NEXUS
Software Project

Henrik Härkönen
Pasi Aho
Minna Rajala
Miikka Lahti

28.05.2002

Contents

1 Introduction

The Nexus system is a distributed computing environment (later referred as GRID). The goal of the Nexus project was to study how a GRID is built up as well as the efficiency of distribution. An application was also made for testing purposes, which calculates 3D fractals in a distributed fashion utilizing the GRID.

One of the basic requirements for Nexus project was that Globus Toolkit [1] is used to build the GRID test-bed. Therefore, Globus Toolkit with libraries required was installed on all computers which took part in the computing process. Also, a network monitoring component called Network Weather Service [2], was installed on the machines.

This document describes the programs installed and the installation procedures. It also describes the settings needed to be set before the system is up and running. Also are presented few example cases of problem situations we came across and how we resolved them.

Chapter 2 describes some preparations you need to make before installing the system, including installation instructions for the libraries which are needed by Globus Toolkit. The installation instructions of Globut Toolkit itself are described in Chapter 3. The installation of NWS is described in the Chapter 4. Chapter 5 describes how to install the test application. Chapter 6 informs about the directory structure we used. And finally, the Chapter 7 gives information about the problems encountered during the installation and setting.

2 Preparations

Before you start to install the Globus Toolkit and other software, few preparations are in order to make the process successful.

2.1 Requirements

You need Linux with kernel version 2.2.x or 2.4.x installed on the computers to run Globus Toolkit and NWS. Also Java 1.3.x is needed. The Java CoG won´t work properly with Java 1.4.x.

Obviously, you need enough free space on your drive. After compiling and installing all software, some 100MB of disc space is consumed. In addition, the compiling process takes a bit more space, thus 500MB should be enough.

Prepare for yourself to wait a while, since it takes about 45 to 60 minutes to install on a modest machine (Celeron 700MHz, 128MB), of which most of the time goes to compiling the code.

You don't have to be root to install Globus, so you can install it anywhere you like. But when starting Globus, you should start it with root permission, perhaps with `sudo`.

2.2 Documentation

Before you download the software packages and start to install the software needed, some additional installation documentation is needed. We used Globus Toolkit's own installation guide [6] as a profound reference as well as a quick installation guide [3] in finnish from CSC, written by Markus Happonen `<Markus.Happonen@csc.fi>`. Happonen's article is quite good outline for installing Globus and needed libraries.

2.3 SSLeay

SSLeay [4] is a free version of Netscape's Secure Socket Layer made by Eric Young `<eay@cryptsoft.com>`. Globus Toolkit uses SSLeay library to handle the certificates and to secure the data transfer between nodes. You must install SSLeay before Globus, since Globus needs it during its compilation. We used SSLeay version 0.9.0b.

Installing SSLeay is pretty straightforward, and the Happonen's document [3] also guides you with it. One small addition to the installation procedure should be mentioned. If you want to install SSLeay to a different location than the default (as in Nexus project) before running `configure` you have to issue the command

```
perl util/ssldir.pl /destination/path/
```

2.4 OpenLDAP

OpenLDAP [5] is a free implementation of the LDAP (*Lightweight Directory Access Protocol*) protocol. It is used by Globus Toolkit to manage it's resources. You must install OpenLDAP before Globus, since Globus needs it at compile time. We used OpenLDAP version 1.2.7-globus, which is modified version for Globus Toolkit.

Installing OpenLDAP is also a simple procedure. The installation is described in Happonen's document [3]. No further additions to that.

2.5 Java CoG

The Java CoG (Commodity kit for Globus Toolkit) [9] is a Java API which we used to interface with the GRID. Java CoG is included in the application statically, but user still needs to install it in order to use Globus certificates. We used Java CoG version 0.9.13.

Installing Java CoG is easy. Unpack the binary package [10] and set the environment variable `COG_INSTALL_PATH` with the path where Java CoG was unpacked.

Next you must go to Java CoG `bin/` directory and run `setup` which asks where the certificates are and where it should create the proxy. Name the proxy file `proxy.txt` and create it with command `grid-proxy-init`. Remember to use the Java CoG's version of `grid-proxy-init`.

