Title: Running RINA on GENI

Overview:
Recursive InterNetwork Architecture (RINA) is a new network architecture based on the fundamental principle that networking is Inter-Process Communication (IPC). RINA separates mechanisms and policies, and enables policy-based dynamic service composition. This tutorial introduces the basic elements of the Recursive InterNetwork Architecture (RINA) (http://csr.bu.edu/rina/) and describes how to setup RINA experiments on GENI nodes.

Prerequisites:

- A basic understanding of GENI concepts such as those covered in the Introduction to GENI and Experimentation using GENI tutorial (http://groups.geni.net/geni/wiki/GEC19Agenda/IntroToGENI).

- Comfortable with running your own experiments on GENI resources.

- Verify that you are able to log into the GENI Portal (https://portal.geni.net).

- A basic familiarity with using a UNIX command line.

- A laptop with Mac OS or Linux OS. For Windows users, install Cygwin, or a recent version of Virtual Box (https://www.virtualbox.org/) with an Ubuntu image.

- A basic understanding of the Recursive InterNetwork Architecture (RINA: http://csr.bu.edu/rina).

Tools:

- GENI Portal.
- UNIX command line.

Where to get help:

- For support and general questions about ProtoRINA, please contact the ProtoRINA team at *protorina-developers@cs.bu.edu*.
- You are welcome to subscribe to ProtoRINA users mailing list at http://cs-mailman.bu.edu/mailman/listinfo/protorina-users

Experiment 1: Enrollment

Tutorial Instructions:

Design/Setup
Execute
Finish

Part1: Design/Setup

- **Design the Experiment**
- **Establish the Environment**

Part2: Execute

- **Login to VMs**
- **Import configuration files**
- **Start IDD and DNS**
- **Start Node1**
- **Start Node2**
- **Analysis**

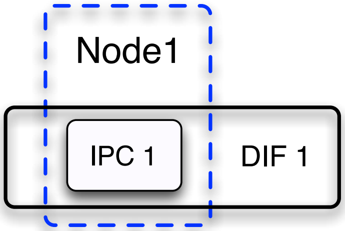
Part3: Finish

Experiment 1: Enrollment

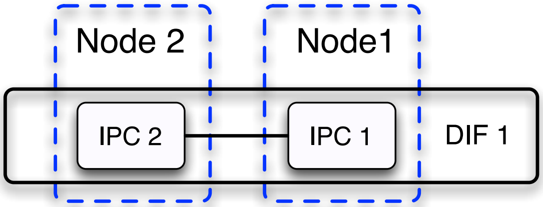
Part1: Design/Setup:

1. Design the Experiment

In this first experiment, we will run a simple RINA experiment for DIF enrollment. We have reserved resources for you. We will first start Node1. This node has an IPC process IPC1 running on it as shown below.



Later we will start another RINA node called Node2. This node will have an IPC process IPC2 running on it and it will join the DIF through IPC1 and become a member of DIF1 as shown below.



2. Establish the Environment

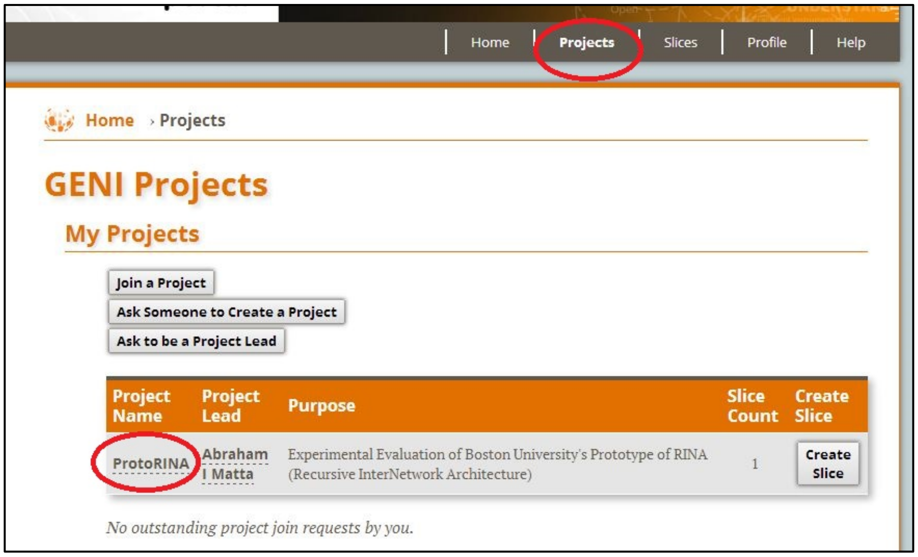
Skip this section if you have already established your environment for RINA

