Remote Graphics on the GPC

Client-Server Application and VNC

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SciNet User Group Meeting

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Outline

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X Forwarding

▼ Remote graphics using X

`ssh -X` forwarding – if an X server has been installed locally (for Linux and MacOS this is often already there by default)

```
$ ssh -Y login.scinet.utoronto.ca
$ ssh -Y gpc0x
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This can be slow, depending on various factors, eg. low-bandwidth/high-latency connections (e.g. home internet connections).

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Example: X forwarding on GPC compute nodes

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$ gpc
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(gpc and debugjob forward X, but ssh or qsub would need explicit -X options)

▼ Let's have some fun...

```
$ module load gnuplot
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  or ...

$ module load grace
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Virtual Network Computing

- VNC: Virtual Network Computing
- VNC uses an X server on the remote machine, and a local *viewer*.
- VNC behaves as if taking continuous desktop snapshots
- It uses compression techniques to reduce the required bandwidth, and trasnfers only the parts of the desktop that have changed.
- Using VNC with an SSH tunnel and a password is quick and secure

VNC vs X forwarding

- X forwarding will work and be just fine in many cases
- VNC offers a potentially more suitable protocol for such remote connections
- Remote X graphics applications require a local X server, and transmit many little events and data messages. On a network with high latency, the number of roundtrips needed makes X slow and less responsive.
- X's speed depends more on the type of application than VNC (eg. java applications tend to be very slow over X, but are OK over VNC).
- VNC typically requires fewer roundtrip, hence is often more responsive.

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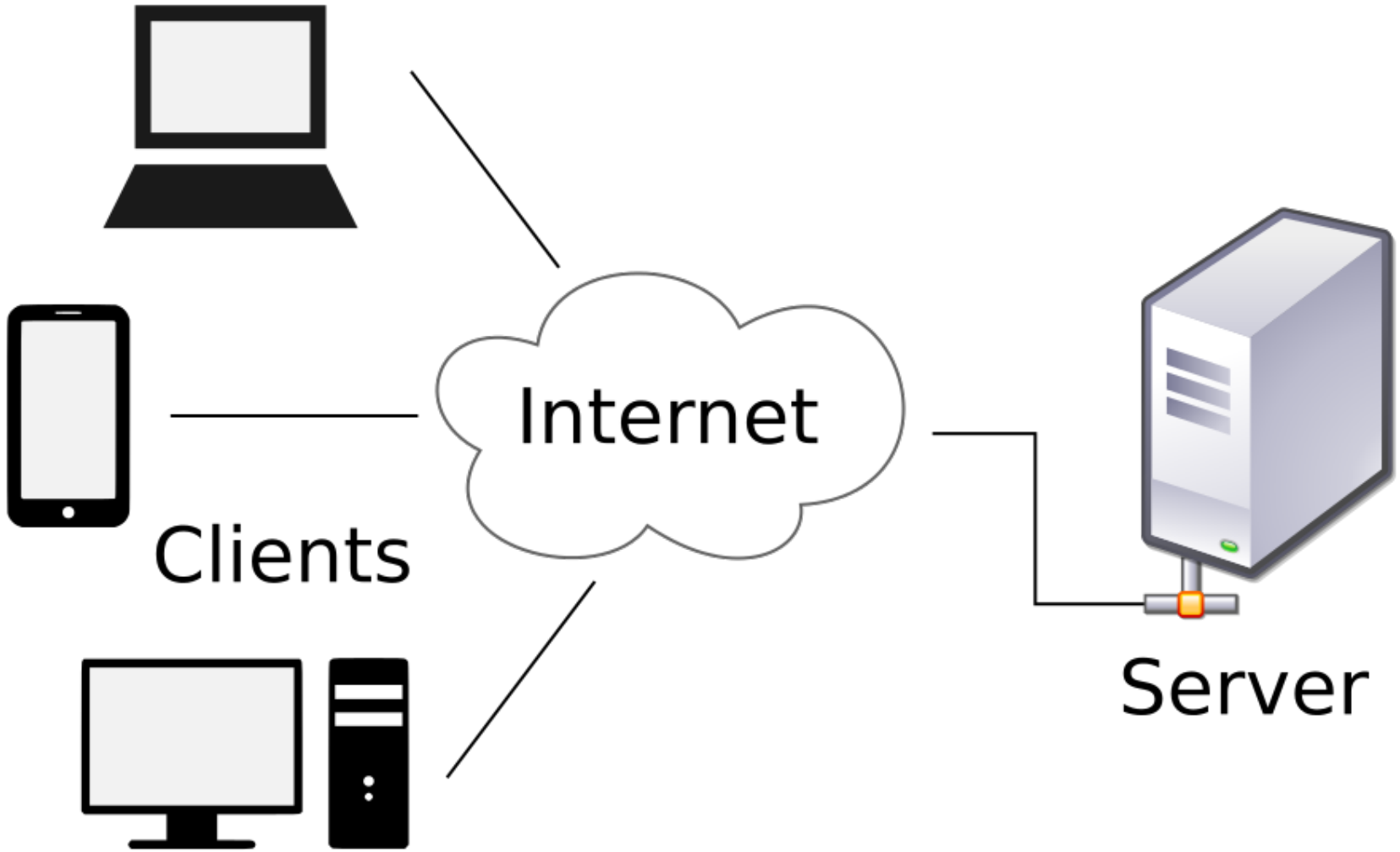
A bit about client-server setups