3 Globus Toolkit

The Globus Toolkit is a set of software tools which are used to build computational grids and grid-based applications. The Globus Toolkit is a open source software toolkit, and you can acquire it from the Globus Project's web page `http://www.globus.org`.

We decided to use version 1.1.4 of the Globus Toolkit, even though version 2.0 Beta was also available. Since it was a beta software and actually didn't quite work at first glance, we felt it was more safe to rely on the older version.

3.1 Installation

We recommend that you use Globus Toolkit's own installation manual [6] as a reference and Happonen's quick install guide [3] as outlined version of installation procedure.

The main steps in installing Globus are

- unpacking the source and compilation,
- running `globus-setup`,
- deploying the globus by running `globus-local-deploy` and
- requesting and managing the certificates.

The System Administration Guide [6] from Globus.org covers these topics quite thoroughly. The CSC installation documentation [3] can be used as quick install guide.

After deploying the globus, instructions are printed how to get the certificates from Globus Organization. It takes usually one day to reveive the certificates due to time difference between Finland and US.

3.2 Settings

The System Administration Guide [6] covers settings too, which might be good to read, as the CSC quick installation guide doesn't tell too much about them.

4 Network Weather Service

We used the Network Weather Service (NWS) [2] software for monitoring the network traffic and latency between the computers at certain time. On Windows machines we used NWS Java API to access the NWS services and to inquire data. Version 2.0.5 of NWS was used in the project.

4.1 Installation

Installing NWS [2] also followed the basic unix pattern in installing software from the source. Run `configure` in source directory and then run `make` and `make install` as follows:

```
./configure --prefix=/destination/directory/to/nws
make
make install
```

4.2 Running

Let us present a brief example how to use NWS. Consult the NWS user manual (which is included in the source package [8]) for further detail on the usage.

First, a NWS name server and a memory server must be set up. The name server keeps track of the machines connected to NWS and the memory server stores data gathered by NWS. If your name or memory server address is `tux.flux.net`, run the commands

```
./nws_nameserver &
./nws_memory -N tux.flux.net &
```

on your name or memory host. Now, you have to set the sensors on the machines that you wish to measure the network activity. On these hosts, start the sensor with the commands

```
./nws_sensor -N tux.flux.net -M tux.flux.net &
```

Next, you need to start the NwsServer which receives the measuring data and sends to the application. Start NwsServer on memory host by running `java NwsServer <memory.host.address> <path/to/nws_extract>`. The NwsServer can be found at the project's source directory.

After this, you are ready to start measuring activities on your hosts. See the NWS user manual [8] for how to control the NWS.

5 Fractal Calculator

The application made in the Nexus project is called Fractal Calculator. It calculates 3D fractals and visualizes them on the screen.

Installing the calculating side of the application is done by copying the `fcalcD` program on each machine that takes part in the calculation. Remember to put the program to the same path on each computer. You must later define the location of the program in the UI part of Fractal Calculator.

Installing the UI side of the application is trivial. Just run the jar package called `ui.jar` with command

```
java -jar ui.jar
```

and the application starts.

You must make sure that the proxy is valid and it is in the same directory with the application. Also the certificate authority file is needed in that same location.

6 Directory Structure

In our project, all software was installed under a user's home directory, and under a directory named `globus`/. The directory structure used in the project was the following one

```
~user/
      globus/
             globus-deploy/
             globus-install/
             nws/
             openldap/
             ssl/
```

7 Problems And Troubleshooting

We had various problems while installing or using Globus Toolkit and NWS. Let us consider the most important ones.

7.1 Setting up Globus

Problems could arise when you are not paying enough attention to setting the needed environment variables. For example `GLOBUS_DEPLOY_PATH`, `GLOBUS_INSTALL_PATH` or `GLOBUS_PATH` should contain the paths to the deploy directory, install directory and install directory's binary directory, as described in the administrators guide [6]. Not setting these might lead to unexpected and defective behavior in deploying stage and in usage.

For example, we had problems with deploying globus correctly, when the environment variables weren't set. When trying to run `globus-job-run` we got error message that said

```
ERROR: proxy does not exists
```

while `grid-proxy-info` said that proxy is valid for the next 10 hours.

