Tutorial at Hainan University (海南大学)

The Basics of Using the NorNet Core Testbed at Hainan University

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April 18, 2017

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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:
    - ```
      ssh <username>@gatekeeper.nntb.no \
          -L 2000:plc.simula.nornet:443 \
          -L 2001:monitor.simula.nornet:80
      ```
    - 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:
  - Monitor: http://localhost:2001/
  - 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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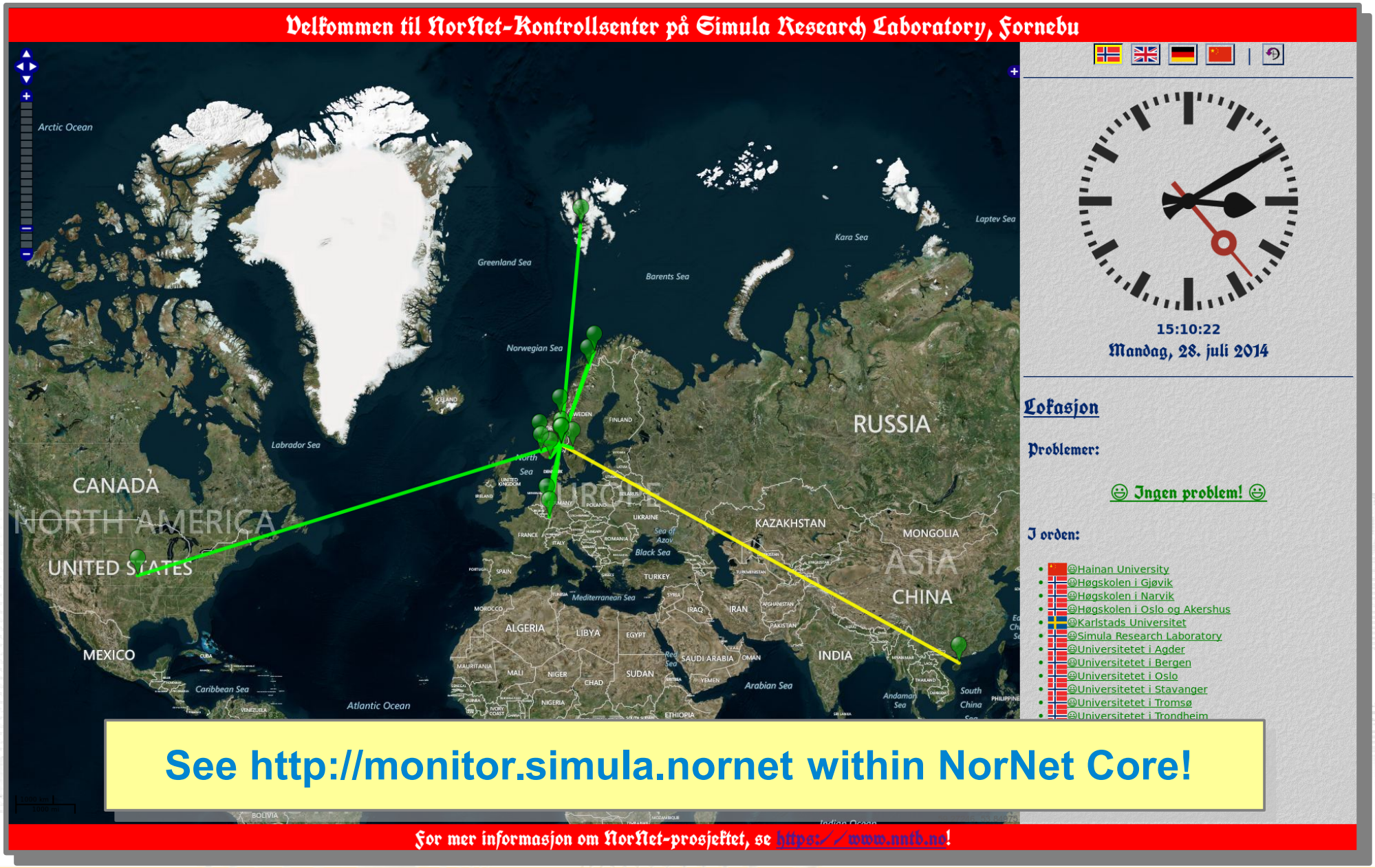
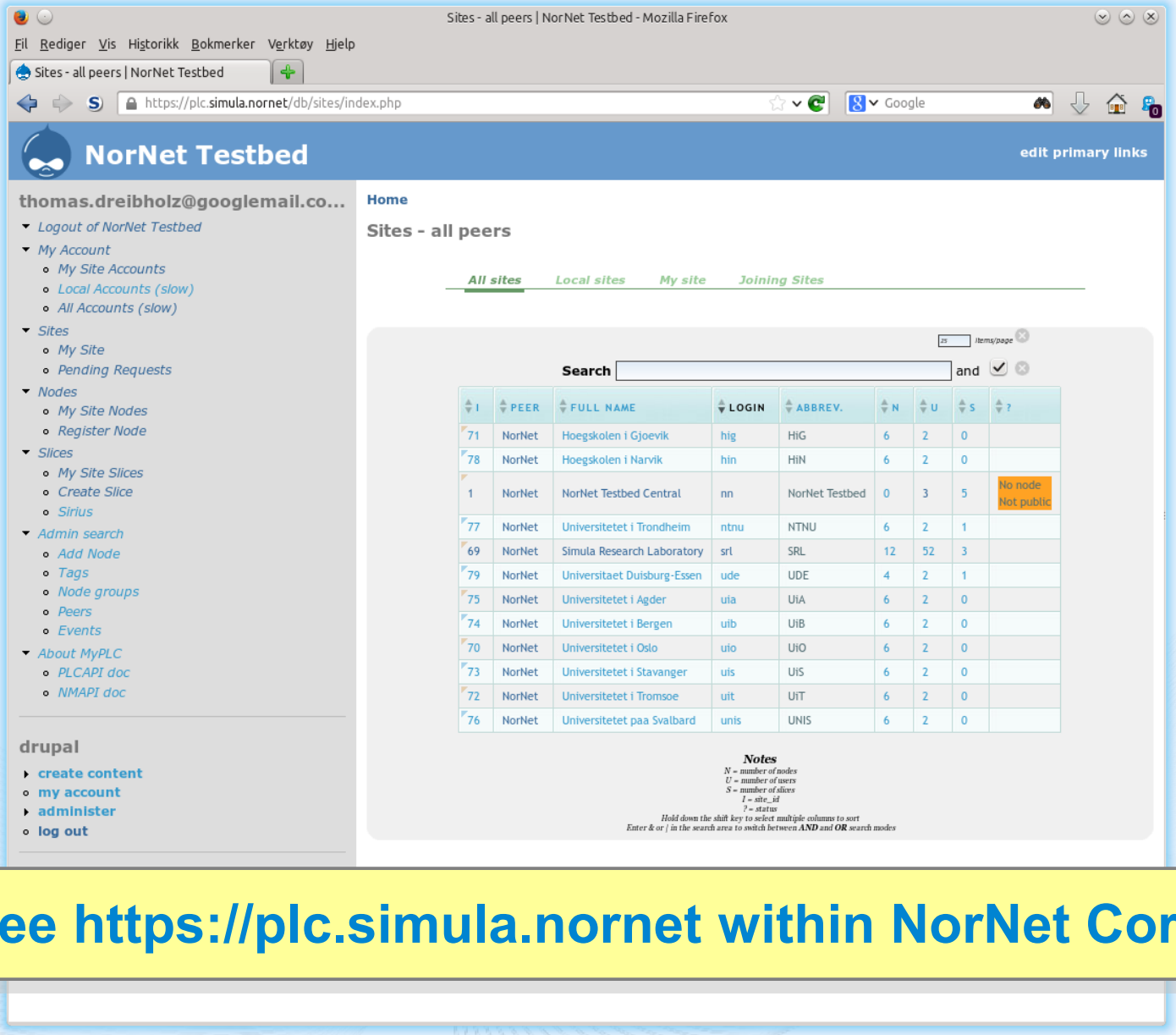
“Kontrollsenteret”