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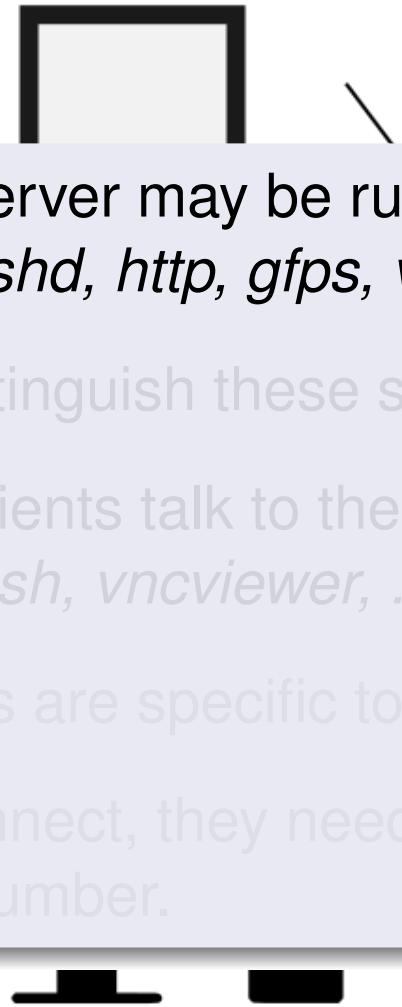

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- To distinguish these services, they listen to different “ports”.
- The clients talk to these services.
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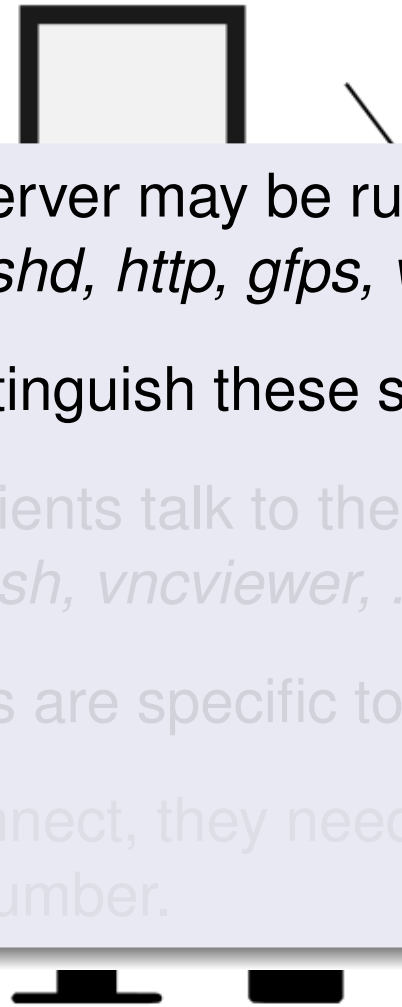

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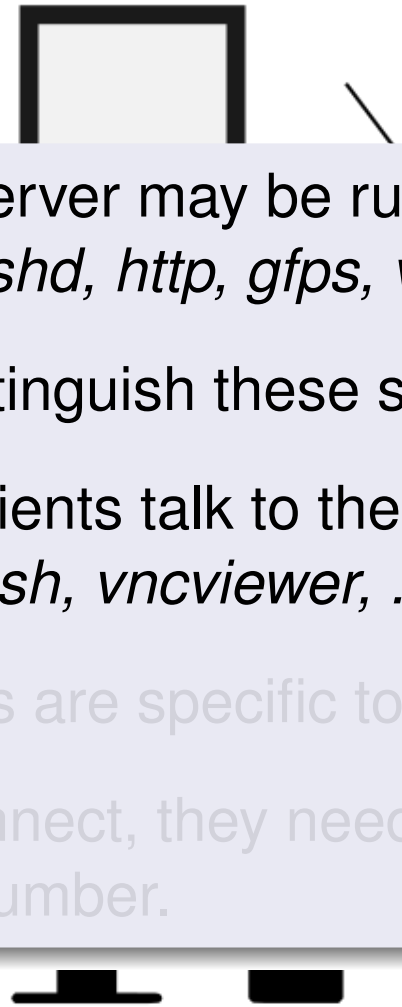

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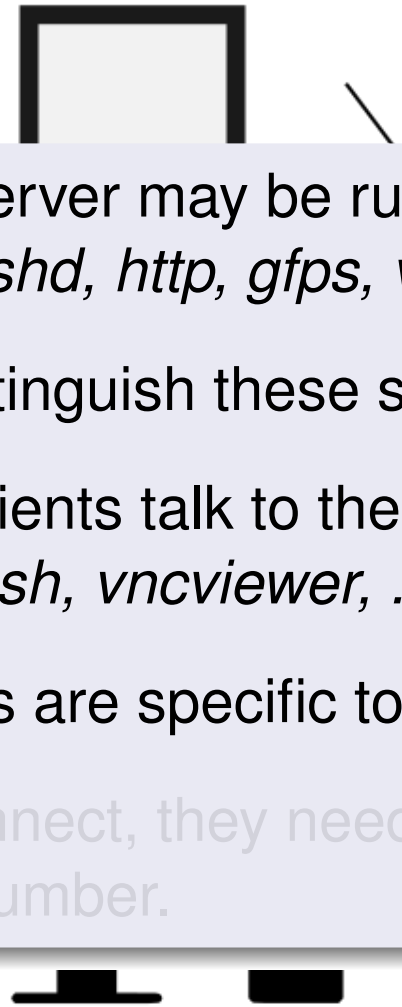

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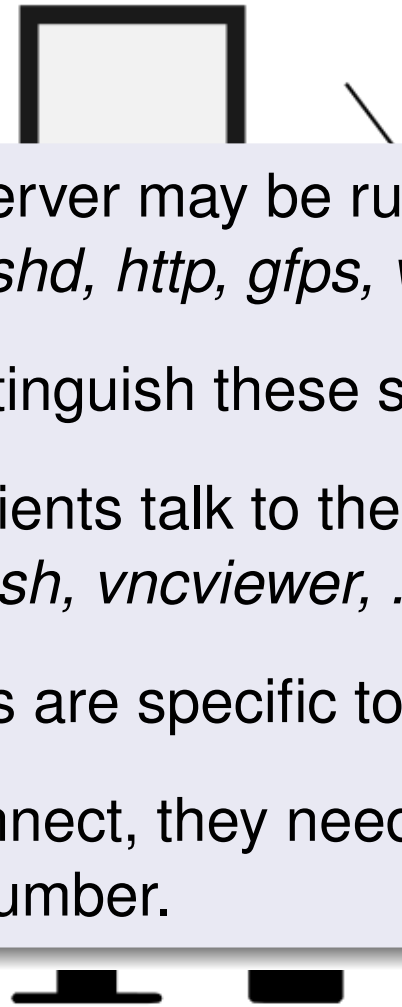