7.2 Running Globus

If you have difficulties in making the Gatekeeper start with `inetd` or `xinetd`, it is easy to start it manually as a daemon process. For example try the command

```
sudo ./globus-gatekeeper -conf ../etc/globus-gatekeeper.conf
```

in the directoy `globus-deploy/sbin`.

7.3 Jobmanager

If you get error code 10 when trying to run a job and the job submission fails, try to check the file `globus-deploy/etc/globus-jobmanager.conf`. The parameters `manufacturer`, `osname` and `osversion` should be set. This can be carried for example with the commands

```
-globus-host-manufacturer unknown
-globus-host-osname Linux
-globus-host-osversion 2.4.9-13
```

7.4 MDS registration

You might have problems getting the MDS to register your Globus hosts, though you are sure that everything is set up correctly in configuration files. This might be caused by a incompatibility issue with Bash2 shell.

If you are using a Bash2 shell on the host which is your MDS server with Globus 1.1.x, there is a big chance that you must patch your Globus to make it work with Bash2. Other option is to change your shell or Bash version.

The patch [7] from Benjamin Temko `<btemko@extreme.indiana.edu>` can be found at

```
http://www.extreme.indiana.edu/~btemko/grads/giis.html
```

Basically, just edit these files with text editor

```
(SRC)/
 InformationServices/mds/services/grid-info-site-backend.in
(INSTALL)/services/(arch)/libexec/grid-info-site-backend
(INSTALL)/tools/(arch)/libexec/grid-info-site-backend
(DEPLOY)/libexec/grid-info-site-backend
```

and make the following changes to the lines (line number in the beginning):

```
746: if test_rdn ${search_attr} $1  (take out the = sign)
760: search_rdns_expanded $1 $2     (take out the comma)
```

If you have already deployed the Globus, then it is only required to edit the `grid-info-site-backend` file from the deploy directory to make the MDS registration to work on that host. The hosts that will be registered to the MDS won't need the patch. If you know that you have this problem and you are carrying out new installation from sources, then it is preferable to edit the source directory version of the backend, of course.

This problem was the most serious one with Globus, since information about it was fairly limited. We were informed by one email from Globus mailing list archive that there is a patch for this bug. Nevertheless, solving this wasn't easy, since the link to the patch was dead, and we had to find and contact the author of the patch for further information. Fortunately, he soon told the new location to the patch.

7.5 NWS sensors

While measuring network traffic, the NWS sensors can be quite unstable from time to time. Especially this problem might be faced when measuring activity is started again before the old was stopped, for example as a result of failed client program. Due to this NWS can give you duplicate information or the sensors will consume much CPU time or even crash.

To resolve the condition where sensor goes haywire, one could try to restart the sensors. If still the results are flawed, the memory and the nameserver must be restarted.

References

[1] Globus Organization, Globus Toolkit, `<URL:http://www.globus.org>`, 2002.

[2] University of California, Santa Barbara, Network Weather Service, `<URL:http://nws.cs.ucsb.edu/>`, 2002.

[3] Happonen, Markus, *Hajautetun laskennan ohjelmisto Globus ja sen asennus*, @CSC 4/2001, `<URL:http://www.csc.fi/lehdet/atcsc/atcsc4-2001/globus.pdf>`, 2001.

[4] Young, Eric, SSleay, `<URL:ftp://ftp.psy.uq.oz.au/pub/Crypto/SSL/>`, 1998.

[5] The OpenLDAP Project, OpenLDAP, `<URL:http://www.openldap.org/>`, 2002.

[6] University of Chicago and The University of Southern California, *Globus Toolkit 1.1.3 System Administration Guide*, `<URL:http://www.globus.org/toolkit/documentation/globus_sag1.1.3.pdf`, 2000.

[7] Temko, Benjamin, Globus Bash2 patch, `<URL:http://www.extreme.indiana.edu/~btemko/grads/giis.html>`, 2002.

[8] University of California, Santa Barbara, Network Weather Service source file, <URL:http://nws.cs.ucsb.edu/download/>, 2002.

[9] Globus Organization, Java CoG, <URL:http://www.globus.org/cog/java/software.html>, 2002.

[10] Globus Organization, Java CoG binary package, <URL:http://www-unix.globus.org/cog/distribution/cog-latest-bin.tar.gz>, 2002.