Presentation at the 93rd IETF Meeting

MPTCP Experiences in the NorNet Testbed

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Motivation: MPTCP in the Internet

- Redundancy
  - Multiple interfaces and addresses
  - **Redundancy** → communication still possible in case of path failures

- Multi-Path Transport
  - Simultaneous usage of paths → better throughput, ...
  - **Multi-Path TCP (MPTCP)**!

**How well is MPTCP performing in the real-world Internet?**
The NorNet Testbed

- **NorNet Core**
  - Cabled, up to 4 ISPs, IPv4+IPv6 (fibre, consumer-grade DSL, etc.)
  - Hosts for virtual machines
  - 20 locations (11 in NO, 9 abroad)

- **NorNet Edge**
  - Embedded system „Ufoboard“
  - Up to 4x 2G/3G/4G, 1x CDMA, 1x cable
  - Hundreds of locations (in NO)

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[https://www.nntb.no]
### NorNet Core Site Deployment Status (July 2015)

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<th>No.</th>
<th>Site</th>
<th>ISP 1</th>
<th>ISP 2</th>
<th>ISP 3</th>
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**IPv4 and IPv6**: IPv4 and IPv6 support.  
**IPv4 only**: IPv4 support only.  
**ISP negotiation in progress**: ISP negotiation in progress.  
**IPv4 only (ISP without IPv6 support)**: ISP without IPv6 support.

**IPv4 only (site's network without IPv6 support)**: Site's network without IPv6 support.

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[https://www.nntb.no/pub/nornet-configuration/NorNetCore-Sites.html](https://www.nntb.no/pub/nornet-configuration/NorNetCore-Sites.html)
The Challenge of the Real-World Internet: MPTCP in NorNet Core

- Internet Scenario:
  - Many sites, up to 4 ISPs per site
  - Heterogeneous connections (DSL, fibre, etc.)

- Goal:
  - MPTCP uses all possible paths
  - Does it work as expected?
Overview of NorNet Core Results

- MPTCP in heterogeneous Internet setups:
  - It works!
  - Some IPv6 issues (with old version 0.88.11 of Linux MPTCP) → new tests needed
  - Details in Dreibholz; Zhou; Fa: „Multi-Path TCP in Real-World Setups – An Evaluation in the NorNet Core Testbed“, PAMS 2015.

- IPv4/IPv6 identity duality:
  - Making simultaneous use of IPv4 and IPv6 paths
  - Improvements already for single-ISP endpoints
  - Details in Livadariu; Ferlin; Alay; Dreibholz; Dhamdhere; Elmokashfi: “Leveraging the IPv4/IPv6 Identity Duality by using Multi-Path Transport”, Global Internet Symposium 2015.

Papers: https://www.nntb.no/publications/
The Challenge of Mobile Broadband: MPTCP in NorNet Edge

Configuration by ISP

Locations

Utilization of Cells

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Overview of NorNet Edge Results

• What to expect from MBB paths?
  – Path characteristics of 5 Norwegian MBB ISPs

• Handling buffer bloat:
  – Multi-path transport buffer bloat mitigation (MPT-BM):
    • Details in Ferlin; Dreibholz; Alay: “Tackling the Challenge of Bufferbloat in Multi-Path Transport over Heterogeneous Wireless Networks”, IWQoS 2014.
  – Dynamic Relative Path Scoring (DRePaS):
    • Details in Ferlin; Dreibholz; Alay: “Multi-Path Transport over Heterogeneous Wireless Networks: Does it really pay off?”, GLOBECOM 2014.

Papers: https://www.nntb.no/publications/
Any Questions?

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

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