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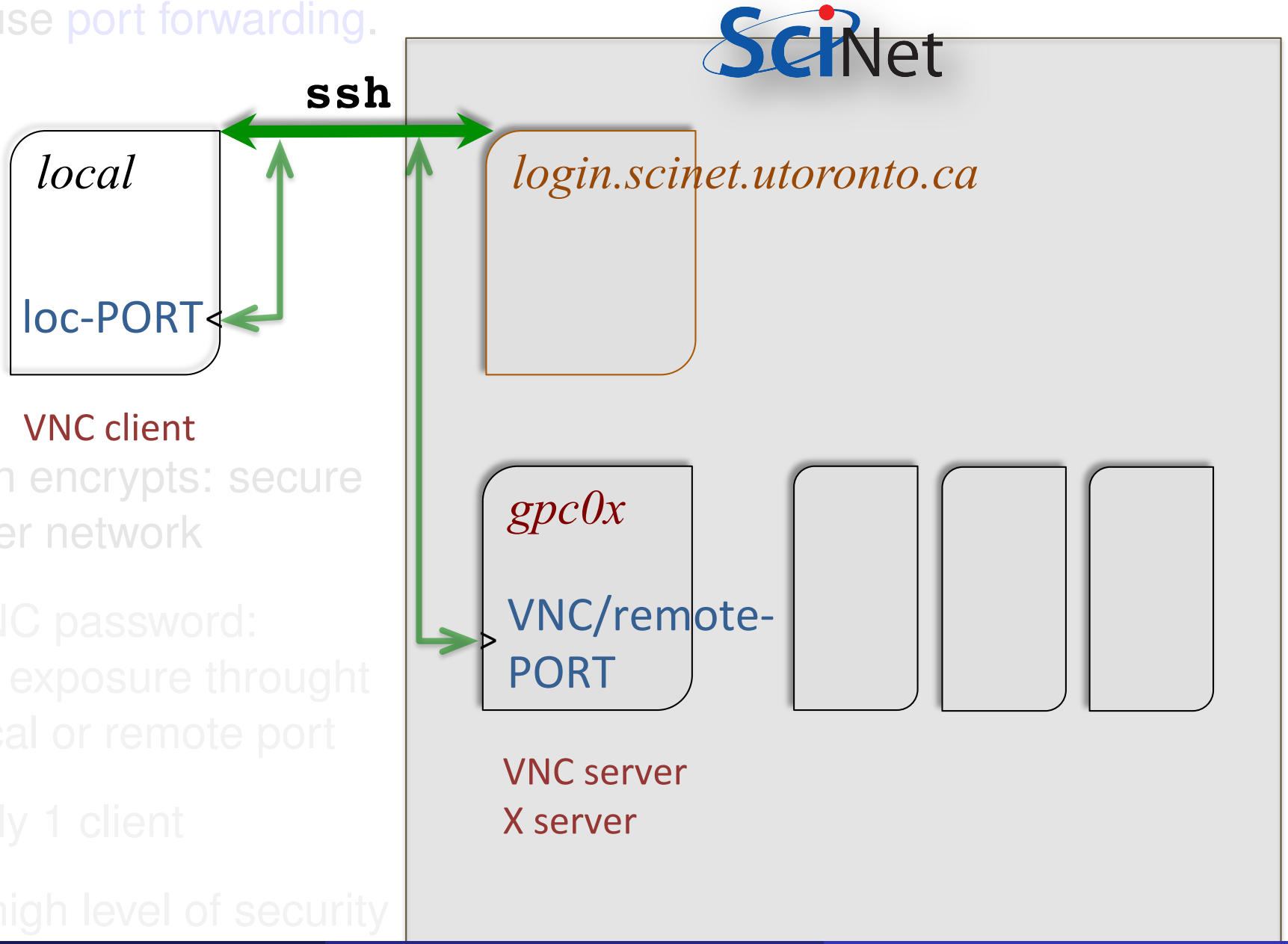
Now via the gateway, login.scinet.utoronto.ca:

Must use port forwarding.



