The NorNet Project

An Introduction to NorNet Core for the Site Deployment at Universitetet i Stavanger

Simula Research Laboratory AS

27 November 2012
Contents

- Motivation
- The NorNet Project
  - NorNet Core
  - NorNet Edge
- Research
- Conclusion
Overview: Motivation

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  - NorNet Core
  - NorNet Edge
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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?
Load Sharing with Multi-Path Transfer

Multi-Path Transfer

- Having (and paying for!) multiple ISPs
- Utilise all connections simultaneously => increased bandwidth

A very hot research topic in the IETF:

- Concurrent Multipath Transfer for SCTP (CMT-SCTP)
- Multi-Path TCP (MPTCP)
- Congestion control challenges for multi-path transport
- ...
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

Research in realistic setups is necessary!
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:
    $A_1 \leftrightarrow B_1$, $A_2 \leftrightarrow B_2$, $A_2 \leftrightarrow B_1$, $A_3 \leftrightarrow B_1$, $A_3 \leftrightarrow B_2$
  - 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:
  - Similar for IPv6, with “/64” network per site

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 V Servers
    - 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
NorNet Core Site Deployment

A NorNet Core site:

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

Status:

- 6 sites deployed
- 4 more during the next weeks
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

How to visualise NorNet?
“Kontrollsenteret”

Velkommen til NorNet-Kontrollsenter på Simula Research Laboratory, Førnebu

Lokasjon

Problemer:

😊 Ingen problem! 😊

I orden:

- @Høgskolen i Gjevik
- @Simula Research Laboratory
- @Universitetet i Oslo
- @Universitetet i Tromsø
- @Universitetet i Bergen
- @Universitetet i Trondheim
- @Universitetet i Stavanger
- @Universitetet i Tromsø
- @Universitetet på Svalbard
- @Universitetet i Trondheim

Før mer informasjon om NorNet-prosjektet, se http://www.nor.net!
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:

- Distribution has just started
- Initial test measurements
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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)
  - ...

- ...

[ simula, research laboratory ]
Load Sharing

- Multi-Path Transfer
  - Network Layer
    - Routing ...
  - Transport Layer
    - CMT-SCTP
    - MPTCP
    - ...
  - Higher Layers
- Applications
  - Multimedia (e.g. IPTV), ...
  - WEBRTC, ...
- ...
Users

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

- Of course, NorNet does **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 by Universitetet i Stavanger!

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
  – Improve/refine management software
  – Do research!
Any Questions?

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