An Experiment Tutorial for the NorNet Core Testbed at Hainan University

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Preparations

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Tutorial Accounts

- You should have received an account
  - Username
  - Password
- Valid for:
  - SSH login server
  - PLC server

Do you have an account? If not, ask!
Initial Tasks

- **Account for our SSH login server** gatekeeper.nntb.no:
  - Server is gateway into NorNet Core network
  - `ssh <username>@gatekeeper.nntb.no`
  - Use port forwarding to access PLC and Monitor servers:
    - Forwards TCP port 2000 to PLC server's HTTPS port
    - Forwards TCP port 2001 to Monitor server's HTTP port
  - **Account for the PLC server** plc.simula.nornet (inside NorNet Core only):
    - Login: `<username>@simula.nornet`
  - **VPN into NorNet Core coming soon**

Try to directly connect to your NorNet Core switch
Access to PLC and Monitor

- Via port forwarding:
  - PLC: https://localhost:2000/

- Inside NorNet Core network:
  - Monitor: http://monitor.simula.nornet
  - PLC: https://plc.simula.nornet

Is everybody able to log in?
Overview:
Getting an Overview of the Testbed

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“Kontrollsenteret”

See http://monitor.simula.nornet within NorNet Core!
See https://plc.simula.nornet within NorNet Core!
PLC User Interface: Nodes View

Node state: should be "boot"
PLC User Interface: Account View

- Upload your SSH public key here!
- Public keys get distributed to all nodes (may take up to 1 hour!)
Overview:
Using a Slice

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The Test Slice *srl_test*

- A test slice has already been created:
  - Name: *srl_test*
  - Special NorNet Core properties:
    - Own IP addresses on each node
    - IPv4 and IPv6
    - Multiple ISPs (at sites with several ISPs)
- The slice is instantiated on all nodes by a sliver (LXC container)
- Your account is mapped as user to *srl_test*
Logging In

• From the login server:
  - ssh -i <your private key> <slice name>@<node name>

• Examples (private key is in ~/.ssh/id_rsa, slice is srl_test):
  - ssh -i ~/.ssh/id_rsa srl_test@boao.hu.nornet
  - ssh -i ~/.ssh/id_rsa srl_test@altenessen.ude.nornet
  - ssh -i ~/.ssh/id_rsa srl_test@nordlys.unis.nornet
  - ssh -i ~/.ssh/id_rsa srl_test@julenisse.uia.nornet
  - ssh -i ~/.ssh/id_rsa srl_test@watson.ku.nornet

• Note: login is via node's SSH server to sliver on the node!

Use PLC to find other nodes. There are more than 100 nodes!
Note the Different Entities: Server, Node, Sliver

- **Server (physical)**
- **Node (virtual)**
  - Sliver hu_multipath
  - Sliver haw_tutorial
  - Sliver ntnu_test
  - Sliver due_rserpool
  - Sliver uib_mptcp
  - ...

**Slice:**
- User list
- Node list

Sliver = an instance of a slice on a node

*SSH* <Sliver>@<Node>*

Forwarding to sliver!
Inside a Sliver

- Each sliver contains a Fedora Core 18 environment

**Obtain root access:**
- `su`
- `sudo bash`

**Install custom software:**
- `dnf install <package> ...`
- **Example:** `dnf install netperfometer`

**Show IP addresses and routes:**
- `ip -4 addr show ; ip -4 route show`
- `ip -6 addr show ; ip -6 route show`

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**Remember:** slivers have their own addresses!
Nodes, Slivers and Addresses

- **Node:**
  - The node itself, e.g. altenessen.ude.nornet
  - Used for SSH login