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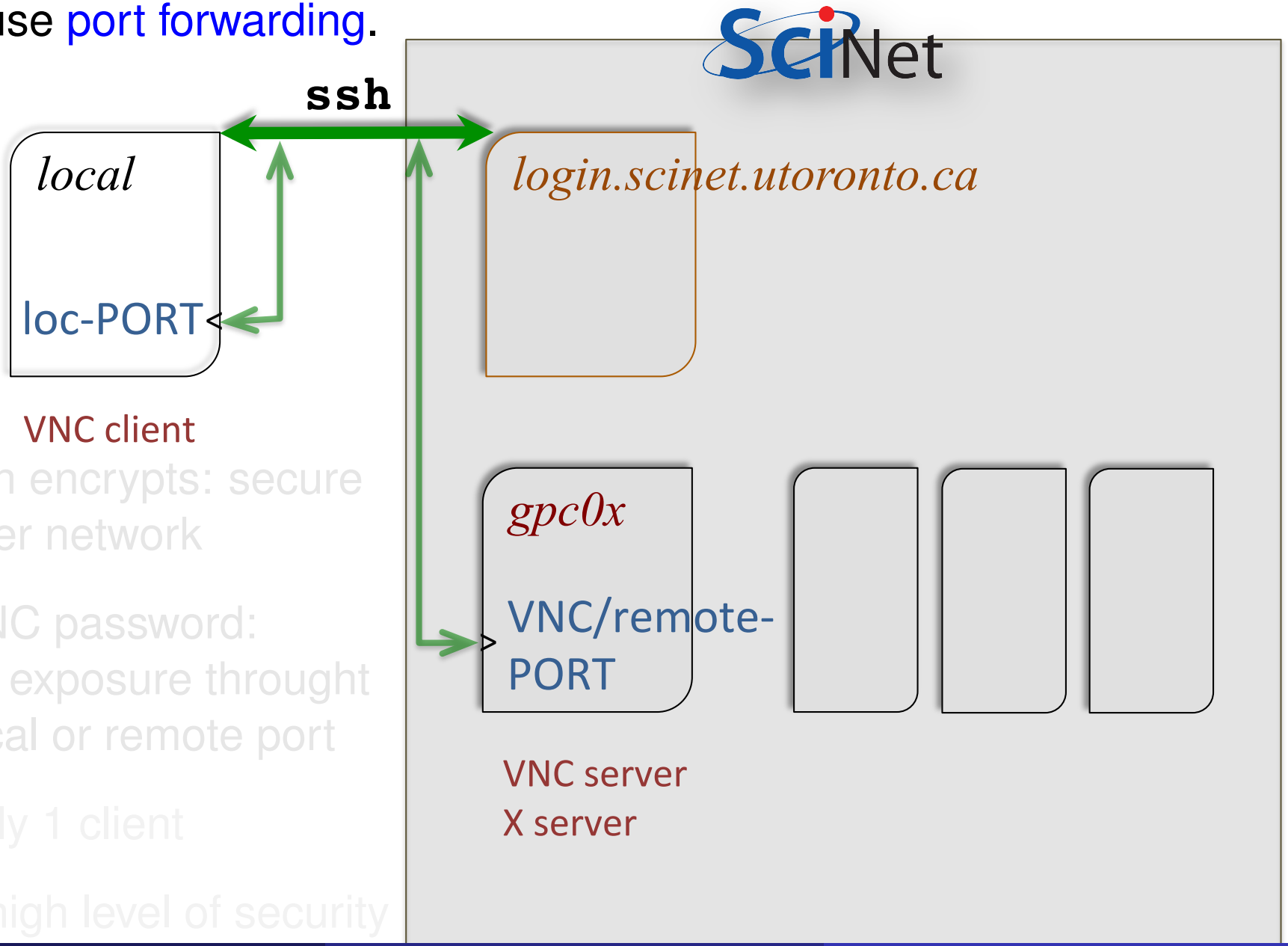

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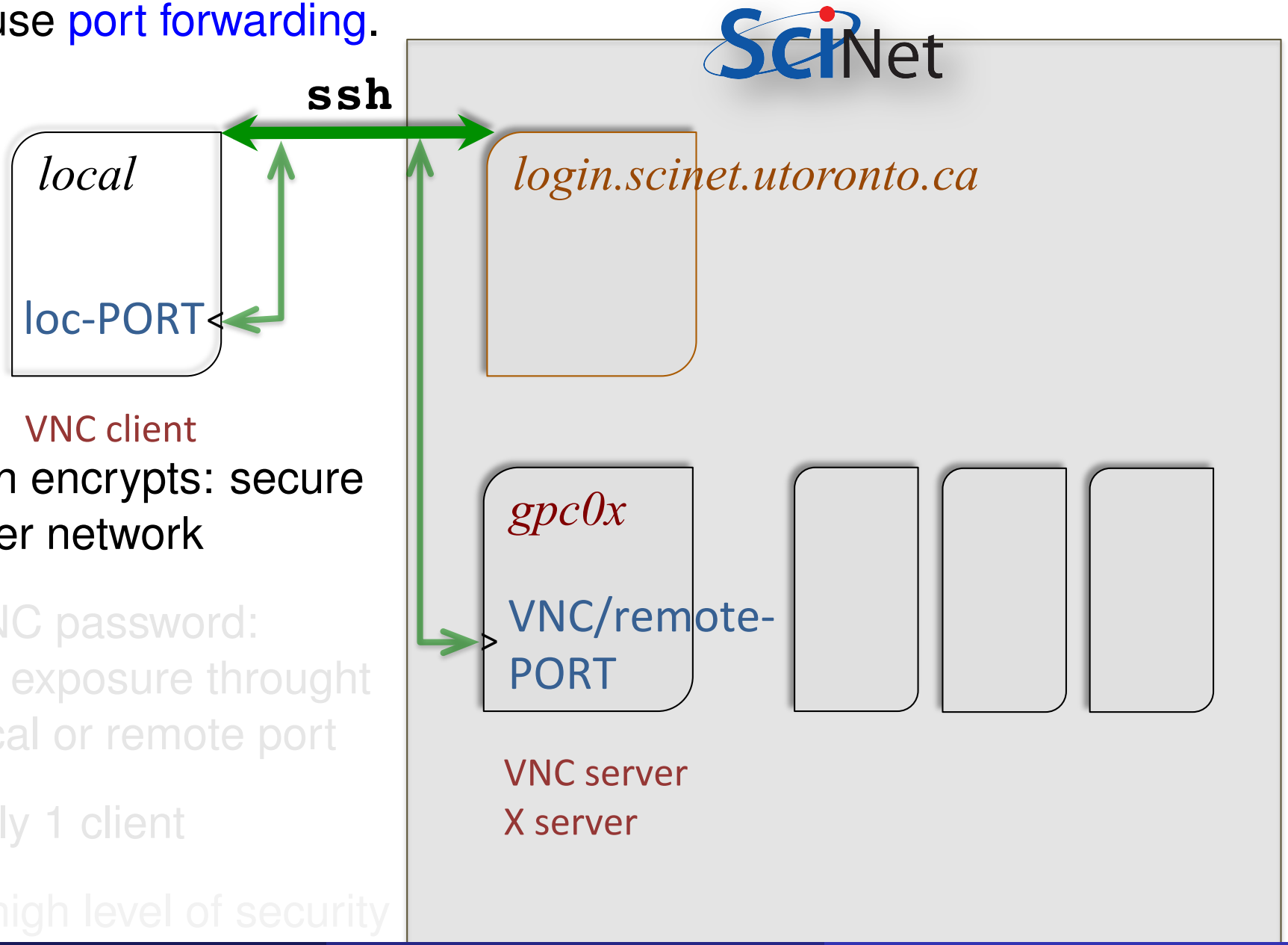

