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

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

Thomas Dreibholz
(托马斯 博士　توماس ترايبهولس)
dreibh@simula.no

Simula Research Laboratory

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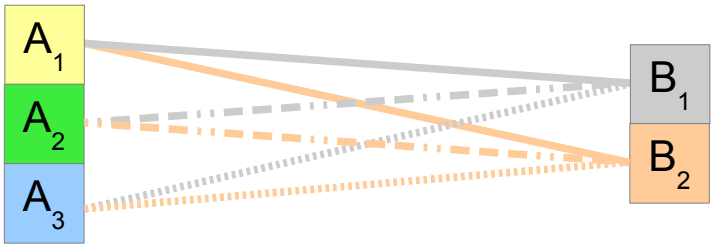
Contents

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:
  - IPv4: 10.<*Provider ID*>.<*Site ID*>.<*Node ID*>/24 per site
  - 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 NorNet Core Site Deployment

A usual NorNet Core site:

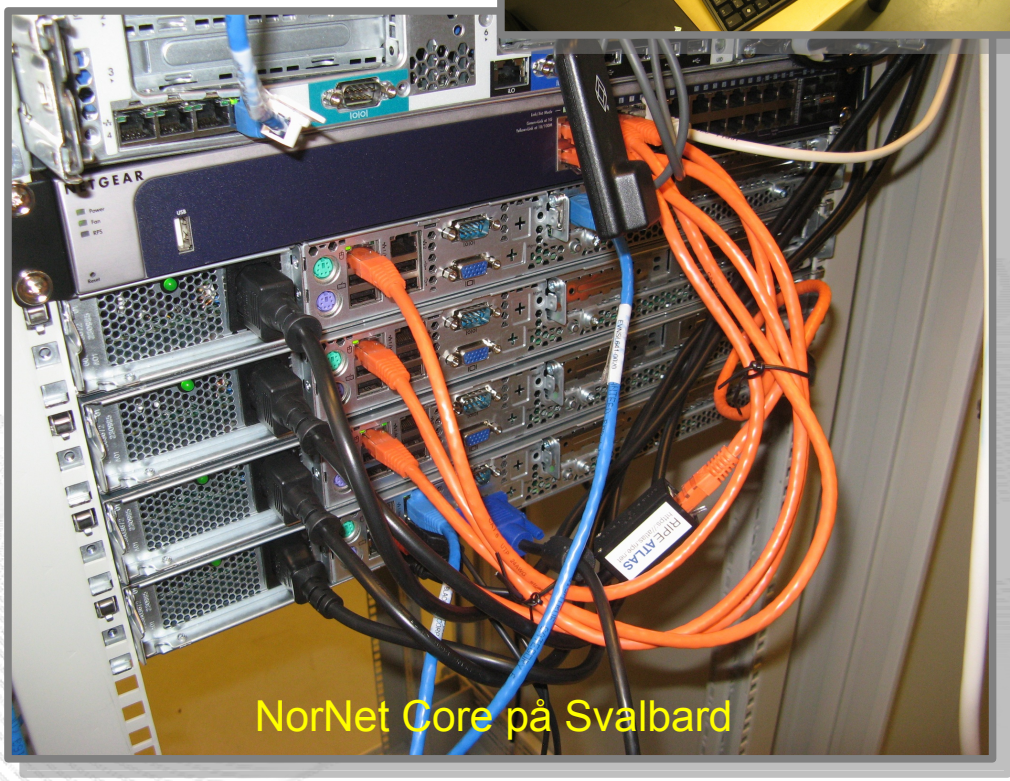
- 1x switch
- 4x server
  - 1x tunnelbox
  - 3x research systems
- At least two ISP connections
  - Research network provider
  - Other providers
- IPv4 and IPv6 (if available)

Additional researcher-provided sites:

- Varying configurations
- VM setups, powerful servers, “retro-style” PCs ...

UNIS

Longyearbyen 78.2°N,15.6°E



NorNet Core på Svalbard

NorNet Core Site Deployment Status (August 2015)

No.	Site	ISP 1	ISP 2	ISP 3	ISP 4
1	Simula Research Laboratory	Uninett	Kvantel	Telenor	PowerTech
2	Universitetet i Oslo	Uninett	Broadnet	PowerTech	
3	Høgskolen i Gjøvik	Uninett	PowerTech		
4	Universitetet i Tromsø	Uninett	Telenor	PowerTech	
5	Universitetet i Stavanger	Uninett	Altibox	PowerTech	
6	Universitetet i Bergen	Uninett	BKK		
7	Universitetet i Agder	Uninett	PowerTech	–	
8	Universitetet på Svalbard	Uninett	Telenor		
9	Universitetet i Trondheim	Uninett	PowerTech		
10	Høgskolen i Narvik	Uninett	Broadnet	PowerTech	
11	Høgskolen i Oslo og Akershus	Uninett	–		
12	Karlstads Universitet	SUNET			
13	Universität Kaiserslautern	DFN			
14	Universität Duisburg-Essen	DFN	Versatel		
15	Hainan University 海南大学	CERNET	China Unicom		
16	The University of Kansas	KanREN			
17	Korea University 고려대학교	KREONET			
18	National ICT Australia (NICTA)	AARNet			
19	Univ. Federal de São Carlos	RNP			
20	HAW Hamburg	DFN			

IPv4 and IPv6
ISP negotiation in progress
IPv4 only (ISP without IPv6 support ☹)
IPv4 only (site's network without IPv6 support)