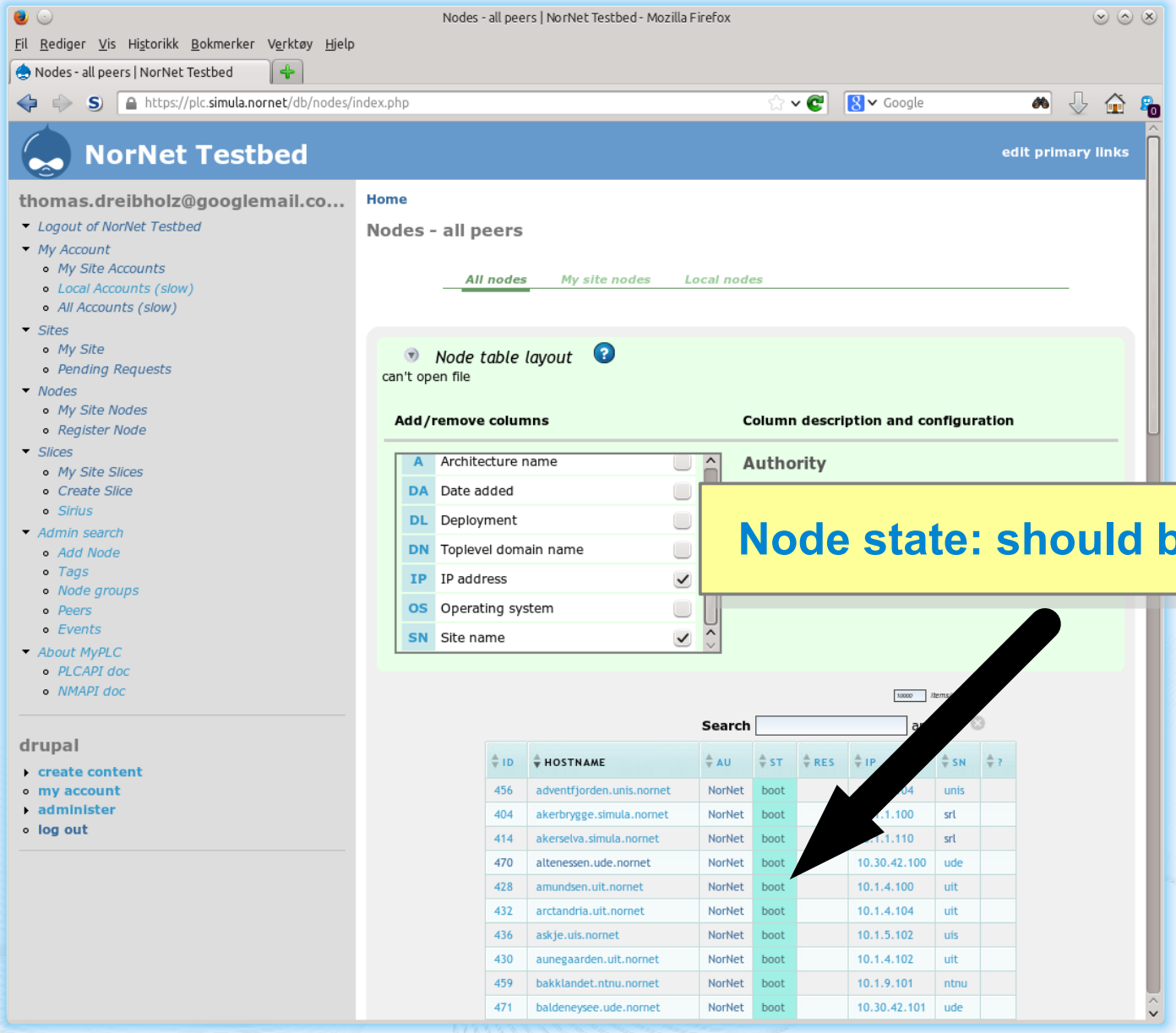


PLC User Interface: Sites View