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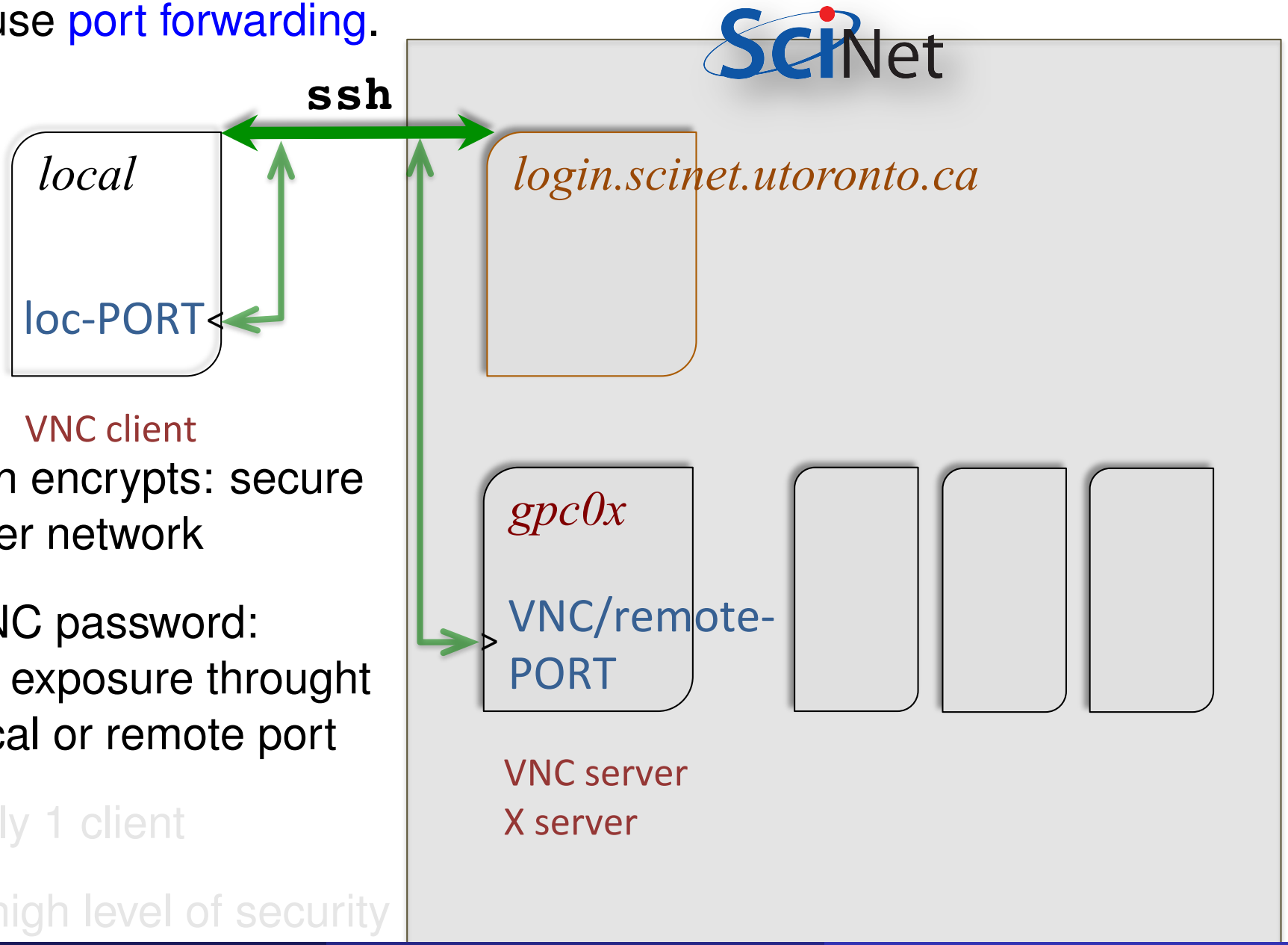

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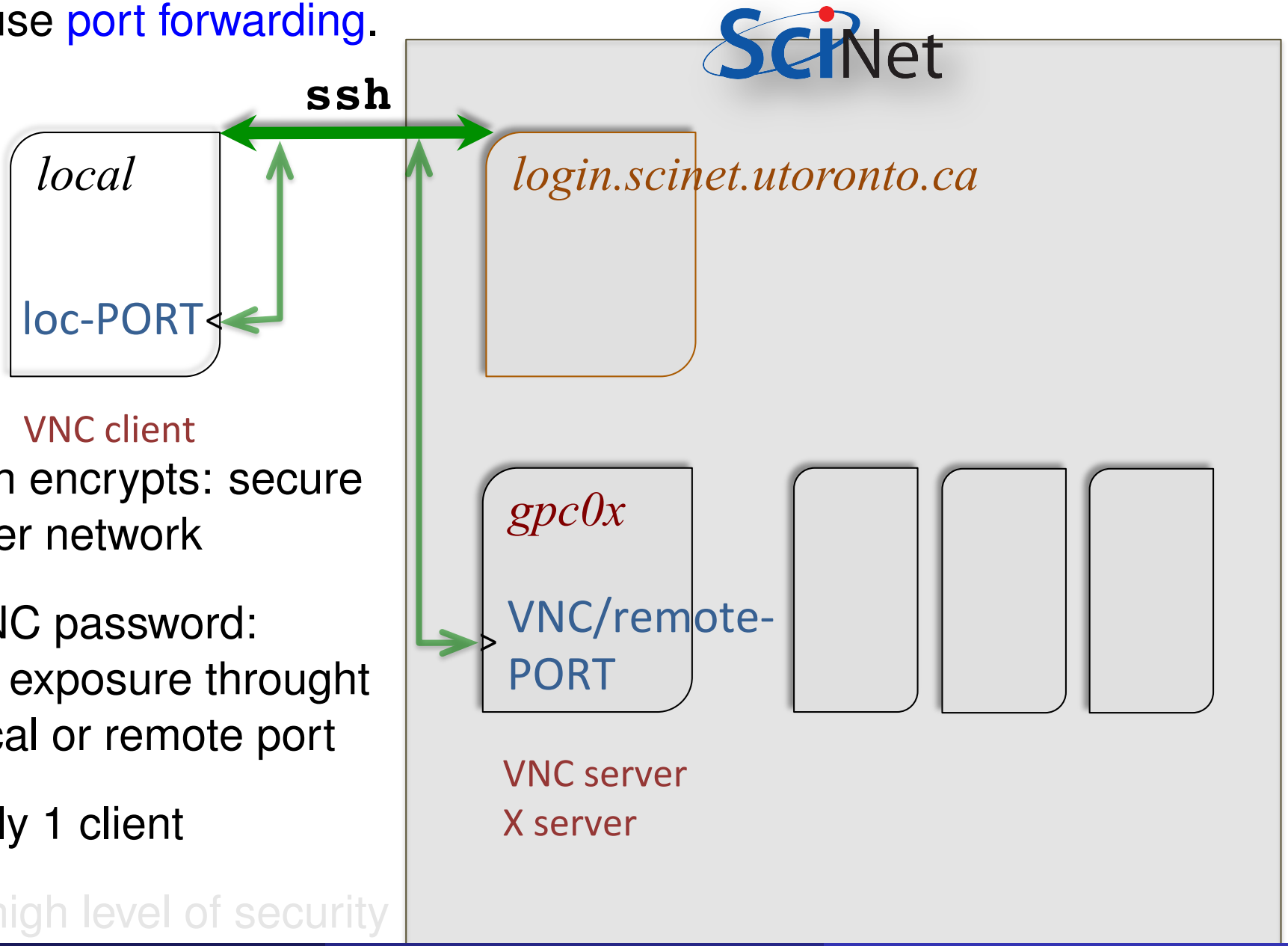

