Software Defined Networking

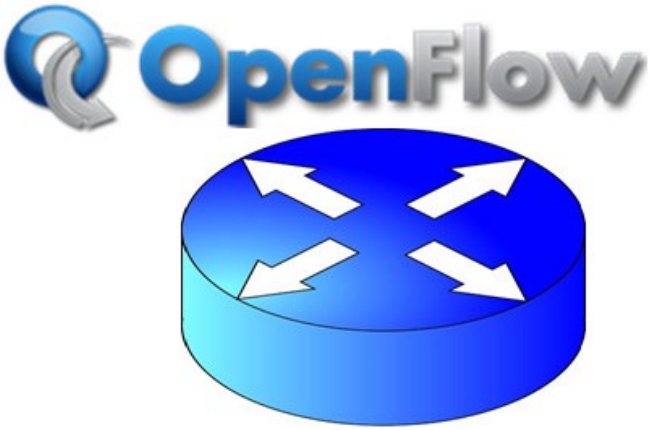
Lecture Organization

TECHNISCHE UNIVERSITÄT DARMSTADT

David Hausheer

Department of Electrical Engineering
and Information Technology
Technische Universität Darmstadt

E-Mail: hausheer@ps.tu-darmstadt.de
http://www.ps.tu-darmstadt.de/teaching/sdn



1. Motivation

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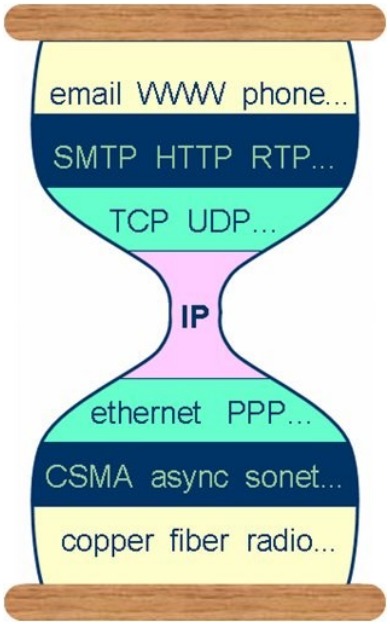
- What is "Software Defined Networking"?
  - An academic networking approach developed at UC Berkeley & Stanford?
  - Just another industry hype (similar to Grid, Cloud, ...)?
  - A revolutionary network abstraction paradigm?
- Until recently the Internet architecture seemed ossified
  - I.e. it appeared that it can hardly been changed
  - New protocols to improve security, QoS, mobility, etc. rarely got deployed across administrative boundaries
    - Examples: DiffServ, IP Multicast, SCTP, etc.
- SDN separates the control plane from the data plane
  - Forwarding of packets (data plane) is done in hardware
  - Decisions on packets (control plane) is done in software
- Is it really new?
  - Active networking (~1996) allowed the dynamic modification of packets flowing through a network



Hourglass architecture of the Internet by Steve Deering

1. Motivation

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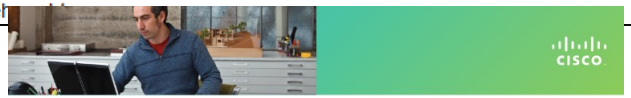
heise Netze « Vorige | Nächste »

TeraStream und die Zukunft des Internet: Neues Netz für alte Carrier

vorlesen / MP3-Download

Im Feldversuch in Kroatien läuft TeraStream schon – Telekoms Netz der Zukunft. Einfacher, klarer strukturiert und leichter zu managen soll das vom schwedischen Netzwerkexperten Peter Löthberg im Auftrag der Deutschen Telekom entworfene Netz sein. Beifall von Seite der Experten gab es viel, trotzdem war man beim deutschen Netzriesen vorsichtig mit öffentlichen Aussagen. Auf der grünen Wiese könnte man TeraStream gut umsetzen, in einem historisch gewachsenen Netz muss vieles angefasst werden. Axel Clauberg, Vice President Aggregation, Transport, IP bei der Deutschen Telekom, erklärt, warum es ohne ein neues Netz zum Ende des Jahrzehnts nicht mehr



