



How Can I Speed up my Interactive Connection to NAS?

Virtual Network Computing:

Improving X11 communication
performance over long haul networks



Why is VNC faster than X11?

- **X11 transmits many short messages each with its own overhead (latency).**
- **VNC uses Remote Frame Buffer (RFB) protocol to transmit a block of data and screen coordinates**
- **VNC's own Xvnc process communicates internally with the user's X11 application (Totalview, Tecplot, etc) using sockets or shared memory for better efficiency**



Other VNC Benefits

- **A transmission line disconnect doesn't terminate VNCserver**
 - The user can recover the working desktop upon reconnection
- **VNC desktops can be shared between colleagues and/or consultants**
 - Each user must have a valid NAS user account
 - The “owner” of the desktop provides a VNC password to others to access the desktop
- **VNCviewers are free downloads and run on most desktops/laptops**

Network Security & Convenience



- **Both X11 and RFB lack transmission security**
- **Using ssh to forward/tunnel provides the same security as other ssh traffic**
- **No port/firewall changes: if ssh is already working from one point on the network to NAS, then VNC will also work**
- **Users have a choice of TWM, MWM and KDE desktops that run on Pleiades**

- **Linux distributions often include both the server and the viewer**
 - Ask your admin for the viewer
- **Apple Macintosh users can download “Chicken of the VNC” from Apple’s website.**
- **Microsoft Windows users can download VNCviewers from:**
 - TightVNC
 - RealVNC
 - UltraVNC

Four Steps to Faster Visualization



- 0. setup NAS passthrough**
- 1. ssh connection to a bridge or a pfe node**
- 2. start a vncserver on the node**
- 3. create a tunnel using your ssh connection**
- 4. connect your VNCviewer to your side of the tunnel**



NAS passthrough

- This example `.ssh/config` file provides the means to access NAS systems by providing a connection to `sfe(1/2)` and to a specified NAS host in a single step. For a VNC user passthrough simplifies creating a VNC tunnel.
- Notice that we have X11 forwarding turned off since we won't be using X11 protocol for our VNC connections.
- See <http://www.nas.nasa.gov/hecc/support/kb/entry/232> for detailed instructions

```
art@jazz ~
$ more .ssh/config
#ForwardX11 yes
ForwardX11 no

Host sfe
    # Replace sfe1 by sfe2 if sfe1 is unavailable
    HostName             sfe1.nas.nasa.gov

Host sfe sfe?.nas.nasa.gov dmzfs?.nas.nasa.gov
    ForwardAgent         yes

Host sfe sfe?.nas.nasa.gov dmzfs?.nas.nasa.gov sup*.nas.nasa.gov
    LogLevel             info
    ProxyCommand         none

Host pfe pfe-last pfe.nas.nasa.gov pfe-last.nas.nasa.gov
    HostKeyAlias         pfe1.nas.nasa.gov
    ProxyCommand         ssh -oCompression=no sfe /usr/local/bin/ssh-balance %h

# Add additional hosts to the list below as needed
Host *.nas.nasa.gov lou lou? cfe? pfe? pfe?? columbia2? bridge? sfe pfe pfe-last
    ForwardAgent         yes
    HostbasedAuthentication no
    ProxyCommand         ssh -oCompression=no sfe /usr/local/bin/ssh-proxy %h
    ServerAliveInterval 10m

    # Replace <NAS_login_name> with your NAS username
    User                 alazanof

    # Enabling compression may improve performance for slow connections
    #Compression         yes

    # Uncomment this line if you are using OpenSSH 4.7 or later
    MACs                 unac-64@openssh.com,hmac-md5,hmac-sha1
```



