

# Remote Development on SciNet Systems

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June 13, 2012

# Outline

## General

- ▶ What is remote development?
- ▶ Decisions
- ▶ Use-cases
- ▶ Tools

# Outline

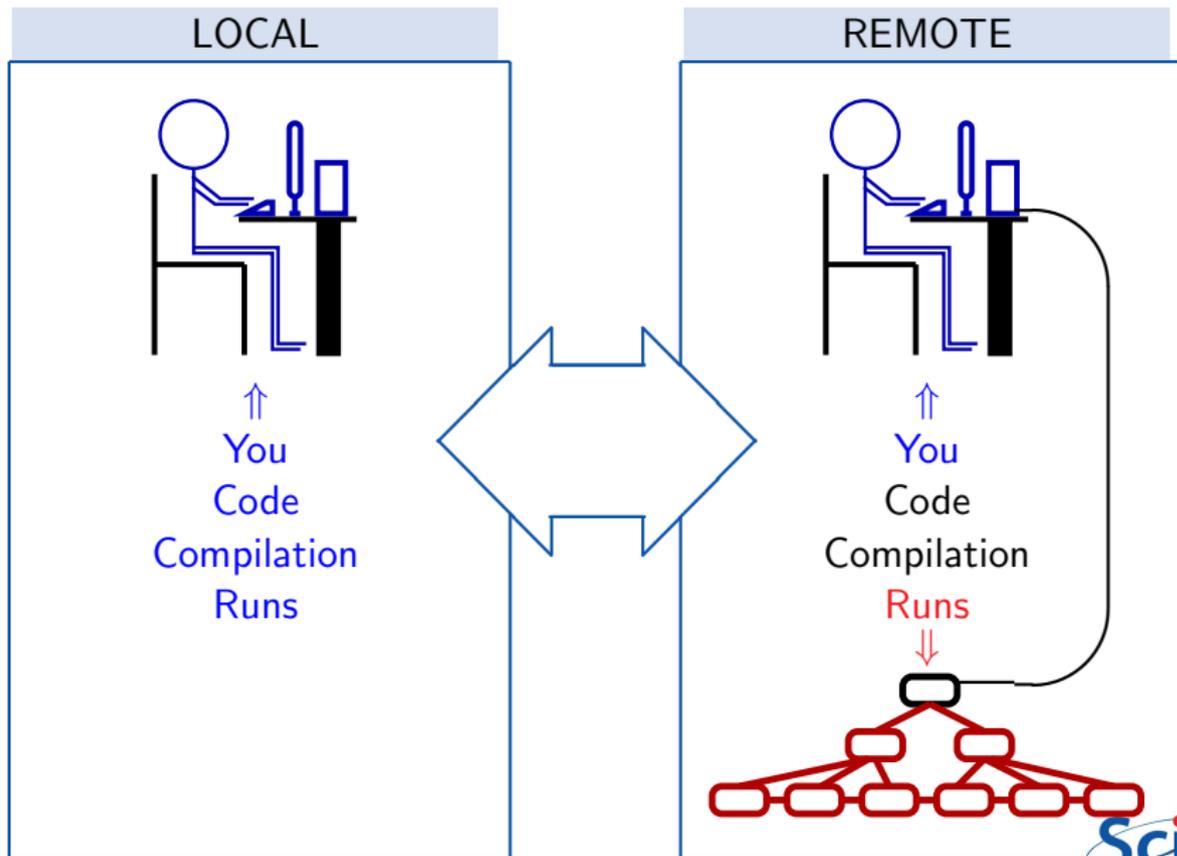
## General

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- ▶ Tools

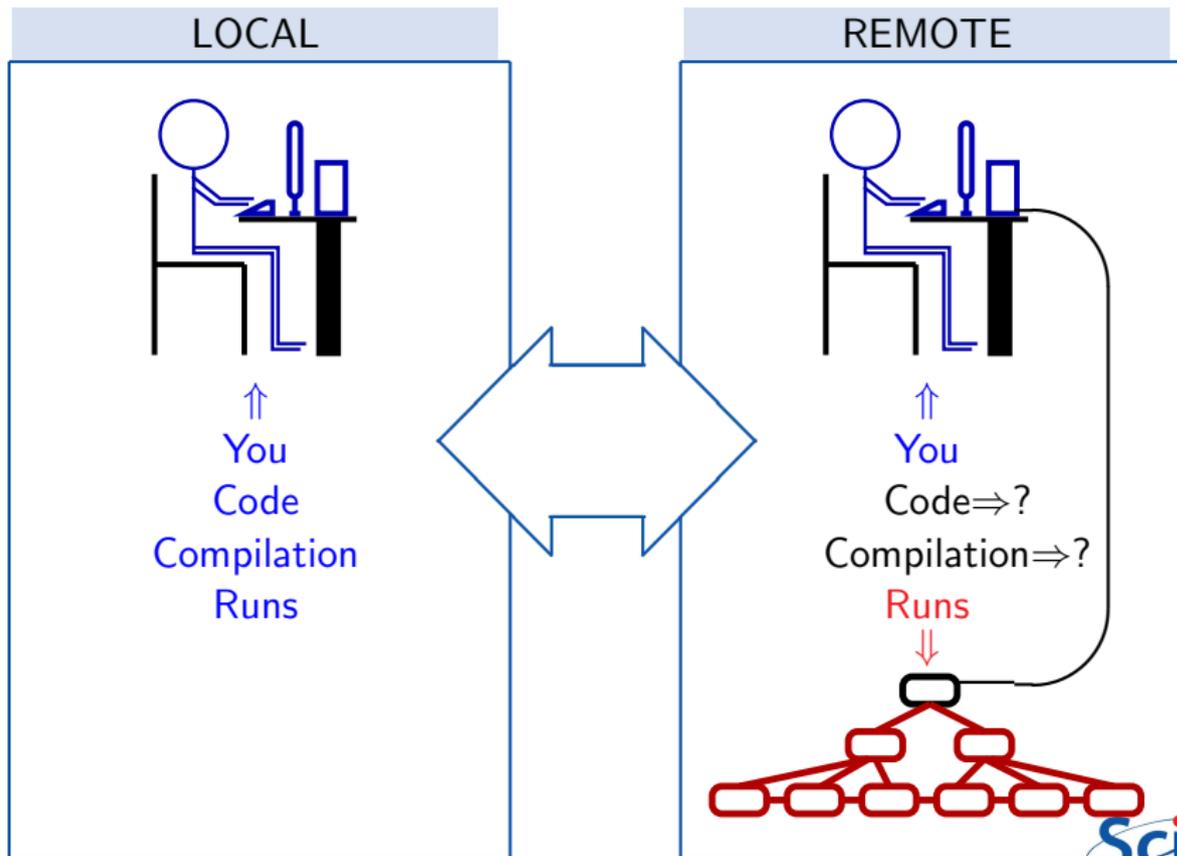
## Technical details

- ▶ Important technical details  
(port and X forwarding)
- ▶ Example development setups
- ▶ Debugging

# Local vs. Remote Development



# Local vs. Remote Development



# Decisions, decisions

What setup you need depends on the answers to the following questions:

- ▶ What tools/ide will you use?
- ▶ Where's the code?
- ▶ Can you cross compile?
- ▶ Do you need to debug? At what scale?

Let's look at some use-cases ...

# Six Degrees of Separation

Case 1

local code

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local  
compile

local debug

local run

Case 2

Case 3

Case 4

Case 5

Case 6

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# Tools

**NetBeans** An IDE with Java, C, C++ (Fortran) support. Mainly supports remote level case 3 (5 can be made to work).

**Eclipse** An IDE with Java, C, C++ and Fortran support. Remote level cases 3, 4 and 5.

**Command line+editor** Without tricks: remote level case 6. Emacs is an editor which can run over X.

**DDT** A commercial graphical debugger installed on all SciNet systems. Can run remotely (over X), ie. case 6.

# NetBeans

- ▶ Open-source IDE for Windows, Mac, Linux, and Solaris.
- ▶ Developed originally by Sun (acquired by Oracle).
- ▶ Supports C, C++, Fortran, Java, PHP, and others.
- ▶ Current version 7.1.2
- ▶ netbeans.org:



The screenshot shows the NetBeans website homepage. At the top left is the NetBeans logo, and at the top right is a language selection dropdown. Below the header is a navigation menu with tabs for Home, IDE, Platform, Plugins, Docs & Support, and Co. The main content area features a large blue banner for NetBeans IDE 7.1.2. On the left of the banner is a 3D-style box for the IDE with a 'NEW' tag and the text 'NetBeans IDE 7.1 The Smarter Way to Code'. To the right of the box, the text reads: 'NetBeans IDE 7.1.2', 'Develop desktop, mobile and web applications with Java, PHP, C/C++ and more.', and 'Runs on Windows, Linux, Mac OS X and Solaris. NetBeans IDE is open-source and free.' At the bottom right of the banner is a large orange button that says 'Download FREE NetBeans IDE 7.1.2'. A small mouse cursor is visible over the 'Platform' tab in the navigation menu.

# Eclipse

- ▶ Open-source IDE for Windows, Mac, Linux, and Solaris.
- ▶ Finds its origins in IBM.
- ▶ Can support C, C++, Fortran, Java, PHP, and others.
- ▶ PTP: parallel tools plugin (MPI, OpenMP)  
Will not cover in this talk.
- ▶ Current version Indigo
- ▶ eclipse.org:



**Stephan Herrmann**  
Project lead of  
Object Teams

Thank you for your support!  
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## Featured Eclipse Project



**Code Recommenders** supports developers on learning new APIs by providing tools which learn correct API usages or valuable API usage patterns by analyzing example code and re-integrates this regained knowledge back into your IDE.

[read more](#)

Get Started  
**Download**

» **Plugins**

» **Documentation**

# DDT

- ▶ Distributed Debugging Tool
- ▶ Made by Allinea
- ▶ Installed on all SciNet's systems (module load ddt/3.1).
- ▶ Runs remotely over X.
- ▶ Very good for debugging MPI, OpenMP and CUDA.

The screenshot displays the Allinea DDT v3.1 (on gpc-f102n084) interface. The main window shows a C++ code editor with the following code:

```
95 p.runtime = ini.get_double("runtime", 1.0e5);
96 p.dt = ini.get_double("dt", 0.2);
97 p.dc = ini.get_double("dc", 2.0);
98 p.l[0] = ini.get_double("lx", 10);
99 p.l[1] = ini.get_double("ly", 10);
100 p.l[2] = ini.get_double("lz", 10);
101 p.n[0] = ini.get_long("nx", 10);
102 p.n[1] = ini.get_long("ny", 10);
103 p.n[2] = ini.get_long("nz", 10);
104
105 cout << "l = "
106 << p.l[0] << " "
107 << p.l[1] << " "
108 << p.l[2] << "\n"
109 << "n = "
110 << p.n[0] << " "
111 << p.n[1] << " "
112 << p.n[2] << "\n";
113
114 // points per processor
115 double ppp = (p.n[0]*p.n[1]*p.n[2])/size;
116 n.dim[0] = n.dim[1] = n.dim[2] = 1;
```

The right-hand side of the interface shows the Locals window with the following variables and values:

Variable Name	Value
-argc	2
-argv	0x7ffffffc5...
-comm	
-coords	
-dfield	0x17
-field	
-fullnn	0x7ffff6e2
-ini	
-lastt	14073729
-negProc	
-negSlabIn	
-negSlabOut	
-npoints	14073735
-nthrds	2
-oldprogress	1342464
-origin	
-p	
-periods	