2.1. Pre-work:

- Ensure SSH keys are setup. If your SSH keys are not setup before, do the following steps:
  - Generate an SSH Private Key on the *Profile* page on the GENI portal
  - Download Private Key to *~/Downloads*
  - Open terminal and execute
    $ mv ~/Downloads/id_geni_ssh_rsa ~/.ssh/.
    $ chmod 0600 ~/.ssh/id_geni_ssh_rsa
    $ ssh-add ~/.ssh/id_geni_ssh_rsa

- Ensure you are part of the project "ProtoRINA".

- To check this, go to portal.geni.net -> Projects. You should be able to see project "ProtoRINA" under "My Projects".



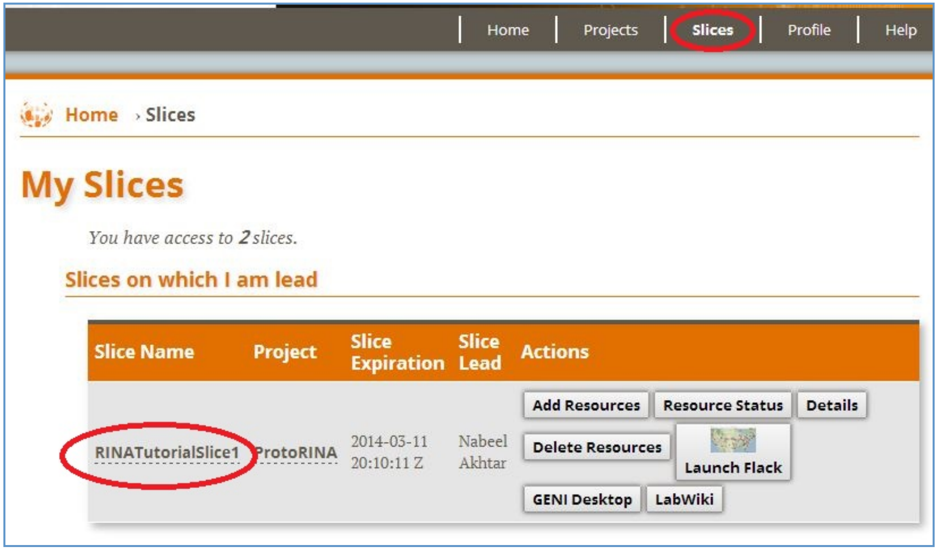
GENI Projects

My Projects

Project Name	Project Lead	Purpose	Slice Count	Create Slice
ProtoRINA	Abraham I Matta	Experimental Evaluation of Boston University's Prototype of RINA (Recursive InterNetwork Architecture)	1	Create Slice

No outstanding project join requests by you.

- Ensure that you are added to the slice by the lead.
  - To check this, go to portal.geni.net -> Slices. You should be able to see slice "RINATutorialSlice1" or "RINATutorialSlice2" under "My Slices".