White Paper

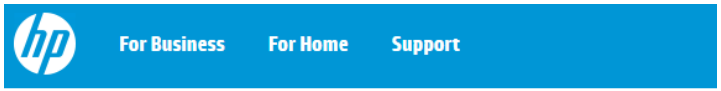
Software-Defined Networking: Why We Like It and How We Are Building On It

VMware to Acquire Nicira

Acquisition expands VMware's networking portfolio to revolutionize networking for the cloud and provide a full suite of capabilities for any cloud environment.

PALO ALTO, Calif., July 23, 2012 – VMware, Inc. (NYSE: VMW), the global leader in virtualization and cloud infrastructure, today announced it has signed a definitive agreement to acquire Nicira, Inc., a pioneer in software-defined networking (SDN) and a leader in network virtualization for open source initiatives.

"VMware has led the server virtualization revolution, and we have the opportunity to do the same in datacenter and cloud networking," said Paul Maritz, chief executive officer, VMware. "The acquisition of Nicira adds to our portfolio of networking assets and positions VMware to be the industry leader in software-defined networking."



Networking / Technology / Software-Defined Networks (SDN)

Software-defined Networking

Programmable network aligned to business applications delivers agility

2. Goals

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- Provide an in-depth view into topics in the area of software defined networking:
  - SDN Architecture (Application, Control, Infrastructure Layer)
  - SDN Interfaces (North/South-bound vs. East/West-bound interface)
  - SDN Applications and Use Cases (e.g. Multicasting)
  - Network Virtualization and Slicing (e.g. FlowVisor)
  - Network Function Virtualization (NFV) & Network Service Chaining
  - SDN Security
  - Network Operating Systems and Languages
  - OpenFlow Controller (e.g. NOX, Beacon, etc.)
  - Hardware Switches (e.g. NEC IP8800, Pronto) vs. Software Switches (e.g. NetFPGA, OpenVSwitch)
  - SDN in Wireless Networks (e.g. OpenWRT)

3. Lecture Overview (tentative)

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Oct 12	(DH)	Lecture 1:	Organization and Introduction
Oct 19	(DH)	Lecture 2:	Past, Current, and Future
Oct 26	(DH)	Lecture 3:	SDN Relatives and OpenFlow
Nov 2	(DH)	Lecture 4:	Network Virtualization and Slicing
Nov 9	(JB/JR)	Lecture 5:	SDN Hardware and Use Case
Nov 16	(DH)	Lecture 6:	Invited Talk: Dirk Kutscher (NEC)
Nov 23	(DH)	Lecture 7:	SDN Security
Nov 30	(DH)	Lecture 8:	SDN in Wireless Networks
Dec 7	(JB/JR)	Lecture 9:	NOS and Languages
Dec 14	(DH)	Lecture 10:	SDN Applications
Christmas Break			
Jan 11	(DH)	Lecture 11:	Tight Network Control
Jan 18	(DH)	Lecture 12:	Tight Network Control (cont'd)
Jan 25	(DH)	Lecture 13:	Invited Talk: NN (Deutsche Telekom)
Feb 1	(DH)	Lecture 14:	Invited Talk: NN
Feb 8	(DH)	Lecture 15:	Backup / Exam Preparation

4. Teaching Aids

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- Basics and background information available within slides.

  Furthermore, detailed studies of important aspects in
  - Journal, conference, or workshop papers.
  - Web sites and white papers.
  - Code examples.