# Important Technical Details

Ssh

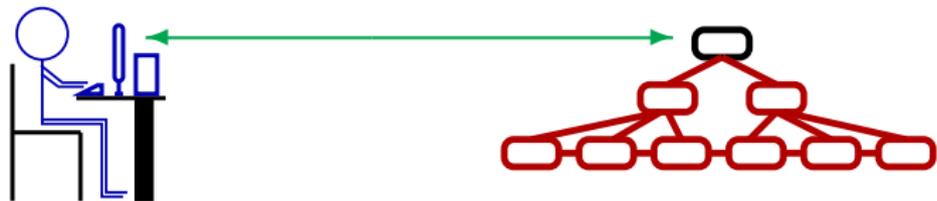
X Tunnels

Port Forwarding

# SSH

# SSH

- ▶ Secure way to login or exchange data with a remote machine.
- ▶ Linux/MacOS users: very likely you'll have ssh.
- ▶ Windows users will have to install SSH software. SciNet recommends, roughly in order of preference:
  1. Cygwin with OpenSSH and X forwarding
  2. MobaXterm
  3. PuTTY (does not have X forwarding).
- ▶ User authentication either by password,
- ▶ Or using cryptographically secure keys.



## SSH Keys (optional)

- ▶ Keys guarantee request is coming from a trusted source;
- ▶ If done properly, as secure as requiring a password;
- ▶ More convenient (and necessary for some apps).

```
local:~$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key ($HOME/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in $HOME/.ssh/id_rsa.
Your public key has been saved in $HOME/.ssh/id_rsa.pub.
...
local:~$ scp $HOME/.ssh/id_rsa.pub me@login.utoronto.ca:lockey
local:~$ ssh me@login.utoronto.ca
me@login.scinet.utoronto.ca's password:
scinet01:~$ cat lockkey >> .ssh/authorized_keys
```

Don't Use passphrase-less keys!

Do **NOT** generate ssh keys on your SciNet account.

## Sshfs (optional)

With ssh setup, can't I just see my remote files as if they're local?

Why, yes you can, using sshfs!

```
local~$ mkdir $HOME/remote
```

```
local~$ sshfs me@login.scinet.utoronto.ca: $HOME/remote
```

Notes:

- ▶ Will need to install sshfs first.
- ▶ Can you any editor now, but still not seeing the compilers, nor can you run or debug. (case 6, but with command line)
- ▶ Reading/writing not as fast as local files (may want to tune down auto-save features).
- ▶ On windows, you can try win-sshfs or Uniwin (I have not tested these).

# X tunneling/forwarding

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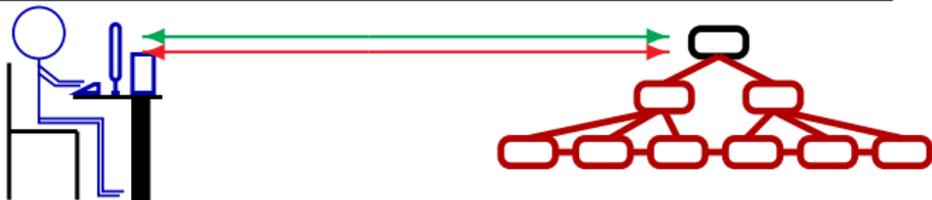
```
local:~ xhost +  
local:~$ ssh me@login.scinet.utoronto.ca  
scinet01:~$ export DISPLAY=local.utoronto.ca:0.0  
scinet01:~$ xterm...
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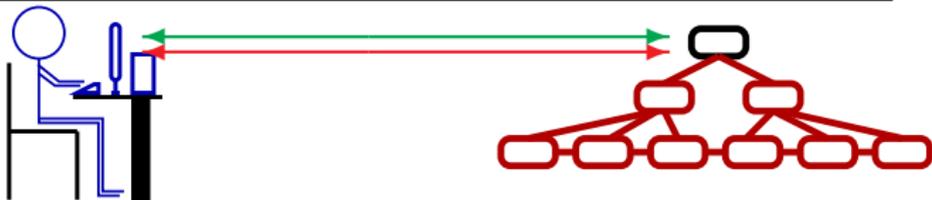


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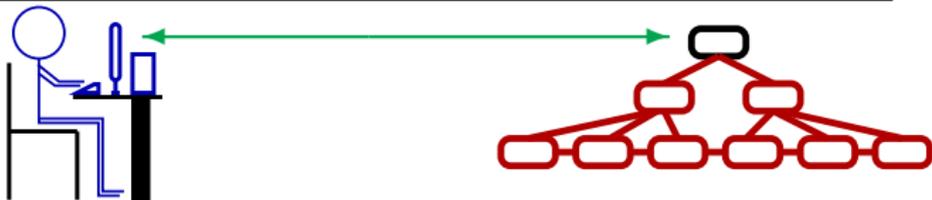


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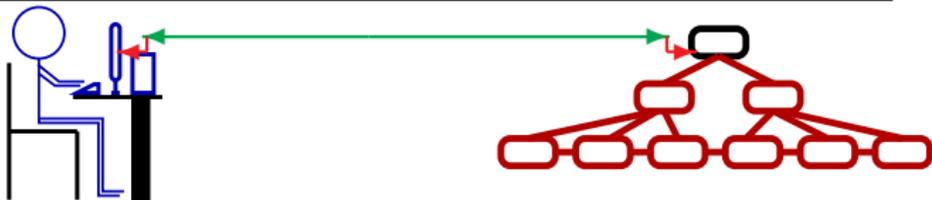


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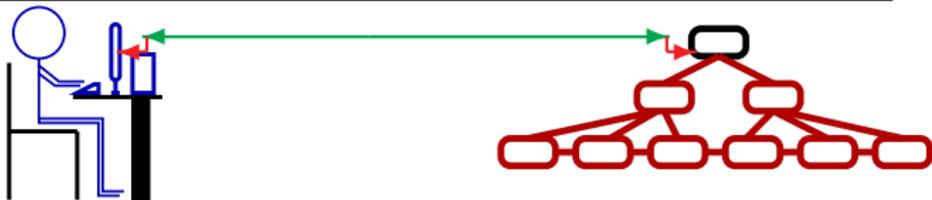
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```
local:~$ ssh me@login.scinet.utoronto.ca -X  
scinet01:~$ xterm...
```