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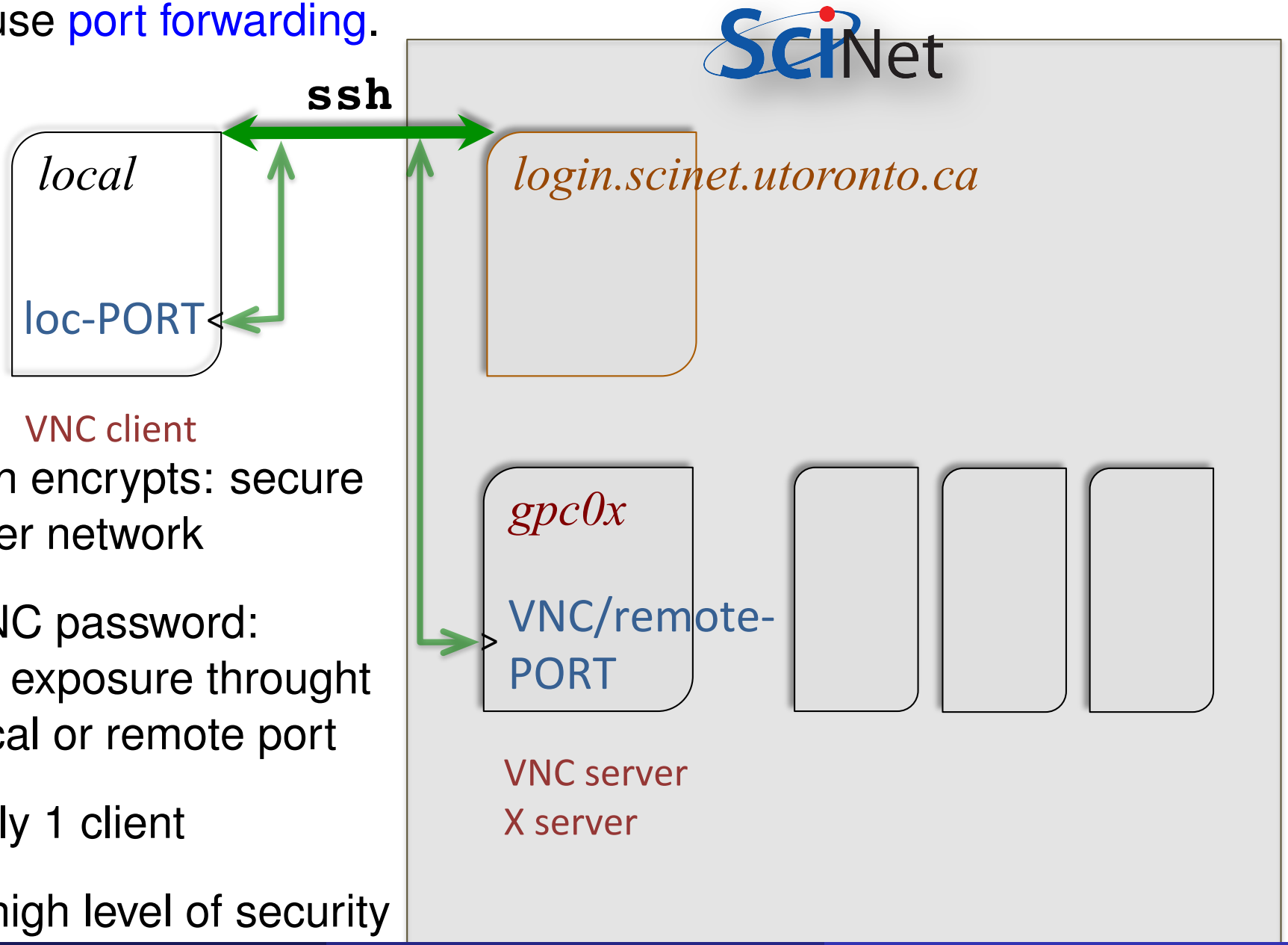

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Prerequisites

➡ on your *local machines*

- Install an **ssh client**
  - Linux and MacOS: come with them!
  - Windows: MobaXterm, Cygwin, PuTTY
- Install a **VNC client**
  - Linux and MacOS: most likely are there already
  - If not: TightVNC or TigerVNC are a good option

➡ on the *remote machine* (on GPC@SciNet)

- Require a **VNC server**
  - we will be using *modules*
  - module load `vnc` ⇝ VNC server & scripts
  - This module requires the `Xlibraries` module.