My Slices

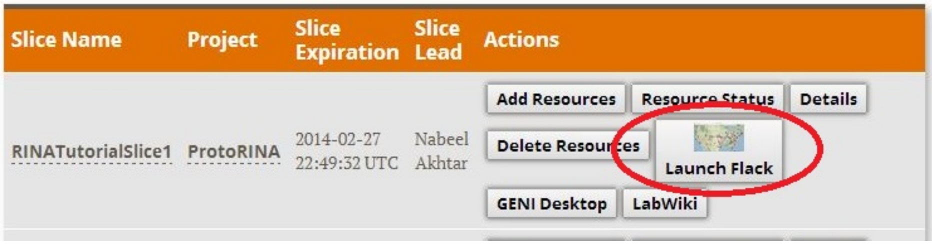
You have access to 2 slices.

Slices on which I am lead

Slice Name	Project	Slice Expiration	Slice Lead	Actions
RINATutorialSlice1	ProtoRINA	2014-03-11 20:10:11 Z	Nabeel Akhtar	Add Resources Resource Status Details Delete Resources Launch Flack GENI Desktop LabWiki

2.2. Check Resources:

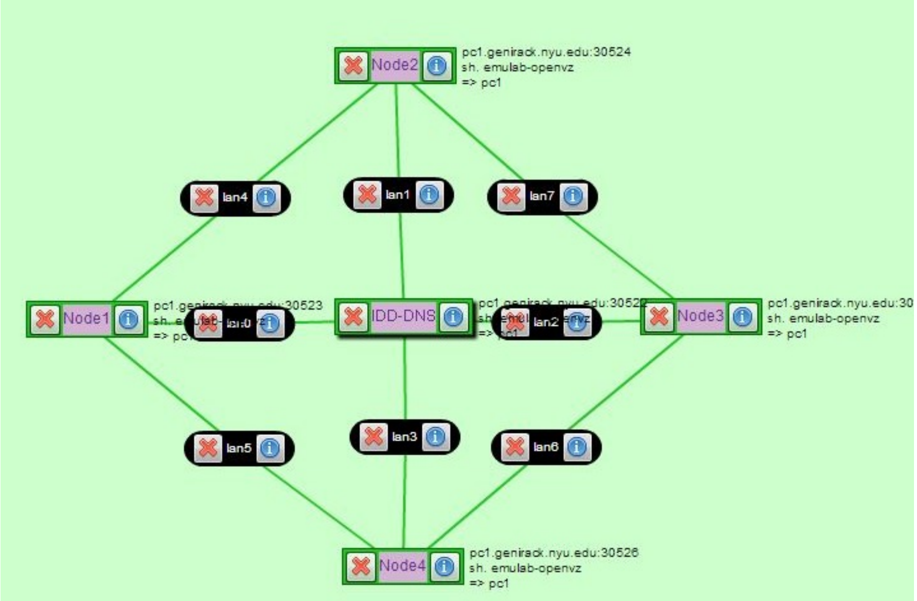
- Click on "Launch Flack" on your slice. That might take a few minutes to display the whole GUI.



Slice Name	Project	Slice Expiration	Slice Lead	Actions
RINATutorialSlice1	ProtoRINA	2014-02-27 22:49:32 UTC	Nabeel Akhtar	Add Resources Resource Status Details Delete Resources Launch Flack GENI Desktop LabWiki

⚠ DO NOT DELETE RESOURCES!!!

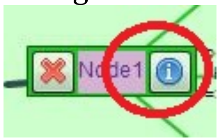
- You should see the following on your Flack.