Pleiades VNC startup

- **Start a VNC; in a previously created .vnc directory one can see a couple of log files:**
 - labeled starting with the Pleiades front-end name and the X11 style console number
 - Plain ASCII; can have useful diagnostic info
- **The passwd file contains the user's read/write and read-only passwords (encrypted).**
- **The xstartup file is a customizable script, by default starts up a TWM window**
 - Use script to specify alternative window managers & terminal configuration choices.
- **Issue the vncserver command specifying the geometry of our screen and the “-localhost” option**
 - LCD displays produce their best image at their native resolution (1280x1024, 1920x1200, etc).
 - If you choose a smaller size, you should maintain the same aspect ratio as the native
- **For security, always include -localhost as the last option on the vncserver list**
- **Console number has several purposes**
- **In .vnc after starting the server: can see a .pid file and a new log file for this session**
 - If you can't recall your pfe or console number, the pid file provides both.

```
-bash-3.2$ ls -l .vnc
total 28
-rw----- 1 alazanof scicon 6061 Jan 20 17:02 bridge3:1.log
-rw----- 1 alazanof scicon 4116 Jan 30 18:06 bridge4:1.log
-rw----- 1 alazanof scicon 8 Jan 30 18:02 passwd
-rwxr-xr-x 1 alazanof scicon 212 Aug 18 00:48 xstartup
-rwxr-xr-x 1 alazanof scicon 150 Nov 10 2008 xstartup.orig
-bash-3.2$ vncserver -geometry 1920x1080 -localhost

New 'X' desktop is bridge4:1

Starting applications specified in /u/alazanof/.vnc/xstartup
Log file is /u/alazanof/.vnc/bridge4:1.log

-bash-3.2$ ls -l .vnc
total 28
-rw----- 1 alazanof scicon 6061 Jan 20 17:02 bridge3:1.log
-rw----- 1 alazanof scicon 2025 Jan 30 18:28 bridge4:1.log
-rw----- 1 alazanof scicon 6 Jan 30 18:28 bridge4:1.pid
-rw----- 1 alazanof scicon 8 Jan 30 18:02 passwd
-rwxr-xr-x 1 alazanof scicon 212 Aug 18 00:48 xstartup
-rwxr-xr-x 1 alazanof scicon 150 Nov 10 2008 xstartup.orig
-bash-3.2$
```



Create SSH tunnel for VNC (RFB)

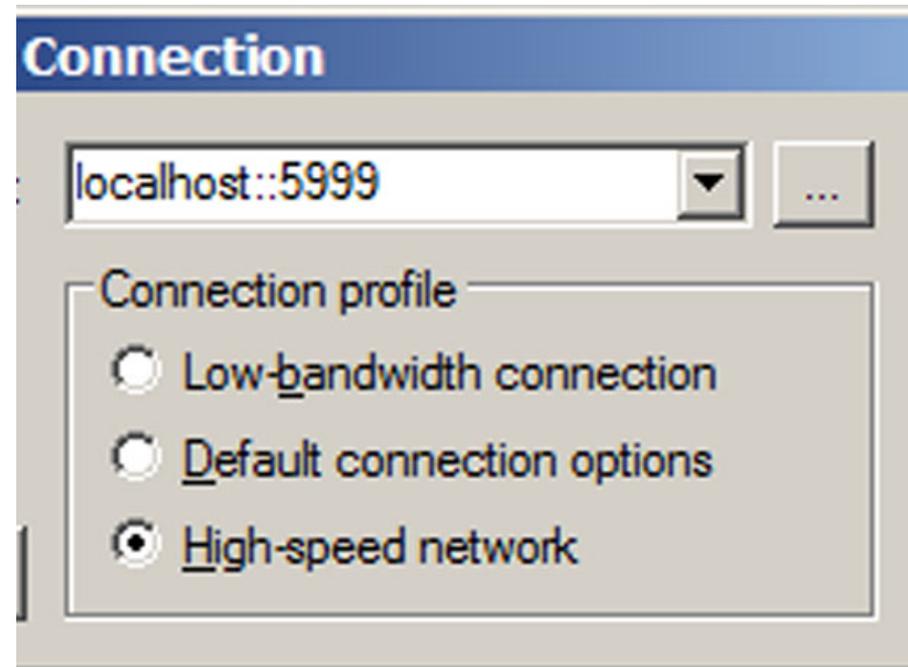
- **With a console number can now create a tunnel**
 - VNC's RFB protocol uses a TCP/IP port range of 5900-5999.
 - Port number of your VNC connection is console number + 5900
 - When you create a ssh tunnel, specify port numbers for each side of the tunnel
 - » The NAS system will be the right-hand side of localhost
 - » your own desktop/laptop's port number is the left-hand side of localhost
- **To get to this ssh prompt, you enter an ssh escape sequence: ctrl C (uppercase C) and NO carriage return or linefeed.**
 - It might take ssh a moment or two to respond.
 - ssh prompt is how you'll know that ssh is ready for the tunnel command.
- **Choice of the user's port number is arbitrary but note:**
 - Macs use port 5900 for their own remote desktop and linux systems consider ports < 1024 as privileged
 - You could run multiple VNC servers on different remote platforms by choosing different desktop/laptop port numbers for each remote system

```
-bash-3.2$  
ssh> -L 5999:localhost:5901  
Forwarding port.
```

Desktop Viewer Startup



- **After starting the VNC/ssh tunnel, we are ready to connect desktop viewer to our end of tunnel**
 - Note: use “localhost” and port # that we supplied on the left-hand side of the tunnel command
 - No need to specify remote system since our ssh connection to it is what tunnel will use