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local:~$ ssh me@login.scinet.utoronto.ca  
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scinet01:~$ xterm...
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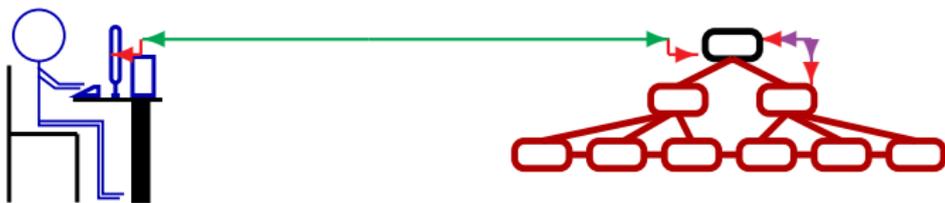
```
local:~$ ssh me@login.scinet.utoronto.ca -X  
scinet01:~$ xterm...
```

- ▶ Note: xterm needs module load Xlibraries.

## X forwarding X forwarding ...

- ▶ X can be forwarded once more:

```
local:~$ ssh me@login.scinet.utoronto.ca -X  
scinet01:~$ ssh gpc02 -X  
gpc02:~$ xterm...
```



- ▶ Cannot forget `-X` at any intermediate stage.
- ▶ Don't set `DISPLAY`!

# When to use X forwarding?

**X can be rather slow.**  
Depends on amount of network traffic and graphics.

Very graphics heavy?

Try to use an **alternative** that has a client run locally, connection to server in other ways.

*Examples: paraview, eclipse, netbeans*

Light graphics/no choice?

**X forwarding**

*Examples: emacs, ddt*



<http://clipartmountain.com/clipart1/turtles1.htm>

# Port Forwarding

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Why do ports need forwarding?