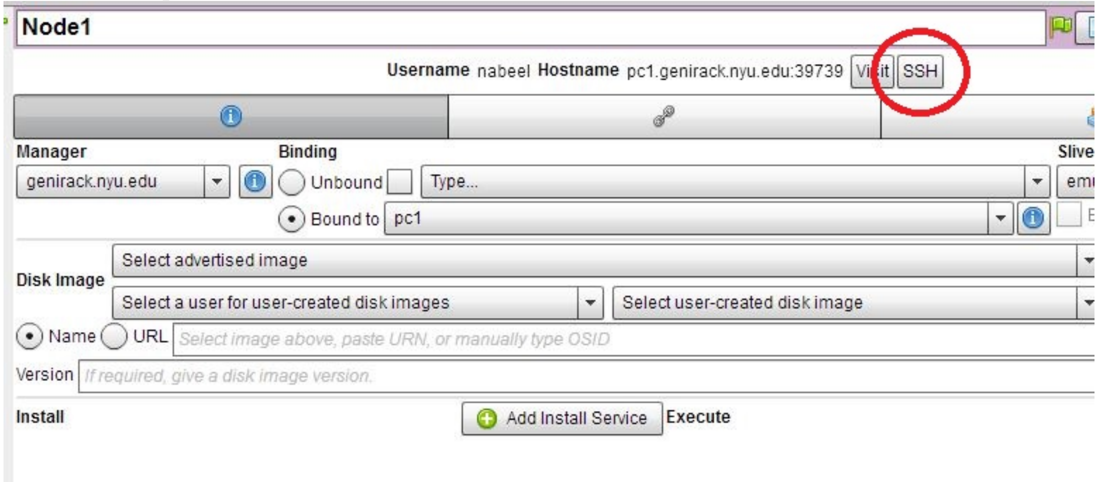
Part2: Execute:

1. **Login to VMs**
   In this experiment, we will use three VMs (named Node1, Node2 and IDD-DNS). You can see these three VMs on Flack.

   a) To login to a VM, click on ⓘ on "Node1" as shown below.



   b) Now, Click on SSH link as shown below. A new terminal window will pop up.



Node1

Username nabeel Hostname pc1.genirack.nyu.edu:39739

Manager: genirack.nyu.edu

Binding: ○ Unbound □ Type... ● Bound to pc1

Slive: emı

Disk Image: Select advertised image; Select a user for user-created disk images; Select user-created disk image

● Name ○ URL: Select image above, paste URN, or manually type OSID

Version: If required, give a disk image version.

Install

To ssh from the command line, do the following (substituting with values shown on the screen).

```
ssh USERNAME@HOSTNAME -p PORT
```

   c) Go back to Flack, and ssh to the other two VMs (Node2 and IDD-DNS) following the instructions given above.

   d) Make sure you open two terminal windows for "IDD-DNS". We will run the IDD process and the DNS process separately using two terminal windows.

You should have 4 terminal windows now: one for Node1, one for Node2 and two for IDD-DNS.

The IDD process provides RINA directory services

2. Import configuration files

Now you will import configuration files to your home directory for three VMs respectively.

For each VM, copy your group files to your local directory as shown below. You can find your group number in the worksheet provided to you.

```
cp -r /users/Tutorial/master/group1/ ~
```

⚠ Make sure you copy data for your own group provided in the handout.

ℹ Each RINA node process and IPC process has a configuration file which specifies their properties. User can try different settings by changing these configuration files. For RINA node, it includes information about application processes and IPC processes that are residing on this node. For an IPC process, it specifies properties such as underlying DIF information, enrollment policy, routing policies.

(1)The following are Node1's configuration. You can find it in `group1/Configurations/exp1/Node1/Node1.properties`.

```
node.name = Node1
IPC.1.DIF = DIF1
IPC.1.name = IPC
IPC.1.instance = 1
IPC.1.configurationFile = IPC1.properties
```

The node's name is Node1. It only has one IPC process, and has no application process on it.

(2)The following are part of the IPC1's configuration file. You can find it in `group1/Configurations/exp1/Node1/IPC1.properties`.

```
rina.enrollment.authenPolicy =AUTH_PASSWD
rina.routing.protocol = linkState
rina.routingEntrySubUpdatePeriod = 2
rina.checkNeighborPeriod = 2
rina.linkCost.policy = hop
```

The IPC1 process asks for user name and password when enrolling a new member into DIF. It uses the link–state routing protocol, link-state updates are sent to its neighbors every 2 second, and reachability to its neighbors is checked every 2 seconds. Hop count is used to compute path cost.