Desktop VNC Authentication

- **Desktop client asks for the VNC client password**
 - not your NAS login password
- **After OK, have completed VNC session startup**
 - next display is produced by TWM, MWM or KDE



Pleiades View—KDE xterm



```
X Desktop
-bash-3.2$ echo $HOSTNAME
bridge4
-bash-3.2$ pwd
/u/alazanof
-bash-3.2$ cd .vimrc
-bash: cd: .vimrc: No such file or directory
-bash-3.2$ cd .vim
-bash: cd: .vim: No such file or directory
-bash-3.2$
-bash-3.2$
-bash-3.2$ echo $HOSTNAME
bridge4
-bash-3.2$ pwd
/u/alazanof
-bash-3.2$ cd .vnc
-bash-3.2$ ls -lt
total 28
-rw----- 1 alazanof scicon 3154 Jan 30 17:46 bridge4:1.log
-rw----- 1 alazanof scicon   6 Jan 30 17:38 bridge4:1.pid
-rw----- 1 alazanof scicon 6061 Jan 20 17:02 bridge3:1.log
-rwxr-xr-x 1 alazanof scicon  212 Aug 18 00:48 xstartup
-rwxr-xr-x 1 alazanof scicon  150 Nov 10 2008 xstartup.orig
-rw----- 1 alazanof scicon   8 Nov 10 2008 passwd
-bash-3.2$
-bash-3.2$ more xstartup
#!/bin/sh

#xrdb $HOME/.Xresources
xsetroot -solid yellow
xterm -geometry 132x43+10+10 -ls -title "$VNCDESKTOP Desktop" &
#xterm -ls -title "$VNCDESKTOP Desktop" &
#twm &
#fvwm &
#mwm &

/opt/kde3/bin/startkde &
-bash-3.2$ █
```

Change VNC Login Password



```
-bash-3.2$ ps -u $USER
  PID TTY          TIME CMD
35878 ?                00:00:00 sshd
35879 pts/1          00:00:00 bash
52459 pts/1          00:00:00 ps
-bash-3.2$ cd .unc
-bash-3.2$ ls -lt
total 28
-rw----- 1 alazanof scicon 5517 Jan 30 17:53 bridge4:1.log
-rw----- 1 alazanof scicon 6061 Jan 20 17:02 bridge3:1.log
-rwxr-xr-x 1 alazanof scicon  212 Aug 18 00:48 xstartup
-rwxr-xr-x 1 alazanof scicon  150 Nov 10  2008 xstartup.orig
-rw----- 1 alazanof scicon    8 Nov 10  2008 passwd
-bash-3.2$ rm passwd
```



Recover VNC Session

- **To reconnect/recover from comm. line drop**
 - can specify the same tunnel option on the ssh command that you first used
 - » Will make the connection and the tunnel in one step
 - » then you can start your desktop's VNCviewer
- **Must reconnect to the same Pleiades front-end used at the time of the disconnect**

- `ssh pfe-last`

- `ssh pfe n`

where n is the specific PFE you were using

```
art@jazz ~
$ ssh -L 5999:localhost:5901 bridge4
Enter passphrase for /home/art/.ssh/home_rsa:
Identity added: /home/art/.ssh/home_rsa (/home/art/.ssh/home_rsa)
Identity added: /home/art/.ssh/id_rsa (/home/art/.ssh/id_rsa)
art@jazz ~
$ ssh -L 5999:localhost:5901 bridge4
-----
WARNING! This is a US Government computer. This system is for
the use of authorized users only. By accessing and using the
computer system you are consenting to system monitoring,
including the monitoring of keystrokes. Unauthorized use of, or
access to, this computer system may subject you to disciplinary
action and criminal prosecution.
-----
PAM Authentication
Enter PASSCODE:
Authenticated with partial success.
```