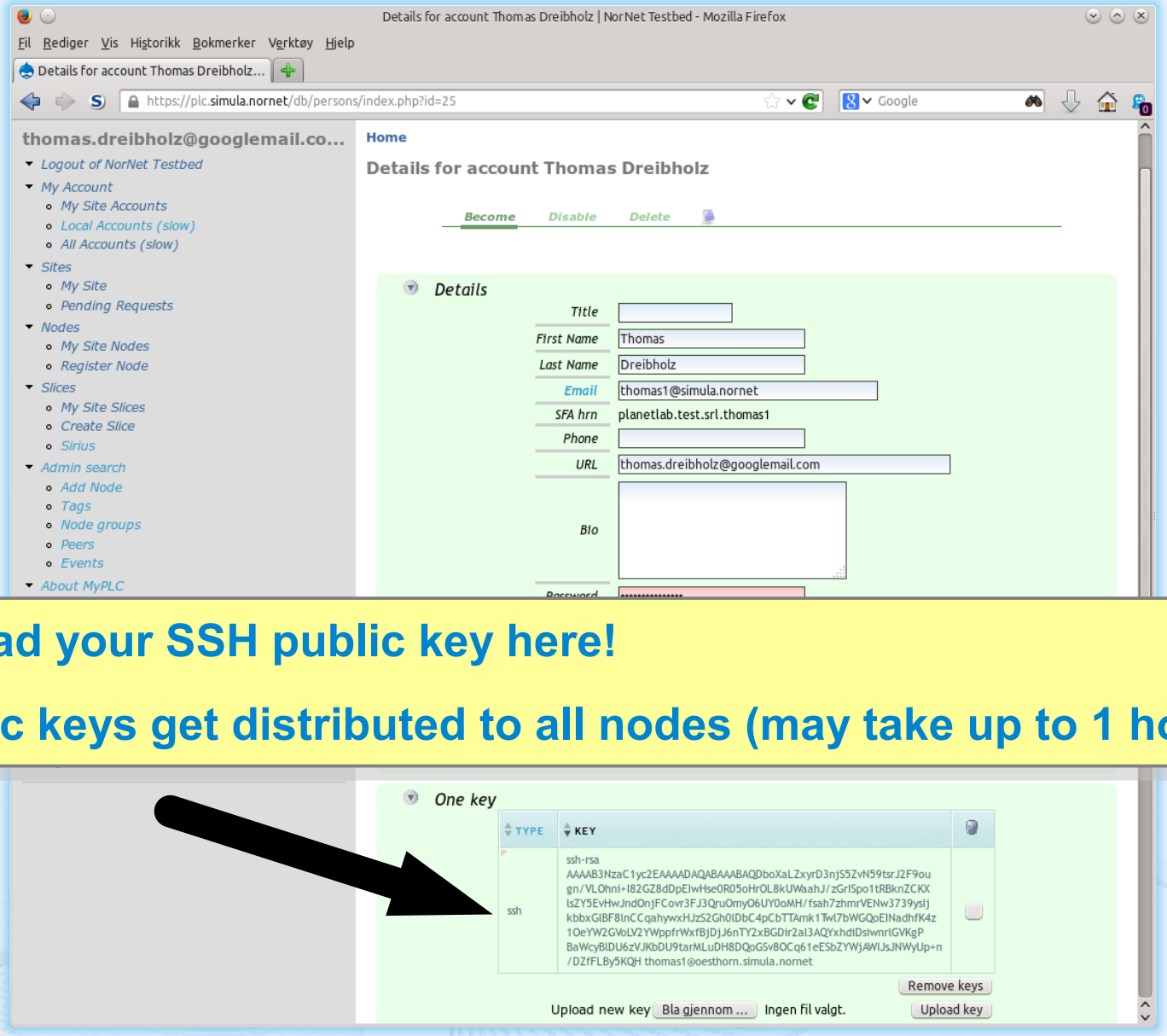


See https://plc.simula.nornet within NorNet Core!