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

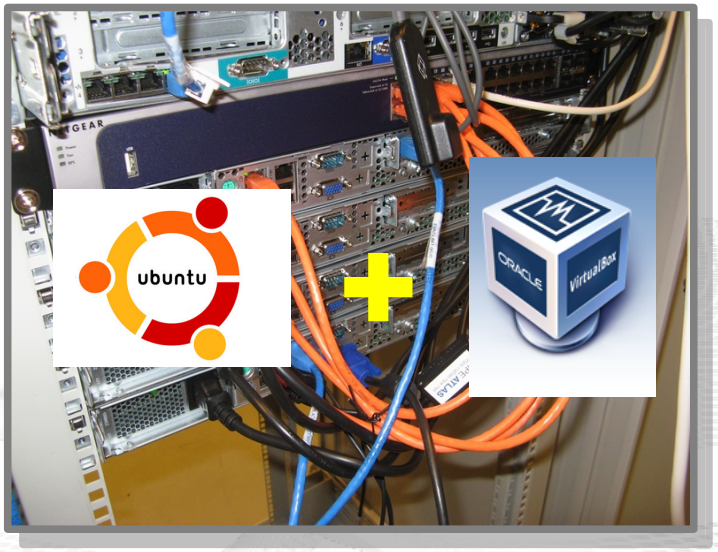
Our servers may be really remote!

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)
  - ...

List to be extended!

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.onelab.eu

- RITE – Reducing Internet Latency
  - Cooperation on multi-path transport research
  - URL: http://riteproject.eu

- ToMaTo
  - Topology Management Tool
  - URL: http://tomato-lab.org
  - Part of the G-Lab testbed

The “NorNet World Tour”

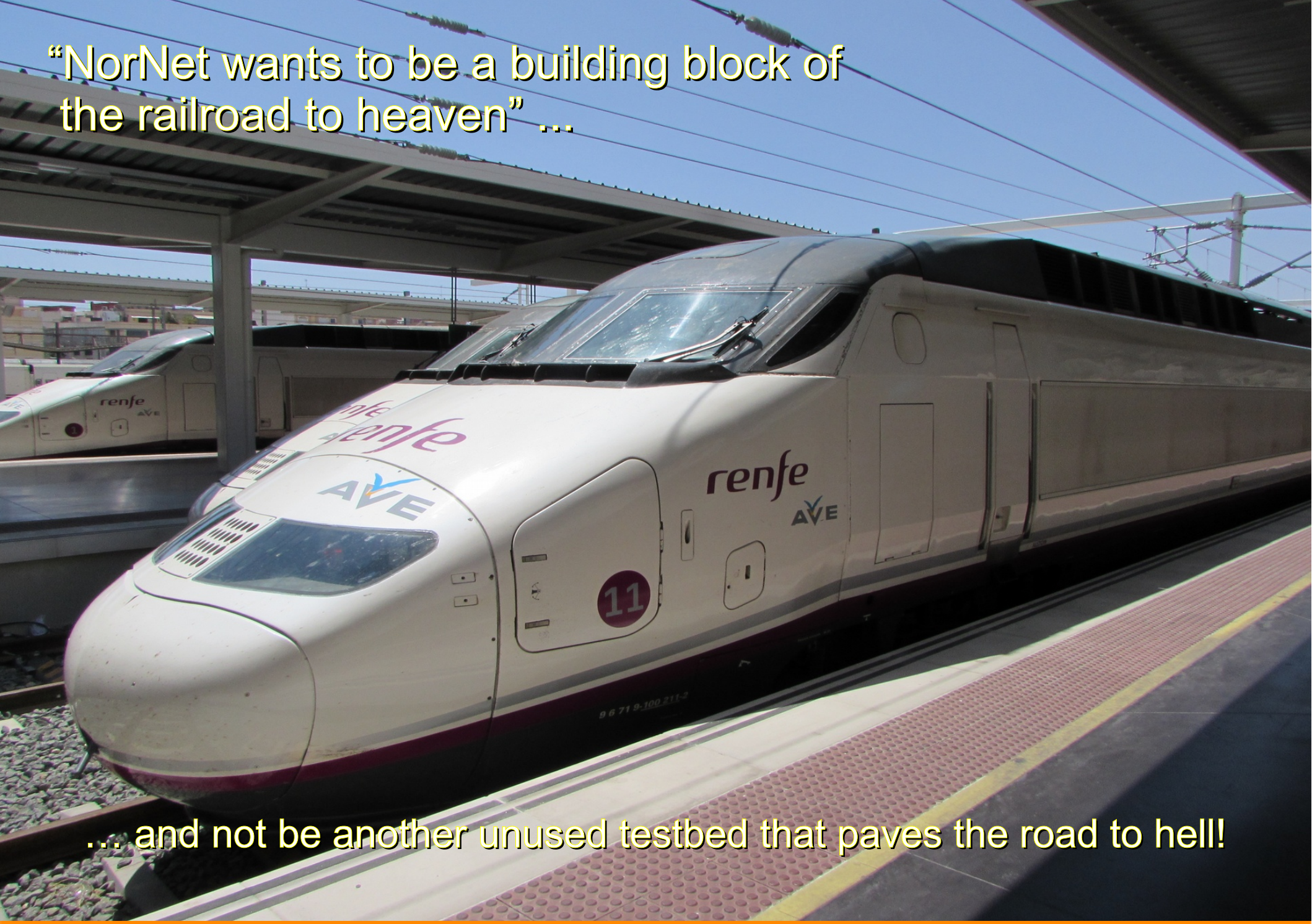
- 09/2014: Kungliga Tekniska högskolan (KTH Royal Institute of Technology)
  Stockholm/Sweden
- 10/2014: Academics, Industry and Government of the Hainan Province
  Haikou, Hainan/China
- 10/2014: Tsinghua University
  Beijing/China
- 12/2014: NorNet demo presentation at the IEEE GLOBECOM
  Austin, Texas/U.S.A.
- 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” ...
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AVE
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... and not be another unused testbed that paves the road to hell!

Any Questions?

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