5. Exercise Overview (Tentative)

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Oct 13	No Exercise – Introduction to CN Lab
Oct 20	Introduction / Exercise 1 Hand-out
Oct 27	Lab Work 1 Introduction
Nov 3	Exercise 1 Discussion / Exercise 2 Hand-out
Nov 10	Lab Work 1 Discussion / Lab Work 2 Introduction
Nov 17	Exercise 2 Discussion / Exercise 3 Hand-out
Nov 24	Lab Work 2 Discussion / Lab Work 3 Introduction
Dec 1	Exercise 3 Discussion / Exercise 4 Hand-out
Dec 8	Lab Work 3 Discussion / Lab Work 4 Introduction
Dec 15	Exercise 4 Discussion / Exercise 5 Hand-out
Christmas Break	
Jan 12	Lab Work 4 Discussion / Lab Work 5 Introduction
Jan 19	Exercise 5 Discussion
Jan 26	Lab Work 5 Discussion
Feb 2	Consultation hour for the exam (ALL)
Feb 9	Backup

Complementary SDN Lab Work: SmartNetsLab WS 2015/2016 Virtual Customer Premises Equipment (vCPE)

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- vCPE
  - Currently a hot topic in the industry
- Task
  - Program home gateway functionality with OpenFlow
  - Implement Software-Defined Multicast (SDM)
  - Design a video chat application that runs in a web browser that leverages SDM for packet duplication
- Orga
  - Challenge: Multiple groups, the best gets a prize
  - **6 Credit points** - In the scope of the **CN Lab** (Introduction: **13.11.15, 16:15, S311|006**)

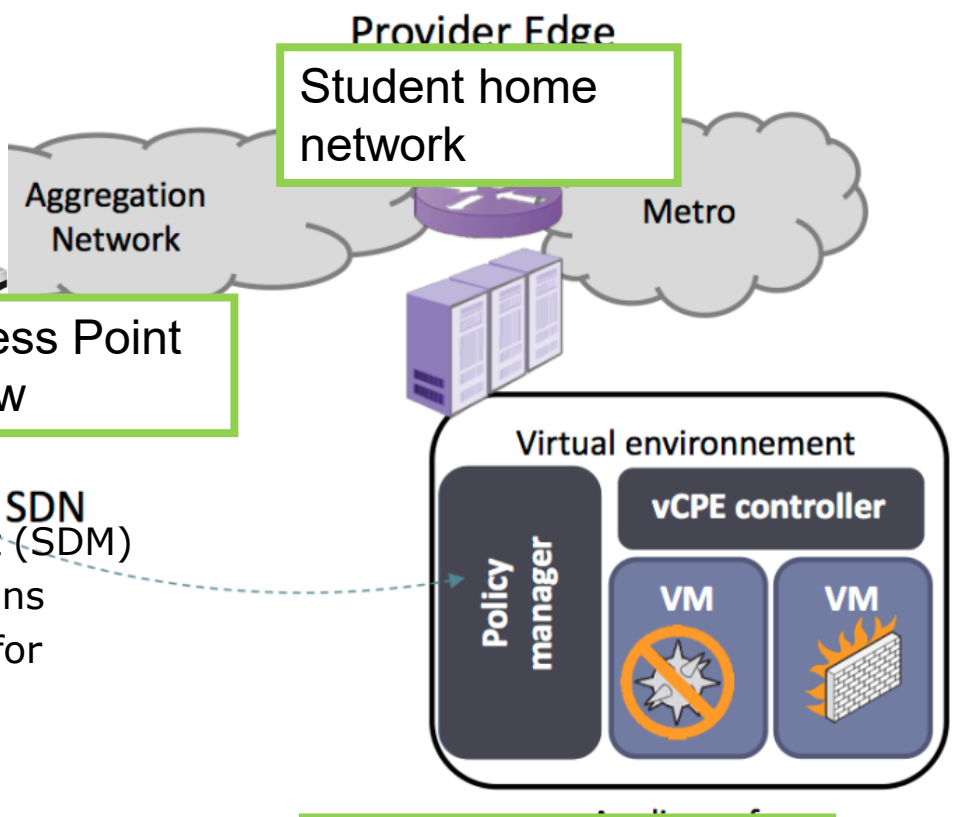

Image source: Wilkinson: "The Critical Role of the CPE", SDN World Congress 2014

6. Organizational Issues – Lectures

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- Lectures: Monday
  - Time: 11:40 - 13:20 hours
  - Location: S3|11 Room 0012 (**Except 23.11.2015: S103/223**)