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  - module load `vnc` $\rightsquigarrow$ VNC server & scripts
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Set up a VNC session on a devel node

1. Log into scinet.
2. Log into a devel node (gpc01, ...).
3. Stay there.
4. Start a VNC server on that node
5. Using `ssh`, **forward** a local port from your local machine to a port on that devel node, via `login.scinet`.
6. Start the VNC client on local machine

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Set up a VNC session on a compute node

1. Log into scinet.
2. Log into a devel node (gpc01, ...).
3. Get an interactive compute node using `qsub -I` or `debugjob`.
4. Start a VNC server on a compute node.
5. Using `ssh`, **forward** a local port from your local machine to a port on that compute node, via `login.scinet`.
6. Start the VNC client on local machine

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Setting up a VNC session - Start the VNC session

- 1) connect with `ssh` to login.scinet.utoronto.ca

```
$ ssh login.scinet.utoronto.ca
```

- 2) connect with `ssh` to a development node: gpc[01-04]

```
$ ssh gpc0x # or just type gpc
```

- 3) Hop to a compute node using qsub

```
$ qsub -I -q debug -l nodes=1:ppn=8,walltime=02:00:00
```

(or just type debugjob)

- 4) finally, load modules & start vnc

```
$ module load Xlibraries vnc
$ vnc start
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➡ prompts for password
Do not leave it blank!
➡ Note down the port number.

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Setting up a VNC session - Setup a secure SSH tunnel

- All *external traffic* has to go through login.scinet.utoronto.ca
- 5) `ssh` allows for port forwarding, which takes a port on a local machine and forwards it to a port on the devel/compute node

```
$ ssh login.scinet.utoronto.ca -Lxxxx:nodeName:PORT -N
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  - `nodeName`: gpc[01-04] or a compute node
  - `xxxx`: port one local machine (usually 5900 or 15900, your choice!)
  - `PORT`: port of VNC server as returned by `vnc start`.
  - do **not** exit this shell, or the *tunnel* will collapse

eg.

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- For faster communication try the following ssh extended command:

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Setting up a VNC session - Start the VNC client

- 6) any VNC viewer, can now be *attached* to the remote VNC server
  - eg. in Linux,

```
$ vncviewer localhost:15901
```

  - eg. in MacOS,

```
$ open vnc://localhost:15901
```

  - type the password for the VNC server
  - you will get a ‘desktop’ with an Xterm
- there may be options to improve the efficiency of the connection,

```
vncviewer -encodings 'copyrect tight hextile' localhost:15901
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or

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Setting up a VNC session - shortcut

- it is possible to combine steps 5+6, when using eg. TightVNC viewer,

```
$ vncviewer -via login.scinet.utoronto.ca gpc03:PORT
```

or

```
$ vncviewer -via login.scinet.utoronto.ca gpc03:ALTPORT
```

where `ALTPORT=PORT-5900`

- to control compression for TightVNC's combining steps 5+6,
  - set environment variable `VNC_VIA_CMD`, e.g.

```
$ VNC_VIA_CMD='ssh -C -c arcfour -f -L %L:%H:%R %G sleep 20'
$ export VNC_VIA_CMD
```

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Setting up a VNC session - shortcut

- it is possible to combine steps 5+6, when using eg. TightVNC viewer,