3. Start IDD and DNS

We will start the IDD process and DNS process now.

a) To run DNS, go to directory with the DNS properties file using one of the IDD-DNS terminal windows:

```
cd group1/IDD-DNS/DNS/
```

Now run the following command to start DNS:

```
java -jar /users/Tutorial/master/IDD-DNS/DNS/DNS.jar dns.properties
```

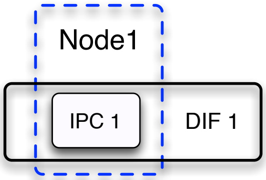
b) To run IDD, go to directory with the IDD properties file using the second IDD-DNS terminal windows:

```
cd group1/IDD-DNS/IDD/
```

Now run the following command to start IDD:

```
java -jar /users/Tutorial/master/IDD-DNS/IDD/IDD.jar idd.properties
```

4. Start Node1



Now we will start the Node1 process on the first VM (Node1).

a) In the terminal for Node1, go to directory for Node1 as shown below:

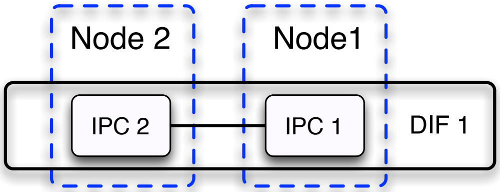
```
cd group1/Configurations/exp1/Node1/
```

b) Start Node1 process using the following command:

```
java -jar /users/Tutorial/master/RINANode.jar Node1.properties
```

At this point, your Node1 should be up and running.

5. Start Node2



Now we will start the Node2 process and begin the enrollment for IPC2.

a) In the terminal for Node2, go to directory for Node2 as shown below:

```
cd group1/Configurations/exp1/Node2
```

b) Start Node2 process using the following command:

```
java -jar /users/Tutorial/master/RINANode.jar Node2.properties
```

At this point, your Node2 should be up and running and it will join the DIF through IPC1 on Node1.

5. Analysis

Now we will analyze of the enrollment procedure by parsing the log file at Node2.

a) Stop Node1 and Node2:
 You can terminate the node process by pressing "Ctrl+c" on the keyboard.

⚠ DO NOT CLOSE TERMINAL WINDOWS

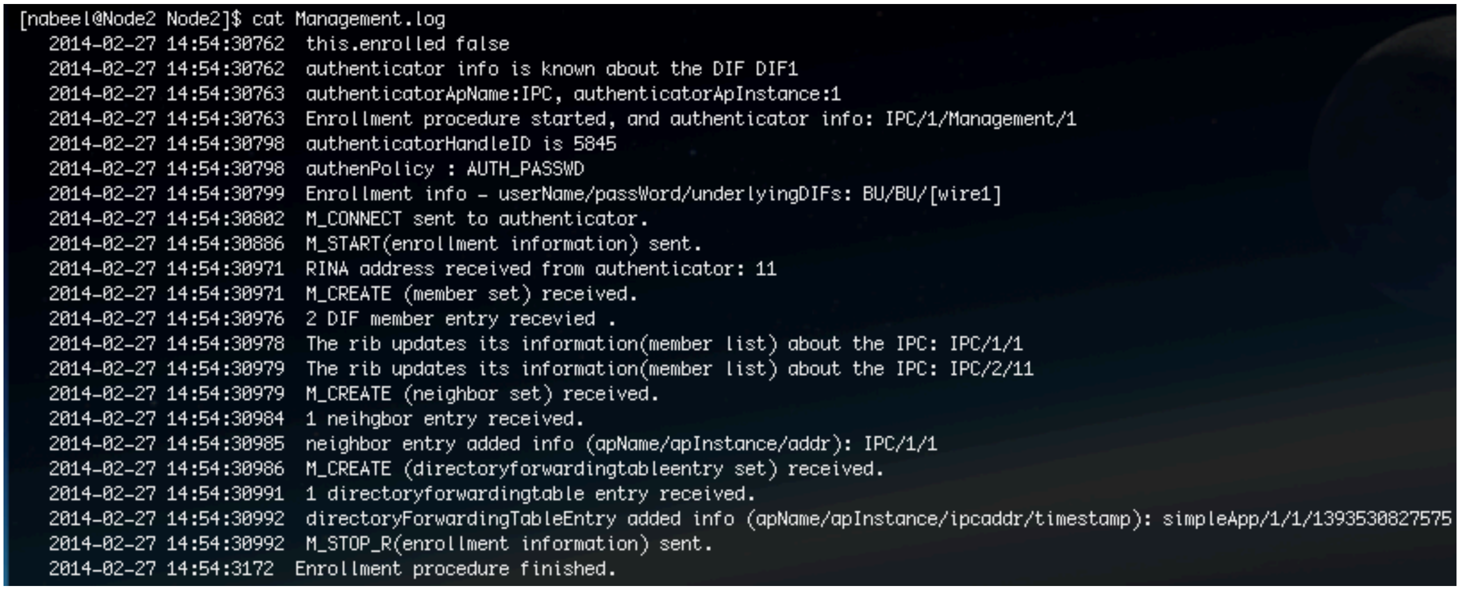
b) We will look at the management messages exchanged between IPC2 and IPC1. Type following in terminal for Node2 to parse the log file:

```
/users/Tutorial/master/LogChecker.sh -i rinaBU.log -o Management
```

