Invited Talk at NTNU Trondheim

An Introduction to NorNet for the Site Deployment at NTNU Trondheim

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Overview:
Motivation

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Motivation: Robust Networks

- More and more applications rely on ubiquitous Internet access!
- However, our current networks are not as robust as they should be...

How to make networks more robust?
Resilience by Redundancy

Multi-Homing

- Connections to multiple Internet Service Providers (ISP)
- Idea: if one ISP has problems, another connection still works

Do multiple ISP connections really improve robustness?
Idea: A Testbed for Multi-Homed Systems

- A multi-homed Internet testbed would be useful
  - Something like PlanetLab?
  - Perhaps with better node availability?
  - Support for mobile access (e.g. 3G) as well as wired?

- **NorNet** – A research testbed for multi-homed systems!
  - Lead by the Simula Research Laboratory in Fornebu, Norway
  - Supported by Forskningsrådet

[http://www.nntb.no](http://www.nntb.no)
Overview: The NorNet Project

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Goals of the NorNet Project

- Building up a **realistic** multi-homing testbed
- Wired and wireless
  - Wired → “NorNet Core”
  - Wireless → “NorNet Edge”
- Perform research with the testbed!

How to get a **realistic** testbed?
Idea: Distribution of NorNet over whole Norway

- **Challenging topology:**
  - Large distances
  - A few “big” cities, many large rural areas
  - Svalbard:
    - Interesting location
    - Many polar research institutions

- **NorNet Core:**
  - Ca. 10 sites planned

- **NorNet Edge:**
  - Ca. 500 nodes planned
Overview: NorNet Core

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Idea: 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 (ca. 10)
  - 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>::/64 (PP=Provider ID; SS=Site ID)

Make it as easy as possible to keep the overview!
Idea: PlanetLab-based Software for Experiments

• Key idea:
  – Researchers should get virtual machines for their experiments
  – Like PlanetLab …
  – … but with multi-homing, of course

• PlanetLab software:
  – Different “stable” distributions: PlanetLab, OneLab, etc.
  – Current implementation: based on Linux VServers
    • Not in mainline kernel
    • Patched kernel, makes upgrades difficult
  – The future: Linux Containers (LXC)
    • Active development by PlanetLab/OneLab
    • We are involved in testing experimental LXC software
A NorNet Core site:

- 1x switch
- 4x server
  - 1x tunnelbox
  - 3x research systems
- At least two ISP connections
  - Uninett
  - Other providers

Status:

- 9+1 sites deployed
- 1 more on Friday
Monitoring

- PlanetLab:
  - 367 nodes of 1035 nodes alive (June 28, 2012) ⇒ availability < 36% 😞
  - NorNet should do much better!
- Direct contact to technical staff/researchers at sites
- Monitoring using Nagios
  - Flexible
  - Extendable by service-specific plug-ins
Velkommen til NorNet-Kontrollsenter på Simula Research Laboratory, Førnebu

For mer informasjon om NorNet-prosjektet, se [https://www.nornet.no](https://www.nornet.no)
Overview:
NorNet Edge

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The NorNet Edge Box: Ready for Deployment

Box contents:
- Beagle Bone embedded Linux system
- 4x USB UMTS (at USB hub):
  - Telenor, NetCom,
  - Network Norway, Tele2
- 1x ICE CDMA mobile broadband
- 1x Ethernet
- Power supplies
- Handbook

Status:
- Ca. 300 nodes distributed already
- Initial measurements
Overview: Research

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Resilience

• Network resilience
  – Are there hidden dependencies among ISPs?
  – Are there dependencies between mobile and wired ISPs?
  – ...

• Mobility and handovers

• Applications
  – Emergency call handling (e.g. healthcare)
  – ...

• Security
Load Sharing

- Multi-Path Transfer
  - Network Layer
  - Transport Layer
    - Concurrent Multipath Transfer for SCTP (CMT-SCTP)
    - Multi-Path TCP (MPTCP)
    - ...
  - Higher Layers

- Applications
  - Multimedia (e.g. IPTV, Video on Demand), ...
  - Web Real-Time Communication (WebRTC)
  - ...
Users

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

- Of course, NorNet does \textbf{not} intend to be another unused testbed!
- NorNet will be open for all interested users!
  - Similar to PlanetLab …
  - … but with higher node availability and tighter monitoring
  - … and, of course, multi-homing
- Particularly, it can also be used at \textbf{NTNU Trondheim}!

More details to be announced soon!
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Conclusion and Future Work

- NorNet is progressing!
  - Management software under development
  - First site deployments have been made

- Future work:
  - Finish the initial deployment
  - Make sites multi-homed
  - Improve/refine management software

And, of course, do some research!
Any Questions?

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