- ▶ Only port 22 of SciNet login nodes is accessible from outside
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- ▶ Hence the *double hop* to get to devel node (e.g. gpc01).
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**Port forwarding to the rescue!**

## Port forwarding - How?

- ▶ Very analogous to X forwarding: use ssh.
- ▶ Make a port on one machine go to another port on another machine.
- ▶ Syntax a bit confusing at first.

```
local:~$ ssh me@remote -N -L<port>:<amachine>:<aport>
```

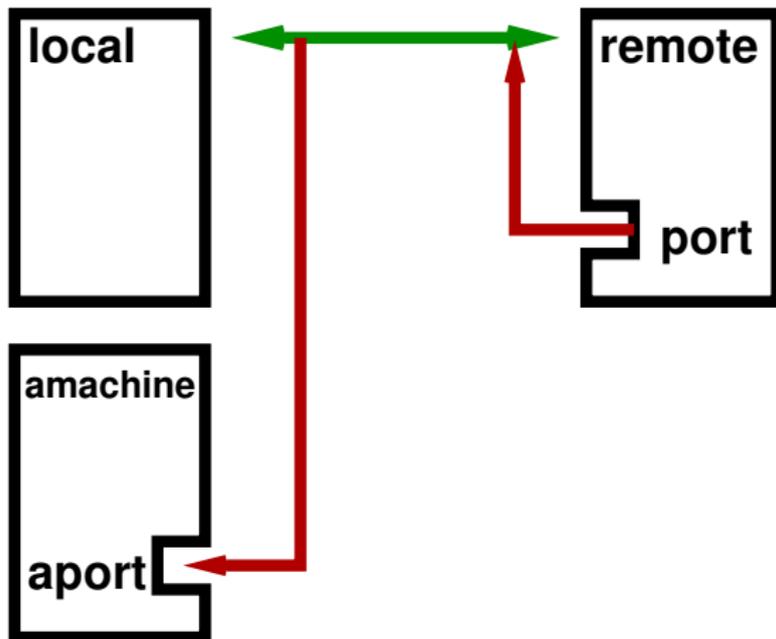
```
local:~$ ssh me@remote -N -R<port>:<amachine>:<aport>
```

- ▶ -N means: do not start a shell

## Port forwarding - remote ports

```
local:~$ ssh me@remote -N -R<port>:<amachine>:<aport>
```

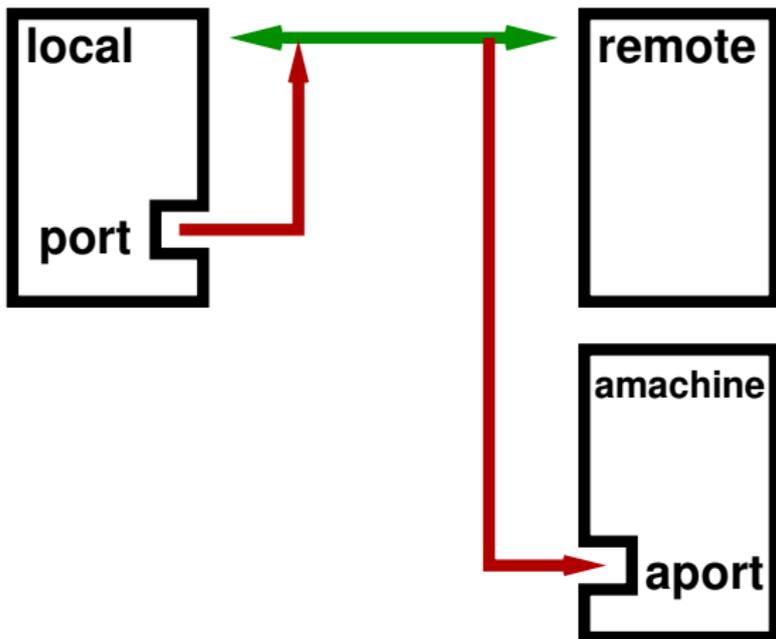
- ▶ -R stands for 'remote' and makes port <port> on remote act as if it were port <aport> on <amachine>.
- ▶ local is just a 'broker' that sets up the forwarding path.
- ▶ Not very useful here (why?)