c) This will generate a log file for all the management messages. To display this log file, type the following:

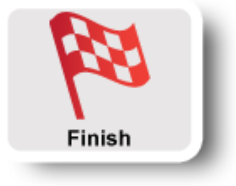
```
cat Management.log
```

Sample output is shown below:



```
[nabeel@Node2 Node2]$ cat Management.log
   2014-02-27 14:54:30762  this.enrolled false
   2014-02-27 14:54:30762  authenticator info is known about the DIF DIF1
   2014-02-27 14:54:30763  authenticatorApName:IPC, authenticatorApInstance:1
   2014-02-27 14:54:30763  Enrollment procedure started, and authenticator info: IPC/1/Management/1
   2014-02-27 14:54:30798  authenticatorHandleID is 5845
   2014-02-27 14:54:30798  authenPolicy : AUTH_PASSWD
   2014-02-27 14:54:30799  Enrollment info - userName/passWord/underlyingDIFs: BU/BU/[wire1]
   2014-02-27 14:54:30802  M_CONNECT sent to authenticator.
   2014-02-27 14:54:30886  M_START(enrollment information) sent.
   2014-02-27 14:54:30971  RINA address received from authenticator: 11
   2014-02-27 14:54:30971  M_CREATE (member set) received.
   2014-02-27 14:54:30976  2 DIF member entry recevied .
   2014-02-27 14:54:30978  The rib updates its information(member list) about the IPC: IPC/1/1
   2014-02-27 14:54:30979  The rib updates its information(member list) about the IPC: IPC/2/11
   2014-02-27 14:54:30979  M_CREATE (neighbor set) received.
   2014-02-27 14:54:30984  1 neihgbor entry received.
   2014-02-27 14:54:30985  neighbor entry added info (apName/apInstance/addr): IPC/1/1
   2014-02-27 14:54:30986  M_CREATE (directoryforwardingtableentry set) received.
   2014-02-27 14:54:30991  1 directoryforwardingtable entry received.
   2014-02-27 14:54:30992  directoryForwardingTableEntry added info (apName/apInstance/ipcaddr/timestamp): simpleApp/1/1/1393530827575
   2014-02-27 14:54:30992  M_STOP_R(enrollment information) sent.
   2014-02-27 14:54:3172  Enrollment procedure finished.
```

Part3: Finish:



You are done with the first experiment. Make sure you terminate all the processes on Node1, Node2 and IDD-DNS nodes.

⚠ DO NOT CLOSE TERMINAL WINDOWS

Let’s proceed to the second experiment. We will use the same resources for the second experiment.