The 3rd International NorNet Users Workshop (NNUW-3)

The NorNet Core Testbed: A Status Update for the NNUW-3

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Idea for NorNet Core: Tunnelling

- Researchers require control over used ISP interfaces
  - Which outgoing (local site) interface
  - Which incoming (remote site) interface

- Idea: Tunnels among sites
  - Router at site A: IPs $A_1$, $A_2$, $A_3$
  - Router at site B: IPs $B_1$, $B_2$
  - IP tunnel for each combination: $A_1 \leftrightarrow B_1$, $A_1 \leftrightarrow B_2$, $A_2 \leftrightarrow B_1$, $A_2 \leftrightarrow B_2$, $A_3 \leftrightarrow B_1$, $A_3 \leftrightarrow B_2$
  - Fully-connected tunnel mesh among NorNet Core sites
  - Each site's router (called tunnelbox) maintains the tunnels
    - Static tunnels
    - NorNet-internal addressing and routing over tunnels
Address Assignment

- NorNet-internal address spaces:
  - Private NorNet-internal IPv4 “/8” address space (NAT to outside)
  - Public NorNet-internal IPv6 “/48” address space
- Systematic address assignment:
  - IPv6: 2001:700:4100:<PP><SS>::<NN>/64
    (PP=Provider ID; SS=Site ID; NN=Node ID)
- NorNet-internal DNS setup including reverse lookup

Make it as easy as possible to keep the overview!
A usual NorNet Core site:

- 1x switch
- 4x server
  - 1x tunnelbox
  - 3x research systems
- At least two ISP connections
  - Research network provider
  - Other providers
- IPv4 and IPv6 (if available)

Additional researcher-provided sites:

- Varying configurations
- VM setups, powerful servers, “retro-style” PCs ...
# NorNet Core Site Deployment Status (August 2015)

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<tr>
<th>No.</th>
<th>Site</th>
<th>ISP 1</th>
<th>ISP 2</th>
<th>ISP 3</th>
<th>ISP 4</th>
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- IPv4 and IPv6
- IPv4 only (ISP without IPv6 support 😞)
- ISP negotiation in progress
- IPv4 only (site's network without IPv6 support)

[https://www.nntb.no/pub/nornet-configuration/NorNetCore-Sites.html](https://www.nntb.no/pub/nornet-configuration/NorNetCore-Sites.html)
Some Site Statistics
(August 2015)

Active Sites | 19
Distinct ISPs of Active Sites | 15
Distinct Countries of Active Sites | 7
Total IPv4 Interfaces | 37
Total IPv4 Tunnels | 666
Total IPv6 Interfaces | 23
Total IPv6 Tunnels | 253

https://www.nntb.no/pub/nornet-configuration/NorNetCore-Sites.html
Remote Systems

Our servers may be really remote!

The “road” to Longyearbyen på Svalbard, 78.2°N
Virtualisation

“Anything that can go wrong, will go wrong.”
[Murphy's law]

- Experimentation software is experimental
- How to avoid software issues making a remote machine unusable?
- Idea: virtualisation
  - Lightweight, stable software setup: Ubuntu Server 12.04 LTS
  - VirtualBox 4.3
  - Other software runs in VirtualBox VMs:
    - Tunnelbox VM on physical server #1
    - 2 LXC-based research node VMs on physical servers #2 to #4
  - In case of problem: manual/automatic restart or reinstall of VM
Research Software Status

- Basic research node software:
  - Based on PlanetLab/OneLab, with NorNet customisations
    - Kernel 3.14 with Linux MPTCP 0.89.4 → soon 0.89.5 (or already 0.90?)
    - Production nodes: still Fedora Core 18
    - Experimental builds for Fedora Core 21 and 22
      (see http://benlomond.nntb.no for nightly builds)

- Custom VMs for special requirements
  - MPTCP tests with custom kernels
  - FreeBSD experiments → CMT-SCTP and FreeBSD MPTCP from CAIA

- Virtualisation:
  - VirtualBox 4.3 (with VNC patch) or VMware
  - Some test systems already run KVM → enhanced flexibility
Users and Research

“The road to hell is paved with unused testbeds.”
[James P. G. Sterbenz]

- We already got some users!
- Examples:
  - Multi-Path Transport (Simula, UDE, UiO, HU, etc.)
  - VoIP Misuse Detection (UDE)
  - Application Server Availability (NTNU)
  - Balia Congestion Control (Bell Labs in South Korea)
  - IPv4/IPv6 Performance Comparison (Simula)
  - ...

See https://www.nntb.no/projects/ for further projects using NorNet!
Some Collaborations

- **PlanetLab/OneLab**
  - Development and testing of the research software
  - URLs: [https://www.planet-lab.org](https://www.planet-lab.org), [https://www.onelab.eu](https://www.onelab.eu)

- **RITE – Reducing Internet Latency**
  - Cooperation on multi-path transport research
  - URL: [http://riteproject.eu](http://riteproject.eu)

- **ToMaTo**
  - Topology Management Tool
  - URL: [http://tomato-lab.org](http://tomato-lab.org)
  - Part of the G-Lab testbed
The “NorNet World Tour”

- 09/2014: Kungliga Tekniska högskolan (KTH Royal Institute of Technology) Stockholm/Sweden
- 10/2014: Academics, Industry and Government of the Hainan Province Haikou, Hainan/China
- 10/2014: Tsinghua University Beijing/China
- 12/2014: NorNet demo presentation at the IEEE GLOBECOM Austin, Texas/U.S.A.
- 01/2015: NICTA in Sydney, New South Wales and CAIA (Swinburne University) in Melbourne, Victoria/Australia
- 07/2015: 93rd IETF Meeting and IETF Hackathon Praha, Czech Republic
- 09/2015: OMNeT++ Community Summit Zürich/Switzerland
- 09/2015: NORDUnet Technical Workshop (NTW) København/Denmark
- TBD: Hainan University Haikou, Hainan/China
Conclusion and Future Work

- NorNet Core is working
  - Nice testbed size (19+ sites)
  - We have a slowly growing number of users and sites
  - International visibility

Future work:
- To further extend NorNet Core's scope beyond multi-path transport topic
- Software-Defined Networking (SDN)?
- Network Function Virtualisation (NFV)?
- Cloud Computing and applications?

To be discussed!
“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!