Closedown

- **Don't consume resources when you aren't actively using VNC; see**
 - number of processes that a KDE desktop can use
 - Proper way to end VNCserver session
- **VNCserver's own "--kill" option will**
 - terminate window manager's processes, delete socket and lock files, terminate the Xvnc server
- **kill -9 xvnc will leave processes, socket and lock files behind**
- **We can support up to 30 VNC users per Pleiades front-end**
- **We ask all our VNC users to do a proper VNC shutdown**

```
-bash-3.2$ vncserver -geometry 1920x1080 -localhost
You will require a password to access your desktops.
Password:
Verify:
Would you like to enter a view-only password (y/n)? n
New 'X' desktop is bridge4:1
Starting applications specified in /u/alazanof/.vnc/xstartup
Log file is /u/alazanof/.vnc/bridge4:1.log

-bash-3.2$ ps -u $USER
  PID TTY          TIME CMD
 35878 ?            00:00:00 sshd
 35879 pts/1        00:00:00 bash
 41167 ?            00:00:00 famd
 56805 pts/1        00:00:00 Xvnc
 56811 pts/1        00:00:00 xterm
 56812 pts/1        00:00:00 startkde
 56823 pts/14       00:00:00 bash
 56854 ?            00:00:00 kdeinit
 56857 ?            00:00:00 dcopserver
 56859 ?            00:00:00 klauncher
 56861 ?            00:00:00 kded
 56866 pts/1        00:00:00 kwrapper
 56868 ?            00:00:00 ksmserver
 56869 ?            00:00:00 kwin
 56871 ?            00:00:00 kdesktop
 56873 ?            00:00:00 kicker
 56874 ?            00:00:00 kio_file
 56883 ?            00:00:00 knotify
 56885 ?            00:00:00 klipper
 59820 pts/1        00:00:00 ps
-bash-3.2$ vncserver -kill :1
Killing Xvnc process ID 56805
-bash-3.2$
```



.vnc After Closedown

- Here we can see that we now have a bare minimum number of processes and the the .vnc/*.pid files have been removed.

```
-bash-3.2$  
-bash-3.2$ vncserver -kill :1  
Killing Xvnc process ID 73618  
-bash-3.2$ ls -l .vnc  
total 28  
-rw----- 1 alazanof scicon 6061 Jan 20 17:02 bridge3:1.log  
-rw----- 1 alazanof scicon 5754 Jan 30 18:40 bridge4:1.log  
-rw----- 1 alazanof scicon 8 Jan 30 18:02 passwd  
-rwxr-xr-x 1 alazanof scicon 212 Aug 18 00:48 xstartup  
-rwxr-xr-x 1 alazanof scicon 150 Nov 10 2008 xstartup.orig  
-bash-3.2$ ps -u $USER  
  PID TTY          TIME CMD  
72878 ?           00:00:00 sshd  
72879 pts/1      00:00:00 bash  
81513 pts/1      00:00:00 ps  
-bash-3.2$
```



VNC Sockets & Processes

- **Each VNC session consumes**
 - one lock: `/tmp/.X1-lock`
 - one socket: `/tmp/.X11-unix/X1`
- **While you can remove these manually, these files will be removed by**
 - `vncserver -kill :1` command

```
-bash-3.2$ ps -aef | grep Xvnc
alazanof 82956      1  0 18:43 pts/1    00:00:00 Xvnc :1 -desktop X -httpd /usr/share/vnc/classes -auth /u/alazanof/.Xauthority -geom
etry 1920x1080 -depth 24 -rfbwait 120000 -rfbauth /u/alazanof/.vnc/passwd -rfbport 5901 -fp /usr/share/fonts/misc:unscaled,/usr/shar
e/fonts/local,/usr/share/fonts/75dpi:unscaled,/usr/share/fonts/100dpi:unscaled,/usr/share/fonts/Type1,/usr/share/fonts/URW,/usr/shar
e/fonts/Speedo,/usr/share/fonts/truetype,/usr/share/fonts/uni,/usr/share/fonts/CID -noreset -localhost
alazanof 86173 83040  0 18:48 pts/17   00:00:00 grep Xvnc
-bash-3.2$ ls -la /tmp/.X*
-r--r--r-- 1 alazanof scicon   11 Jan 30 18:43 /tmp/.X1-lock

/tmp/.X11-unix:
total 576
drwxrwxrwt  2 root    root    4096 Jan 30 18:43 .
drwxrwxrwt  77 root    root   581632 Jan 30 18:47 ..
srwxrwxrwx  1 alazanof scicon      0 Jan 30 18:43 X1
-bash-3.2$
```

X11perf Performance

- Use **x11perf** to test latency and performance of a variety of graphics components, for example

- The first run shown is a stand-alone desktop
- The next two runs use bridge4 with **x11perf** sending a display back to a local X11 server, and a test running an xterm on bridge4
- Last test is a VNC test running x11perf using a xterm on Pleiades and a vnc viewer for local display. In this example, VNC's times are comparable to the locally run test. VNC is best used for remote graphics and video.