PLC User Interface: Nodes View



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_tutorial*

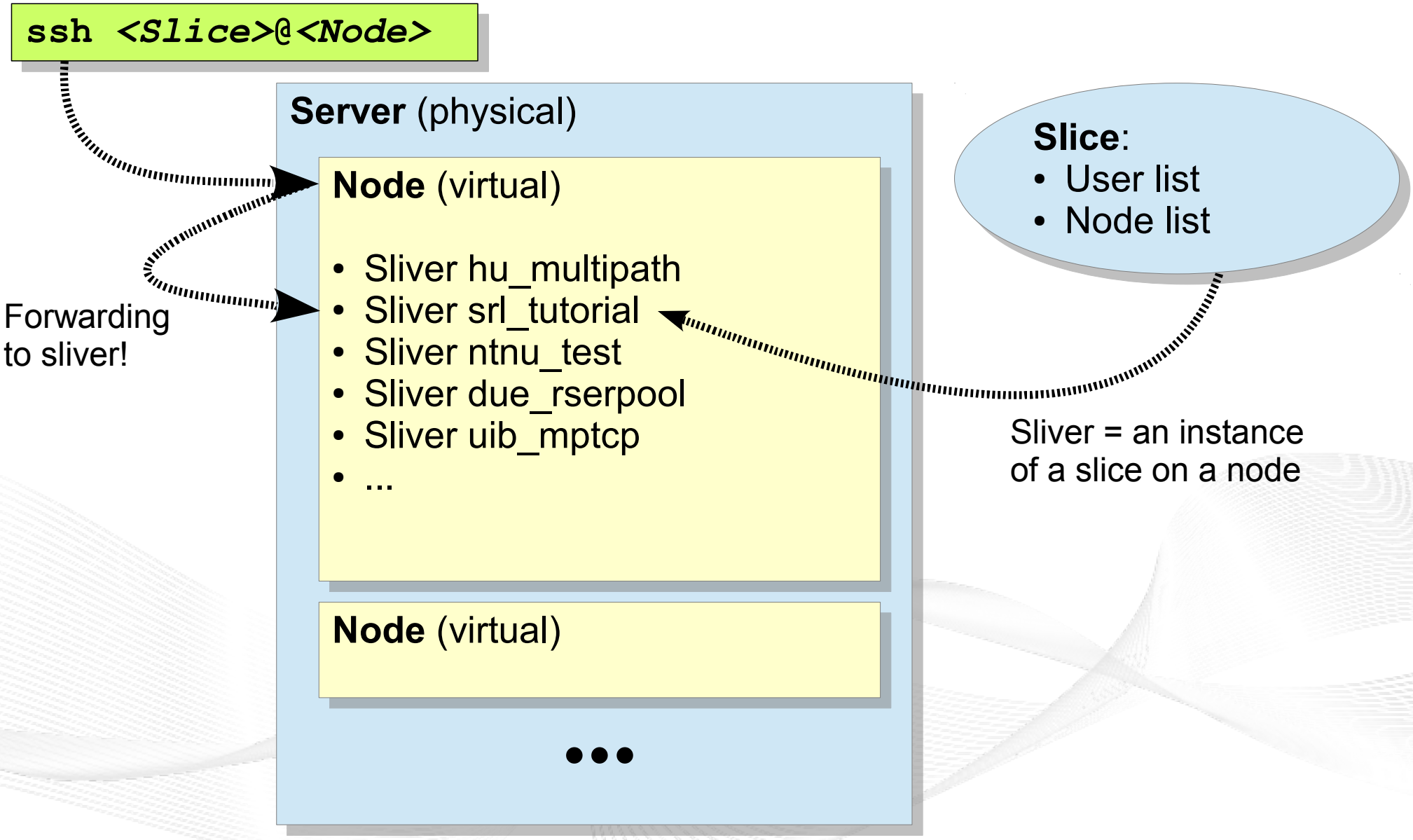
- A test slice has already been created:
  - Name: *srl_tutorial*
  - Special NorNet Core properties:
    - Own IP addresses on each node
    - IPv4 and IPv6
    - Multiple ISPs (at sites with several ISPs)
- The slice is instantiated on all nodes by a sliver (LXC container)
- Your account is mapped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

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_tutorial*):
  - `ssh -i ~/.ssh/id_rsa srl_tutorial@boao.hu.nornet`
  - `ssh -i ~/.ssh/id_rsa srl_tutorial@altenessen.ude.nornet`
  - `ssh -i ~/.ssh/id_rsa srl_tutorial@nordlys.unis.nornet`
  - `ssh -i ~/.ssh/id_rsa srl_tutorial@julenisse.uia.nornet`
  - `ssh -i ~/.ssh/id_rsa srl_tutorial@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



Inside a Sliver

- Each sliver contains a Fedora Core 24 environment
- **Obtain root access:**
  - `su`
  - `sudo bash`
- **Install custom software:**
  - `dnf install <package> ...`
  - Example: `dnf install netperfmeter`
- **Show IP addresses and routes:**
  - `ip -4 addr show ; ip -4 route show`
  - `ip -6 addr show ; ip -6 route show`

Remember: slivers have their own addresses!

