterminals – Deprecated

This section is now deprecated. You should use the shell device for packet and the ncat device for the multi-op network. The pseudoterminal support does still work.

You can set up packet, multi-op networking etc. exactly as under DOS trlog using serial ports.

An alternative that allows you to connect using standard networking connections – so, for example, you can connect to a packet cluster over telnet, is to use pseudoterminals. You can use either the legacy berkeley pseudoterminals if you have support compiled in your kernel or as of version 0.04, standard pseudoterminals using `/dev/ptmx` etc. Note the legacy Berkeley pseudoterminals have been deprecated, and may not be compiled into your kernel by default. Now that standard pseudoterminals are supported in trlog, you should probably use them.

17.1 Telnet packet with standard pseudoterminals

Here's a minimal LOGCFG.DAT to use a pseudoterminal for telnet packet:

```

MY CALL = W9CF
CONTEST = CQ WW
DISPLAY MODE = COLOR
PACKET PORT = SERIAL ptypacket
EIGHT BIT PACKET PORT = TRUE
BAND MAP ENABLE = TRUE

```

You can choose any unique name that starts with pty or PTY. I chose the name ptypacket above. Trlog will open the next available pseudo tty master and use it for the serial port. It then opens the file given by the name you used (here ptypacket) and write the slave device name to that file.

I use the following script to fire up trlog (trlog must be in your path)

```
#!/bin/bash
xterm -class BigDosTerm -e trlog &
sleep 2
ptyslave='cat ptypacket'
stty icrnl erase '^h' < /dev/ttyqa
telnet n7az.net < $ptyslave > $ptyslave
```

The first line creates an xterminal of the BigDosTerm class as described above, and runs trlog putting the process in the background. It then sleeps 2 seconds to allow trlog to set up the master end of the pseudotty. The next line reads the slave device from the file ptypacket that trlog creates. Then it sets up the slave end translating carriage returns to line feeds and using ctrl-h as the erase character. The last line starts a telnet connection to the n7az.net telnet cluster.

When trlog opens, you type ctrl-b to get to the packet window, and login to n7az.net. You can type sh/dx to get some spots to start. Close the packet window with another ctrl-b and it should act exactly as a serial port connection to a packet radio cluster.

17.2 Telnet packet with legacy Berkeley pseudotty

Here's a minimal LOGCFG.DAT to use a legacy pseudotty for telnet packet:

```
MY CALL = W9CF
CONTEST = CQ WW
DISPLAY MODE = COLOR
PACKET PORT = SERIAL /dev/ptyqa
EIGHT BIT PACKET PORT = TRUE
BAND MAP ENABLE = TRUE
```

where I have assumed that no other process is using the master /dev/ptyqa. Normally this will be true since most linux codes will use the more modern /dev/ptmx method, but if not, look in /dev and choose a different pty device. Note, you need to have the required permissions to open the device. On my systems, they are owned by root and in the tty group, so including my username in /etc/group for the tty group gives me permission. That is, if my user name is w9cf, then I have a line in /etc/group like tty:x:5:w9cf .

I use the following script to fire up trlog (trlog must be in your path)

```
#!/bin/bash
xterm -class BigDosTerm -e trlog &
sleep 2
stty icrnl erase '^h' < /dev/ttyqa
telnet n7az.net < /dev/ttyqa > /dev/ttyqa
```

The first line creates an xterminal of the BigDosTerm class as described above, and runs trlog putting the process in the background. It then sleeps 2 seconds to allow trlog to set up the master end of the pseudotty. The next line says to set up the slave end translating carriage returns to line feeds and using ctrl-h as the erase character. The last line starts a telnet connection to the n7az.net telnet cluster.

When trlog opens, you type ctrl-b to get to the packet window, and login to n7az.net. You can type sh/dx to get some spots to start. Close the packet window with another ctrl-b and it should act exactly as a serial port connection to a packet radio cluster.

17.3 Multi networking with standard pseudottys

The N6TR multi networking can be set up the same way on two machines with the configuration files below. Assume the first machine has ip address 192.168.0.1 with TRlog configuration file

```
MY CALL = W9CF
CONTEST = CQ WW
DISPLAY MODE = COLOR
MULTI PORT = SERIAL ptymulti
COMPUTER ID = X
```

and the second with ip address 192.168.0.2 and configuration file

```
MY CALL = W9CF
CONTEST = CQ WW
DISPLAY MODE = COLOR
MULTI PORT = SERIAL ptymulti
COMPUTER ID = Y
```

It is convenient (but not necessary) to use the same pty name (here I chose ptymulti) for all of the machines.

Start trlog on each machine. Note the current directory name where the LOGCFG.DAT file. Below I will assume this is \$HOME/radio/multi. In this example, trlog will connect will write out the name of the slave device in the file \$HOME/radio/multi/ptymulti on each machine. Once all the trlog instances are running, you can connect the slave devices together. On machine 192.168.0.1, execute the script in another terminal window

```
#!/bin/sh
nextcomputer=192.168.0.2
nextptyfile=radio/multi/ptypacket
mypty='cat ptypacket'
ssh $nextcomputer "cat > \'cat $nextptyfile\'" < $mypty
```

and similarly on 192.168.0.2 execute

```
nextcomputer=192.168.0.1
nextptyfile=radio/multi/ptypacket
mypty='cat ptypacket'
ssh $nextcomputer "cat > \'cat $nextptyfile\'" < $mypty
```

For more computers, each will need to execute such a command to connect to the next machine in the circular N6TR multi network simulating a serial port connections around the loop. That is for four computers, computer 1 connects to computer 2 which connects to computer 3, which connects to computer 4, which connects back to computer 1.

17.4 Multi networking with legacy pseudottys

The N6TR multi networking can be set up the same way on two machines with the configuration files below. Assume the first machine has ip address 192.168.0.1 with TRlog configuration file

```
MY CALL = W9CF
CONTEST = CQ WW
DISPLAY MODE = COLOR
MULTI PORT = SERIAL /dev/ptyqb
COMPUTER ID = X
```

and the second with ip address 192.168.0.2 and configuration file

```
MY CALL = W9CF
CONTEST = CQ WW
DISPLAY MODE = COLOR
MULTI PORT = SERIAL /dev/ptyqb
COMPUTER ID = Y
```

It is convenient (but not necessary) to use the same master pseudotty device name for all of the machines.

Start trlog on each machine. This will open all the master pseudottys. Now on machine 192.168.0.1, execute the command in another terminal window

```
ssh 192.168.0.2 "cat > /dev/ttyqb" < /dev/ttyqb
```

and similarly on 192.168.0.2 execute

```
ssh 192.168.0.1 "cat > /dev/ttyqb" < /dev/ttyqb
```

For more computers, each will need to execute such a command to connect to the next machine in the circular N6TR multi network simulating a serial port connections around the loop. That is for four computers, computer 1 connects to computer 2 which connects to computer 3, which connects to computer 4, which connects back to computer 1.