```
$ vncviewer -via login.scinet.utoronto.ca gpc03:PORT
```

or

```
$ vncviewer -via login.scinet.utoronto.ca gpc03:ALTPORT
```

where `ALTPORT=PORT-5900`

- to control compression for TightVNC's combining steps 5+6,
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```

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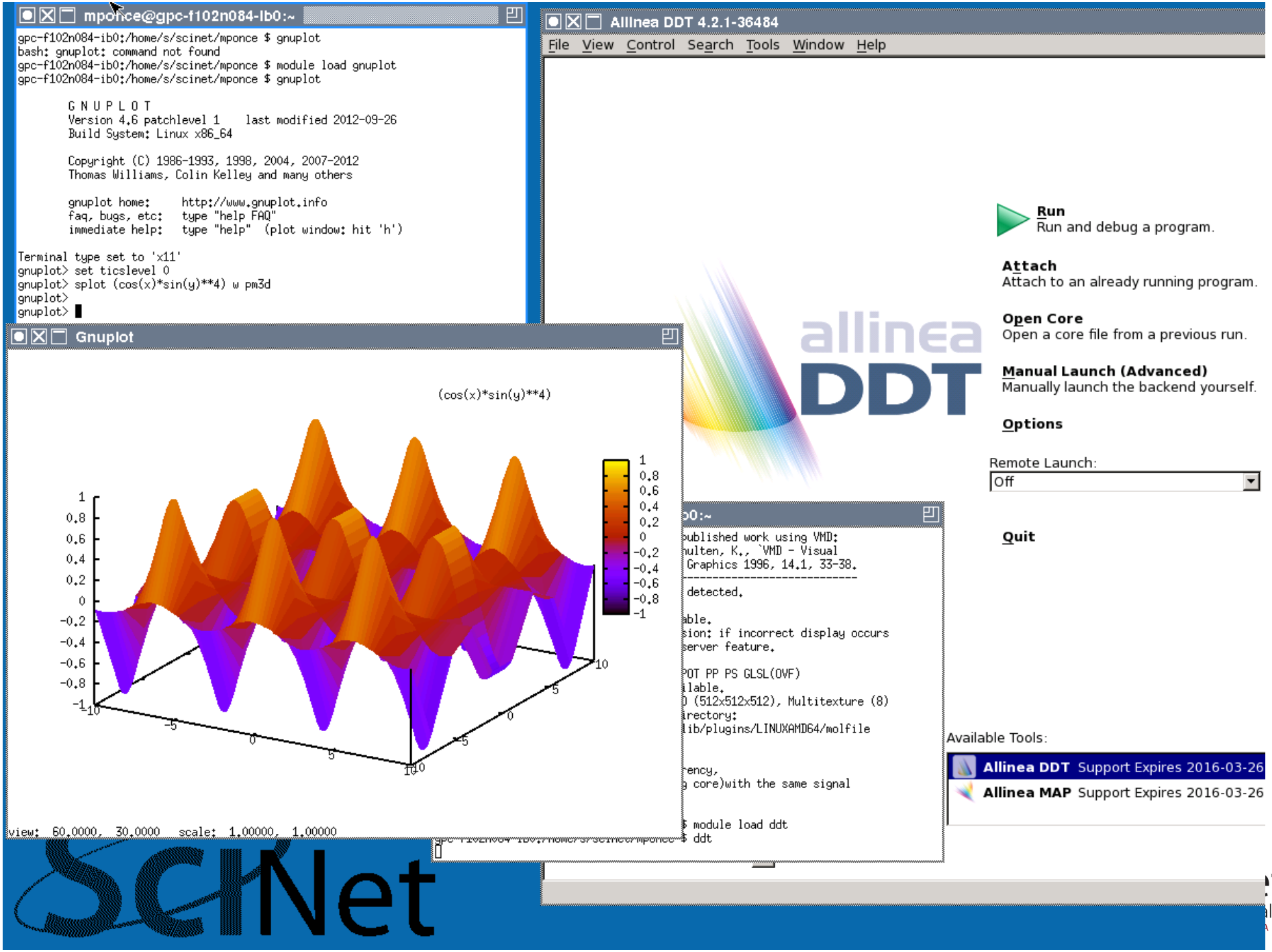
What does it look like?


mponce@gpc-f102n084-ib0:~
gpc-f102n084-ib0:/home/s/scinet/mponce $ gnuplot
bash: gnuplot: command not found
gpc-f102n084-ib0:/home/s/scinet/mponce $ module load gnuplot
gpc-f102n084-ib0:/home/s/scinet/mponce $ gnuplot
G N U P L O T
Version 4.6 patchlevel 1 last modified 2012-09-26
Build System: Linux x86_64
Copyright (C) 1986-1993, 1998, 2004, 2007-2012
Thomas Williams, Colin Kelley and many others
gnuplot home: http://www.gnuplot.info
faq, bugs, etc: type "help FAQ"
immediate help: type "help" (plot window: hit 'h')
Terminal type set to 'x11'
gnuplot> set ticslevel 0
gnuplot> splot (cos(x)*sin(y)**4) w pm3d
gnuplot>
gnuplot>
Gnuplot
(cos(x)*sin(y)**4)
view: 60.0000, 30.0000 scale: 1.00000, 1.00000
Allinea DDT 4.2.1-36484
File View Control Search Tools Window Help
Run
Run and debug a program.
Attach
Attach to an already running program.
Open Core
Open a core file from a previous run.
Manual Launch (Advanced)
Manually launch the backend yourself.
Options
Remote Launch:
Off
Quit
allinea
DDT
published work using VMD:
Graphics 1996, 14.1, 33-38.
detected.
(512x512x512), Multitexture (8)
core)with the same signal
module load ddt
ddt
Available Tools:
Allinea DDT Support Expires 2016-03-26
Allinea MAP Support Expires 2016-03-26
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Client-side usage Details

Light-weight window manager `twm`

- `Xterm` starts by default
- Icon, close, maximize and resize buttons are found in title bars
- `Ctrl-Tab` brings successive windows to the foreground
- left mouse click on the background pops up the `twm` menu
- use 'Exit' option from the `twm` menu to terminate VNC

Implementation

- `Xvfb` for the Xserver
- `x11vnc` for the VNC server

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Server-side usage Details

VNC scripts available

`vnc stop`	Stop the VNC servers, killing any X applications
`vnc status`	Probes whether the VNC server and the X server are running
`vnc detach`	Stop the VNC servers, killing any X applications
`vnc help`	Display a help message about VNC/X/twm environment
`vnc start`	Has some additional options: `-r RESOLUTION` ➟ set X's resolution (default: 800x544x16) `-s FRACTION` ➟ use x11vnc's scaling feature `-v 0|1|any` ➟ also attach a viewer `-n` ➟ switch on x11vnc's ncache feature `-b` ➟ use a blank background

Server-side usage Details: Files & Directories

`~/.xinitrc`	Initialization of X: start window manager twm and xterm
`~/.twmrc`	Settings file for window manager twm
`~/.vnc`	Directory with encrypted VNC password and other settings
`~/.fr`	Directory with settings for FileRunner

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Server-side usage Details: Final Comments

- Closing the VNC viewer window instead of using Exit in the twm menu, keeps the X server running on the remote devel/compute node
  - try, for instance doing so, and reconnecting the local viewer
  - also useful, when the connection is lost...
- SciNet usage
  - only available on GPC system

Alternative remote visualization: paraview

- Some visualization packages have a built-in server-client setup
- Paraview is a prime example.
- Still need to do port forwarding.
- Server and client versions of paraview must match.

Example

1. Setup tunnel:

```
$ ssh login.scinet.utoronto.ca -L11111:nodeName:11111 -N
```

2. Start paraview server

```
$ module load intel/15.0.2 gcc/4.8.1 python/2.7.5
$ module load openmpi/intel/1.6.4 extras paraview/4.1.0
$ mpirun -np 8 pvserver -use-offscreen-rendering
```

3. Start local paraview gui and select “File->Connect”.

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Example

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3. Start local paraview gui and select “File->Connect”.

Planned Dedicated Visualization Nodes

We are planning to repurpose a couple of nodes dedicated as visualization nodes

- Longer than usual interactive jobs
- Large memory pool ($\sim$ 128 GB)
- Software available: eg. VisIt, ParaView, VMD, ...
- Available both interactively and through job submission

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Dedicated Viz Nodes- preloaded modules?

```
Xlibraries
vnc
git
gcc/4.8.1
intel/15.0.2
python/2.7.5
openmpi/intel/1.6.4
paraview/4.1.0
gnuplot/4.6.1
grace/5.1.22
vmd/1.9
visit/2.6.3
ImageMagick/6.6.7
ffmpeg/2.1.3
hdf5/187-v18-serial-intel
octave/4.0.0
pgplot/5.2.2-intel
ncl/6.1.0
```

We welcome your input as we set this up!

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