## Port forwarding - local ports

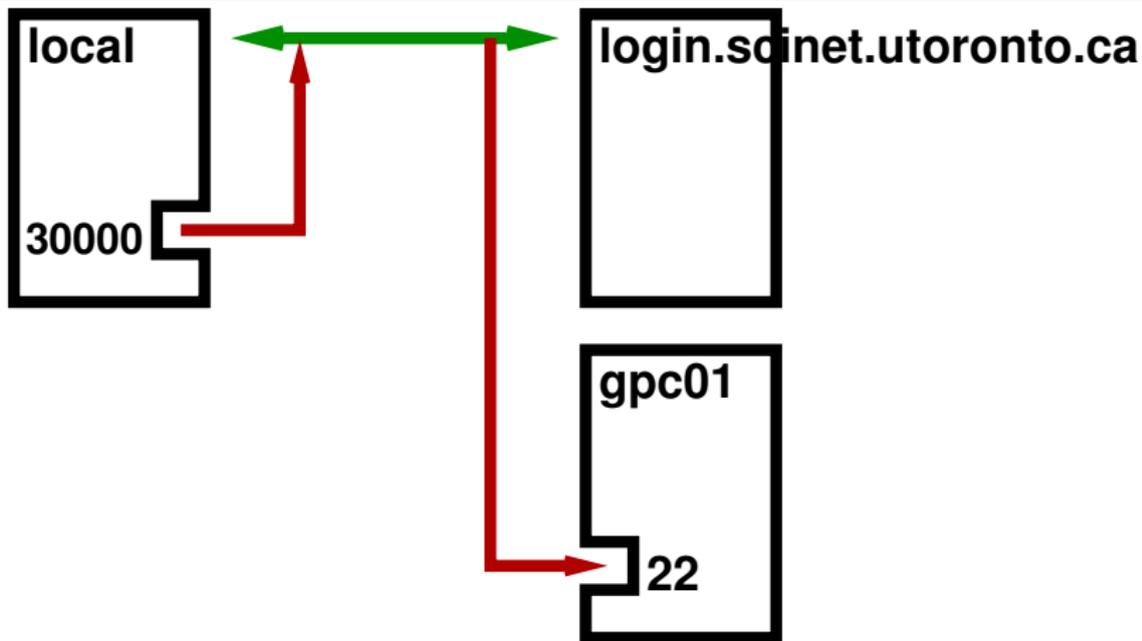
```
local:~$ ssh me@remote -N -L<port>:<amachine>:<aport>
```

- ▶ -L stands for 'local' and makes port <port> on local act as if it were port <aport> on <amachine>.
- ▶ remote is just a 'broker' that sets up the forwarding path.



## Port forwarding - Example

```
local:~$ ssh login.scinet.utoronto.ca -N -L30000:gpc01:22
```



- ▶ From another window on local, can now ssh to gpc01:

```
local:~$ ssh localhost -p 30000
```

## NetBeans setup example

- ▶ netbeans.org:  
Download NetBeans with c/c++ support  
Will then have Fortran as well.
- ▶ Hybrid MPI+OpenMP diffusion code (3d)
- ▶ NetBeans running locally
- ▶ Code remote on SciNet, but files shared to the local machine
- ▶ Aim: Remote build and remote run on GPC
- ▶ Little snag: netbeans does not read .bashrc when doing remote commands.  
⇒ wrapper scripts for compilers.

A few steps to be taken...



## A few steps to be taken...



Configure remote host:

a) Forward ports

b) Mount remote files

c) NetBeans:  
New 'C/C++  
Build Host'

## A few steps to be taken...

1 Setup Remote Host	2 Setup Compiler	3 Create Project	4 Setup Run
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Netbeans screencast....

## Eclipse setup example

- ▶ eclipse.org:  
Download “Eclipse IDE for Parallel Application Developers”
- ▶ Warning: In eclipse, everything is a plugin.
  - ▶ Great for new features:
    - ▶ CDT : C/C++ development
    - ▶ Photran: Fortran development
    - ▶ Remote Tools: remote development
    - ▶ PTP: parallel tools
  - ▶ Common operations are sometimes nested deeply in the menus.  
Google is your ally.
  - ▶ With changes from release to release.
- ▶ Will show preview release “Juno” here.
- ▶ Eclipse remote commands for seem to read .bashrc.  
⇒ should have compilers, mpi versions, in .bashrc.
- ▶ Needs java on the remote end: `module load java` in .bashrc .

Eclipse screencast....