- In case of questions, concerns, help, or ideas concerning the lecture please contact:
  - David Hausheer
    - By e-mail hausheer@ps.tu-darmstadt.de
  - Julius Rückert, Jeremias Blendin, Leonhard Nobach, Christian Koch
    - By e-mail [rueckert|jblendin|lnobach|ckoch]@ps.tu-darmstadt.de

7. Organizational Issues – Exercises

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- Exercises / Lab Work: Tuesday
  - Time: 16:15 - 17:55 hours
  - Location: S3|11 Room 006
- Introduction: **20.10. 16:15 (S311/006)**
- Support:
  - Julius Rückert, Jeremias Blendin, Leonhard Nobach, Christian Koch
    - By e-mail [rueckert|jblendin|lnobach|ckoch]@ps.tu-darmstadt.de

8. Teaching Resources

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- All resources will be available on the Moodle platform
  - Lecture slides as PDF, on regular basis before the lecture date
  - Exercise assignments (typically two weeks before the exercise date) and solutions (directly after the exercise date)
- Location
  - https://moodle.tu-darmstadt.de/
    - Course: Software Defined Networking - 18-hh-2050-vl
    - Direct link: https://moodle.tu-darmstadt.de/course/view.php?id=6349
- You will be registered to the Moodle course automatically
  - After signing up in TUcAN

9. Exam

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- The written exam will take place on **<tbd>**
- 90 minutes exam
- Exam material: lecture slides (incl. invited talks)
  - Further reading helps to understand the material better
- Max. 90 points
  - General SDN knowledge questions
  - Understanding and application of basic SDN concepts
    - E.g. completion of signaling scheme for a specific use case
  - Understanding of differences between alternatives
  - Calculations based on specific use case examples
  - Etc.
- *In case of few registrations, an oral exam will be held.*

10. Registration in TUCaN

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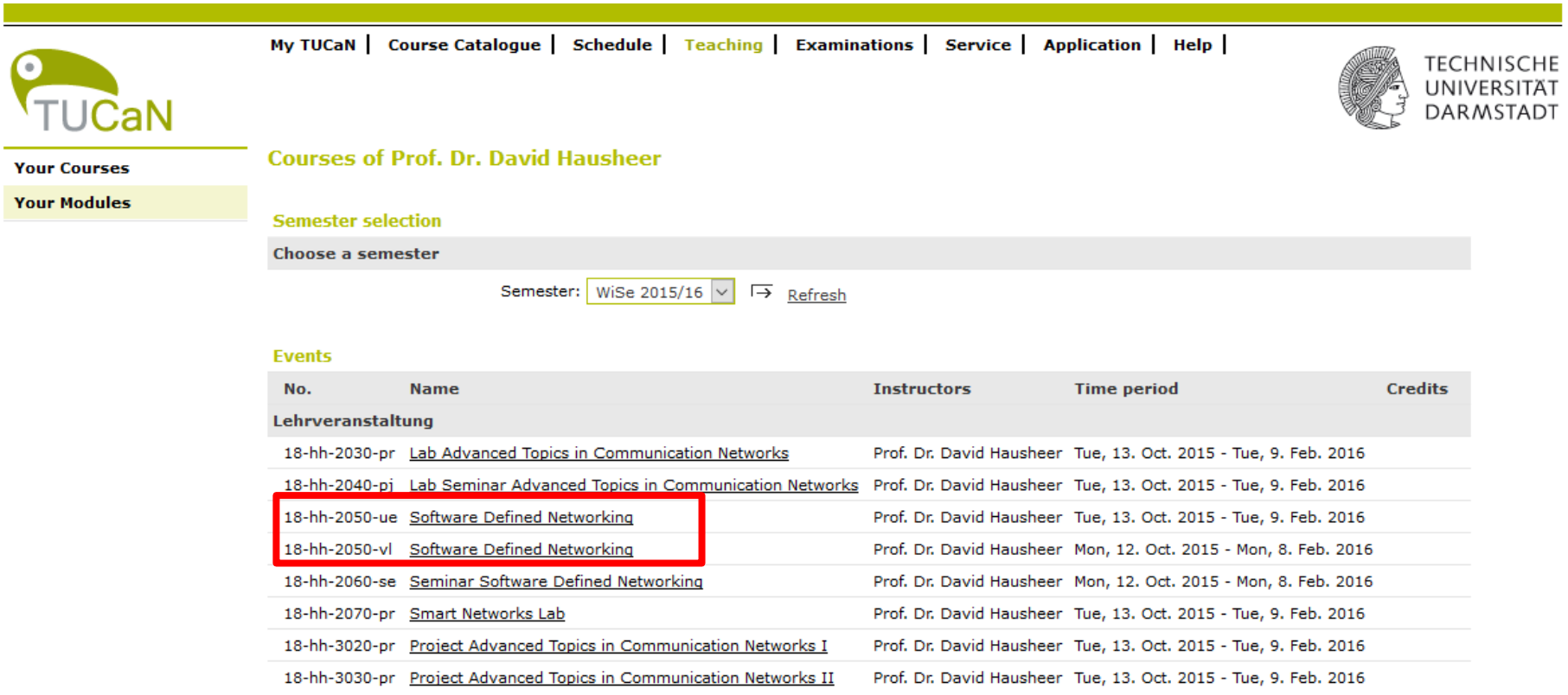