- **How to find sliver addresses of a node?**
  - Look inside the sliver itself (login to sliver → ip addr show)
  - Ask the DNS server:
    - Use “dig” (part of bind-utils package for Fedora Core)
    - `dig <slice name>.<node name>.<site name>.nornet`
    - But replace “_” by “–” in slice name!
  - Examples for haw_tutorial slice:
    - `dig haw-tutorial.altenessen.ude.nornet any` to obtain primary provider (it is in the CNAME, here: “dfn”)
    - `dig haw-tutorial.altenessen.all.ude.nornet any` to obtain all providers' addresses
    - `dig haw-tutorial.solvang.all.simula.nornet` without “any” → gets only A RRs (i.e. IPv4 addresses)
A `dig` Example

```
olal@nordberg:~$ dig haw-tutorial.solvang.all.simula.nornet any
;; DiG 9.9.2-P1 <<>> haw-tutorial.solvang.all.simula.nornet any
...

;; ANSWER SECTION:

haw-tutorial.solvang.all.simula.nornet. 86400 IN A 10.2.1.130
haw-tutorial.solvang.all.simula.nornet. 86400 IN A 10.1.1.130
haw-tutorial.solvang.all.simula.nornet. 86400 IN AAAA 2001:700:4100:101::82:69
haw-tutorial.solvang.all.simula.nornet. 86400 IN AAAA 2001:700:4100:201::82:69
haw-tutorial.solvang.all.simula.nornet. 86400 IN HINFO "Amiga 5000" "Slice haw_tutorial"
haw-tutorial.solvang.all.simula.nornet. 86400 IN LOC 59 53 45.240 N 10 37 39.360 E 15.00m

;; AUTHORITY SECTION:

simula.nornet. 86400 IN NS ns.ntnu.nornet.
...```
Overview:
A Practical Example

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A Multi-Path Routing Test

- Select two nodes at different sites
  - List: [https://www.nntb.no/pub/nornet-configuration/NorNetCore-Sites.html](https://www.nntb.no/pub/nornet-configuration/NorNetCore-Sites.html)
  - Login to `srl_test` sliver: `ssh srl_test@<node name>`
  - Check IP addresses: `ip -4 addr show dev eth0`
  - Example:
    - `srl-test.kettwig.ude.nornet`: 10.30.42.122 10.31.42.122
      - ISPs: 30=DFN, 31=Versatel (an ADSL connection)
    - `srl-test.frogner.simula.nornet`: 10.1.1.131 10.2.1.131 10.4.1.131 10.9.1.131
      - ISPs: 1=UNINETT, 2=Kvantel, 4=Telenor, 9=PowerTech
- Try ping/traceroute:
  - `ping [-f] [-s <size>] [-c <count>] <dest IP> -I <src IP>`
  - `traceroute <dest IP> -s <src IP>`
  - Look at the second and third hop (and their reverse DNS lookups)!
  - What do you see?
Some Flood Ping Results

srl_test@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.1.1.129 -l 10.30.42.122
PING 10.1.1.129 (10.1.1.129) from 10.30.42.122 : 1400(1428) bytes of data.
1000 packets transmitted, 1000 received, 0% packet loss, time 14591ms
rtt min/avg/max/mdev = 70.115/108.064/177.958/26.870 ms

srl_test@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.2.1.129 -l 10.30.42.122
PING 10.2.1.129 (10.2.1.129) from 10.30.42.122 : 1400(1428) bytes of data.
1000 packets transmitted, 1000 received, 0% packet loss, time 14783ms
rtt min/avg/max/mdev = 31.009/76.446/136.024/27.666 ms

srl_test@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.1.1.129 -l 10.31.42.122
PING 10.1.1.129 (10.1.1.129) from 10.31.42.122 : 1400(1428) bytes of data.
1000 packets transmitted, 999 received, 0% packet loss, time 14412ms
rtt min/avg/max/mdev = 121.153/175.432/252.685/28.585 ms

srl_test@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.2.1.129 -l 10.31.42.122
PING 10.2.1.129 (10.2.1.129) from 10.31.42.122 : 1400(1428) bytes of data.
1000 packets transmitted, 999 received, 0% packet loss, time 14182ms
rtt min/avg/max/mdev = 78.643/124.496/207.773/26.729 ms

RTT differences among provider combinations; higher ADSL delay (Versatel)
Some Traceroute Results

Hop 2: Router's ICMP TTL Exceeded is sent back via Simula's primary ISP!
What Else To Do?

- Try the same with IPv6!
  - ping6 [-f] [-s <size>] [-c <count>] <dest IP> -I <src IP>
  - traceroute6 <dest IP> -s <src IP>

- Try NetPerfMeter!
  - Supports TCP including **MPTCP**, SCTP, UDP, DCCP
  - **Server side:** netperfmeter <port>
  - **Client side:** netperfmeter <server>:<port> <flow details> ...
    (see manpage for details!)

- Install custom software
  - But note: do **not** assume the slivers to be permanent storages
  - Write scripts to automatise installation
  - In case of problems, nodes may just be **wiped and reinstalled**

And, of course, try your own experiments in NorNet!
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Conclusion

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Conclusion and Future Work

- NorNet Core is ready for your ideas!
  - Think about your experiments
  - Let them run in NorNet Core

- How to get permanent access?
  - Talk to us!
  - Provide some information on your project
    Let us discuss the details about running your experiment in NorNet Core!

In case of questions, ask us!
“NorNet wants to be a building block of the railroad to heaven” ...

... and not be another unused testbed that paves the road to hell!
Any Questions?

Visit https://www.nntb.no for further information!