Inside a Sliver

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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 srl_tutorial slice:
    - `dig srl-tutorial.altenessen.ude.nornet any`
      to obtain primary provider (it is in the CNAME, here: “dfn”)
    - `dig srl-tutorial.altenessen.`**`all`**`.ude.nornet any`
      to obtain all providers' addresses
    - `dig srl-tutorial.solvang.`**`all`**`.simula.nornet`

      without “any” → gets only A RRs (i.e. IPv4 addresses)

A *dig* Example

```
ola1@nordberg:~$ dig srl-tutorial.solvang.all.simula.nornet any

; <<>> DiG 9.9.2-P1 <<>> srl-tutorial.solvang.all.simula.nornet any

...

;; ANSWER SECTION:

srl-tutorial.solvang.all.simula.nornet. 86400 IN A 10.2.1.130

srl-tutorial.solvang.all.simula.nornet. 86400 IN A 10.1.1.130

srl-tutorial.solvang.all.simula.nornet. 86400 IN AAAA 2001:700:4100:101::82:69

srl-tutorial.solvang.all.simula.nornet. 86400 IN AAAA 2001:700:4100:201::82:69

srl-tutorial.solvang.all.simula.nornet. 86400 IN HINFO "Amiga 5000" "Slice srl_tutorial"

srl-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.

...
```

IPv4

IPv6

Software

Geographic location

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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
  - Login to *srl_tutorial* sliver: `ssh srl_tutorial@<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_tutorial@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.1.1.129 -I 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
```

DFN → UNINETT

```
srl_tutorial@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.2.1.129 -I 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
```

DFN → Kvantel

```
srl_tutorial@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.1.1.129 -I 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
```

Versatel → UNINETT

```
srl_tutorial@kettwig.ude.nornet # ping -c 1000 -s 1400 -f 10.2.1.129 -I 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
```

Versatel → Kvantel

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

Some Traceroute Results

```
srl_tutorial@kettwig.ude.nornet # traceroute 10.1.1.129 -s 10.30.42.122
traceroute to 10.1.1.129 (10.1.1.129), 30 hops max, 60 byte packets
 1  essen.dfn.ude.nornet (10.30.42.1)  2.104 ms  2.849 ms  2.831 ms
 2  dfn.ude.uninett.simula.nornet (192.168.178.10)  95.059 ms  95.024 ms  94.961 ms
 3  srl-test.frogner.uninett.simula.nornet (10.1.1.129)  105.432 ms  105.281 ms  105.220 ms
```

DFN → UNINETT

```
srl_tutorial@kettwig.ude.nornet # traceroute 10.2.1.129 -s 10.30.42.122
traceroute to 10.2.1.129 (10.2.1.129), 30 hops max, 60 byte packets
 1  essen.dfn.ude.nornet (10.30.42.1)  1.190 ms  1.739 ms  1.031 ms
 2  dfn.ude.uninett.simula.nornet (192.168.178.10)  56.972 ms  56.722 ms  56.853 ms
 3  srl-test.frogner.kvantel.simula.nornet (10.2.1.129)  100.773 ms  99.513 ms  99.337 ms
```

DFN → Kvantel

```
srl_tutorial@kettwig.ude.nornet # traceroute 10.1.1.129 -s 10.31.42.122
traceroute to 10.1.1.129 (10.1.1.129), 30 hops max, 60 byte packets
 1  essen.versatel.ude.nornet (10.31.42.1)  1.830 ms  2.633 ms  2.609 ms
 2  versatel.ude.uninett.simula.nornet (192.168.133.222)  127.768 ms  127.954 ms  127.507 ms
 3  srl-test.frogner.uninett.simula.nornet (10.1.1.129)  182.544 ms  182.564 ms  182.269 ms
```

Versatel → UNINETT

```
srl_tutorial@kettwig.ude.nornet # traceroute 10.2.1.129 -s 10.31.42.122
traceroute to 10.2.1.129 (10.2.1.129), 30 hops max, 60 byte packets
 1  essen.versatel.ude.nornet (10.31.42.1)  1.178 ms  1.805 ms  1.769 ms
 2  versatel.ude.uninett.simula.nornet (192.168.133.222)  88.834 ms  91.932 ms  96.620 ms
 3  srl-test.frogner.kvantel.simula.nornet (10.2.1.129)  79.603 ms  75.599 ms  69.910 ms
```

Versatel → Kvantel

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 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” …
Shanghai Transrapid
SMT
… and not be another unused testbed that paves the road to hell!

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Literature

Dreibholz, T.; Ferlin, S.; Alay, Ö.; Elmokashfi, A. M.; Livadariu, I. A.; Zhou, X.: "MPTCP Experiences in the NorNet Testbed" (TXT, 25 KiB), IETF, Individual Submission, Internet Draft draft-dreibholz-mptcp-nornet-experience-03, March 30, 2017.

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Any Questions?

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