11. Summary

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- Check out the Moodle
  - https://moodle.tu-darmstadt.de/course/view.php?id=6349
- Register in TUCaN
  - Module, Lecture, and Exercise
    - "Software Defined Networking" (18-hh-2050)
- Check out the course website for all infos
  - Scan the QR code with your smartphone
  - Direct link: http://tinyurl.com/sdn-lecture
  - or http://www.ps.tu-darmstadt.de/teaching/sdn

CN Lab – Advanced Topics in Communication Networks

Introduction on 13.10.15
16:15h S3|11 Room 006

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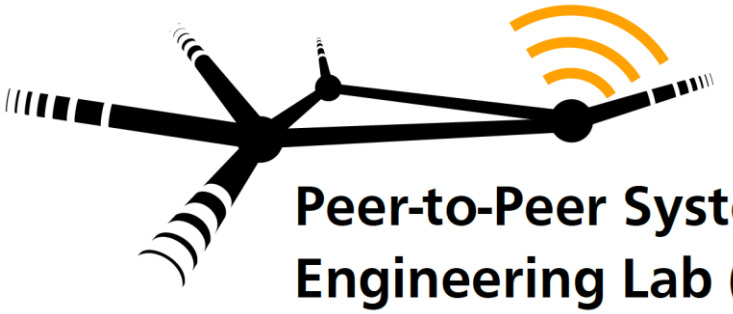
- Lecturer
  - Prof. Dr. David Hausheer



- Organization
  - Single/group work, 2-6 hours/week, 3-9 CP
  - In parallel with the SmartNets Lab
  - Offered in parallel as five modules: 18-hh-2030-pr, 18-hh-2040-pj, 18-hh-3020-pr, 18-hh-3030-pr, 18-hh-2070-pr
- Prerequisites
  - Solid programming experience; Interest to develop challenging network applications
  - Students of M.Sc. ETiT, B. Sc./M. Sc. CS

- Contents, not limited to:
  - Peer-to-peer and overlay networks
  - Mobile P2P networks, P2P video streaming
  - Network virtualization & programmability
  - Software-defined networking
  - Energy-efficient networking
  - Network simulation
  - Economic aspects
- Competencies
  - Design & development of communication networks & applications
  - Application of object-oriented programming techniques

Interested?
Scan the QR code with your smartphone or visit the course page:
http://tinyurl.com/ps-cnlab

Theses

- Open Theses
  - http://www.ps.tu-darmstadt.de/ => Teaching => Theses