FG INET: Internet Network Architectures

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INET: Research Group

- Location
  - MAR-4

- Office hours
  - Tuesday 12:30 – 13:00
  - After the lecture or per e-mail

- Contact
  - Best per e-mail 😊

- Teaching contact
  - Arne Ludwig

Current research topics

- IXP data analysis
- ISP-application collaboration
  - Content aware traffic engineering
  - Caching and content distribution networks
- Software defined networks
  - Berlin Open Wireless Mesh, OpenFlow, Software defined radios
- Broadband access evolution
  - Multipath TCP, Socket Intents Licensed/unlicensed spectrum, Mobile user experience
- Cloud Networking
Internet and traffic engineering

Source: Arbor Networks 2009
Internet and traffic engineering

Traffic Engineering:
Adjust routing or peering, dimension the network

→ Offline Process

Source: Arbor Networks 2009
The new Internet

→ New core of interconnected content and consumer networks

Source: Arbor Networks 2009
The new Internet

New core of interconnected content and consumer networks

Source: Arbor Networks 2009
The new Internet

Moving Target I: Popular Applications

→ New core of interconnected content and consumer networks

Source: Arbor Networks 2009
The new Internet

Moving Target I: Popular Applications
Moving Target II: Bottlenecks

→ New core of interconnected content and consumer networks

Source: Arbor Networks 2009
The new Internet

Moving Target I: Popular Applications
Moving Target II: Bottlenecks

→ New core of interconnected content and consumer networks
→ ISPs lost control of their traffic

Source: Arbor Networks 2009
The new Internet

Moving Target I: Popular Applications

Moving Target II: ISPs lose control of their network

New core of interconnected content and consumer networks

“Telekom’s chief executive, said Google and others should pay telecoms groups for carrying content on their networks”
Challenge

Content-aware Traffic Engineering

ISPs re-gain control of their traffic by biasing host selection
Improving content access time
Case study: CDN
PaDIS

Provider-aided Distance Information System

External DNS

Internet Service Provider (ISP)

PaDIS

Client

Provider DNS

Host
PaDIS

External DNS

Internet Service Provider (ISP)

Full View of the ISP Network

Provider DNS

PaDIS

Content can be downloaded from any eligible host!
ISP-Application cooperation

- **Insight**: ISP knows its network
  - Node: bandwidth, geographical location, service class
  - Routing: policy, OSPF/BGP metrics, distance to peers

- **PADIS concept**
  - Service of AS / ISP
  - Input: list of possible dst IPs
  - Output: ranked list of dst IPs
    - E.g., according to distances between src IP and dst IPs

- **Applicable, whenever there is a choice!**
Teaching

- Lectures (Vorlesungen)
- Seminars (Seminare)
- Lab course (Praktika)
- Projects (Projekte)
- Theses (Diplom / Master / Bachelor)

- PGT: Project Group Meeting (Ph.D. Seminar)
- NLS: Networking Lecture Series (External visitors)
Lectures

- Network protocols and architectures (VL+UE)
  - Design principles of the Internet....
  - Base for all other INET classes

- Internet Routing (VL)
- Internet Security (VL)

- Network Algorithms (VL+UE)
- Internet Measurement (VL)
Dr. Stefan Schmid

- Biography:
  - PhD in Distributed Computing Group (DISCO) @ ETH Zürich
  - Postdoc at Chair for Efficient Algorithms (TU München) and Chair for Theory of Distributed Systems (Uni Paderborn)
  - Senior Research Scientist @ Deutsche Telekom Laboratories

- Research Interests:
  - Robust distributed systems
  - Software defined networking
  - Online Algorithms
  - Network virtualization
Seminars

- Internet Routing
- Internet Measurement
- How
  - Topics: Current research papers
  - Task:
    - Summary paper + presentation
    - Participation in discussion during the seminar
  - En block after the end of term
Lab courses

- Hands on exercises
- **Wireless Lab**
  - Understanding various wireless concepts (e.g., interference, MAC layer, multi-hop routing)
  - Experiments with mesh routers in the BOWL indoor network
- **Router Lab**
  - Configuring and managing networks
  - Internet experiments in a Lab
Projects and theses

Topics:
- See Web pages
- Talk to members of INET
- Suggest your own topic

Work flow:
- Literature/background search
- Presentation of idea at students` talks series (20 minutes 😊)
- Execution of idea / preparation of thesis document
- Presentation of results at students` talks (20 minutes)
Teaching at INET / Anja Feldmann

Topics

Internet Protocols:
- Routing and IP
- Transport (TCP/UDP)
- Applications
- Future Internet

- Traffic Measurement
- Workload Modeling
- Wireless
- Performance analysis
- Network Security

Example Module Paths

Bachelor 0-15 LP
- NPA (6LP)
- NPA (6LP)
- SE+PJ (9LP)
- IR, IS, IM, SE (6/9LP)
- IR, IS, IM (6LP)
- WL or/and RL (6/12 LP)
- WL (6/12 LP)

Master 12-27LP
- NPA (6LP)
- IR, IS, IM, SE (6/9LP)
- IR, IS, IM (6LP)
- WL or/and RL (6/12 LP)
- WL (6/12 LP)

Course Overview

WiSem

- NPA (VL+UE) 6LP
- Net-work (VL) 3LP

- IR or IS or IM: Internet Routing, Security, Measurement

SoSem

- WL: WirelessLab (PR) 6LP
- SE: Routing (SE) 3LP
- SE: Measurement (SE) 3LP

- RL: RouterLab (PR) 6LP
- PJ: Projekt (PJ) 6LP or 12LP
- Bachelor Thesis (12LP)
- Master Thesis (30 LP)

Fachgebiet INET – Prof. Anja Feldmann – www.inet.tu-berlin.de