- Plain text windows will generally do better than VNC**

```

t@jazz ~
x11perf -f8itext
lperf - X11 performance program, version 1.2
e Cygwin/X Project server version 11103000 on 127.0.0.1:0.0
om jazz
n Jan 30 19:39:27 2012
nc time adjustment is 0.1378 msecs.
600000 reps @ 0.0003 msec <3090000.0/sec>: Char in 70-char image line <8x13>
600000 reps @ 0.0003 msec <3110000.0/sec>: Char in 70-char image line <8x13>
600000 reps @ 0.0003 msec <3120000.0/sec>: Char in 70-char image line <8x13>
600000 reps @ 0.0003 msec <3100000.0/sec>: Char in 70-char image line <8x13>
8000000 trep @ 0.0003 msec <3100000.0/sec>: Char in 70-char image line <8x13>
h -X bridge4
ash-3.2$ x11perf -f8itext
lperf - X11 performance program, version 1.2
e Cygwin/X Project server version 11103000 on bridge4:37.0
om bridge4
n Jan 30 19:38:20 2012
nc time adjustment is 96.6198 msecs.
000000 reps @ 0.0016 msec <629000.0/sec>: Char in 70-char image line <8x13>
000000 reps @ 0.0011 msec <917000.0/sec>: Char in 70-char image line <8x13>
000000 reps @ 0.0021 msec <473000.0/sec>: Char in 70-char image line <8x13>
000000 reps @ 0.0017 msec <588000.0/sec>: Char in 70-char image line <8x13>
000000 reps @ 0.0015 msec <658000.0/sec>: Char in 70-char image line <8x13>
0000000 trep @ 0.0016 msec <624000.0/sec>: Char in 70-char image line <8x13>
erm running on bridge4
sh-3.2$ x11perf -f8itext
lperf - X11 performance program, version 1.2
e Cygwin/X Project server version 11103000 on bridge4:37.0
om bridge4
n Jan 30 19:40:28 2012
nc time adjustment is 97.3810 msecs.
200000 reps @ 0.0013 msec <796000.0/sec>: Char in 70-char image line <8x13>
200000 reps @ 0.0018 msec <562000.0/sec>: Char in 70-char image line <8x13>
200000 reps @ 0.0013 msec <749000.0/sec>: Char in 70-char image line <8x13>
200000 reps @ 0.0017 msec <592000.0/sec>: Char in 70-char image line <8x13>
200000 reps @ 0.0014 msec <735000.0/sec>: Char in 70-char image line <8x13>
6000000 trep @ 0.0015 msec <674000.0/sec>: Char in 70-char image line <8x13>
Cserver KDE xterm running on bridge4
ash-3.2$ x11perf -f8itext
lperf - X11 performance program, version 1.2
e X.Org Foundation server version 10605000 on :1.0
om bridge4
n Jan 30 19:44:18 2012
nc time adjustment is 0.0208 msecs.
600000 reps @ 0.0003 msec <2990000.0/sec>: Char in 70-char image line <8x13>
600000 reps @ 0.0003 msec <2990000.0/sec>: Char in 70-char image line <8x13>
600000 reps @ 0.0003 msec <3000000.0/sec>: Char in 70-char image line <8x13>
600000 reps @ 0.0003 msec <3000000.0/sec>: Char in 70-char image line <8x13>
6000000 trep @ 0.0003 msec <3000000.0/sec>: Char in 70-char image line <8x13>

```



MATLAB Startup

- The first time of ~11s is the VNC time it takes for a usable display and an exit command. The second time shows 3m 14s for a conventional X11 remote display.
- Besides the longer startup latency, every event like pulling a window down to make a selection is intolerably slow for many people. If the user is further away on the public network, the startup times grow even larger.

```
/cygdrive/d/NASA_VNC
UNC matlab startup
-bash-3.2$ module load matlab
-bash-3.2$ time matlab

Warning: Our version of glibc has not been tested with this version of Matlab.
MathWorks issues a warning that we have disabled. Please proceed with
this in mind.

real    0m10.968s
user    0m12.817s
sys     0m1.612s
-bash-3.2$

ssh -X bridge4
-bash-3.2$ time matlab

Warning: Our version of glibc has not been tested with this version of Matlab.
MathWorks issues a warning that we have disabled. Please proceed with
this in mind.

real    3m14.393s
user    0m13.509s
sys     0m1.564s
-bash-3.2$
```



Slides Prepared by Art Lazanoff

pdf and recording of this webinar will be available shortly at:
<http://www.nas.nasa.gov/hecc/support/training.html>

Next webinar

“How Can I Speed Up My Data Transfers to/from NAS?”
tentatively scheduled on March 7, 2012

Suggestions for future webinar topics are welcome