

FG INET: Internet Network Architectures

Prof. Anja Feldmann, Ph.D.

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<http://www.inet.tu-berlin.de/>

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

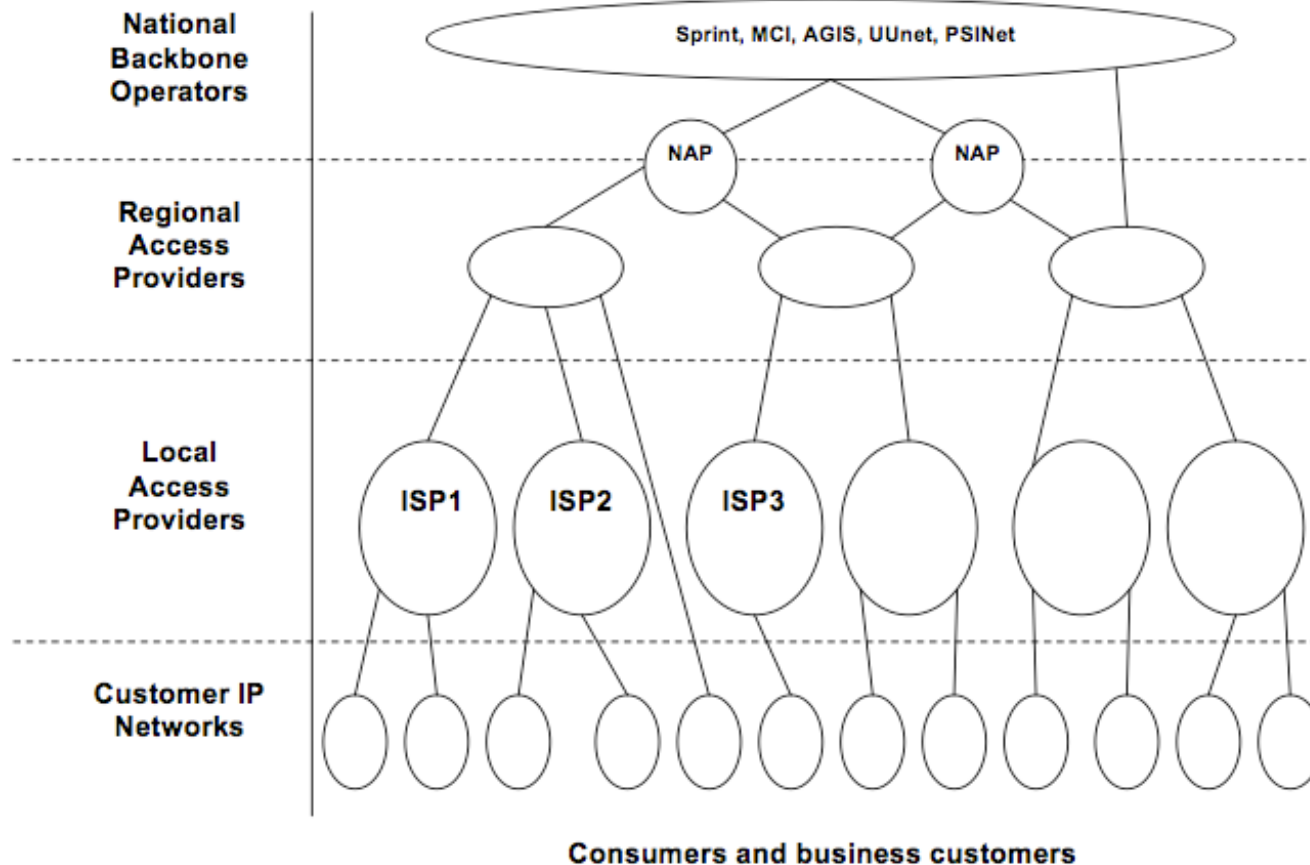
- Arne Ludwig

❑ Web site <http://www.inet.tu-berlin.de/>

Current research topics

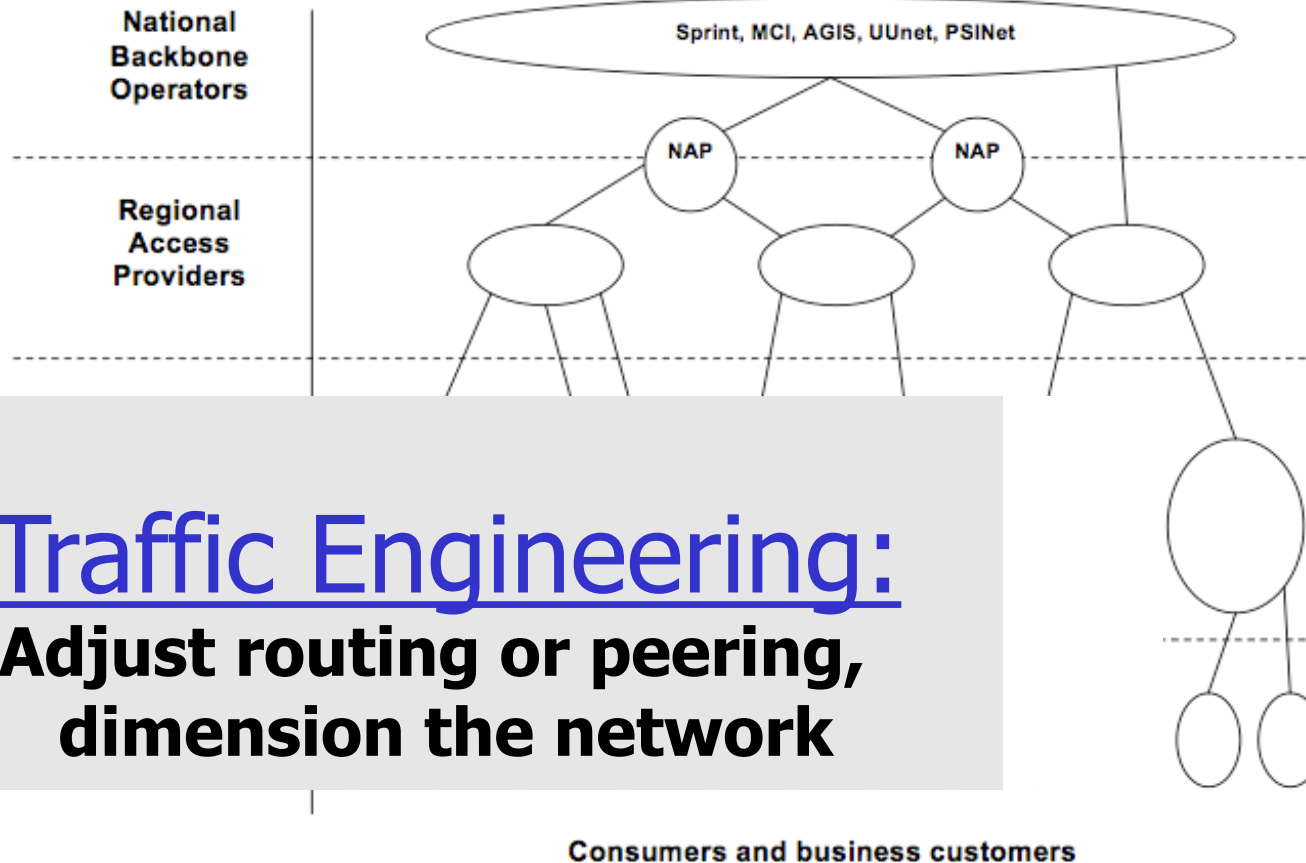
- ❑ IXP data analysis
- ❑ ISP-application collaboration
 - Content aware traffic engineering
 - Caching and content distribution networks
- ❑ Software defined networks
 - Berlin Open Wireless Mesh, OpenFlow, Software defined radios
- ❑ Broadband access evolution
 - Multipath TCP, Socket Intents Licensed/unlicensed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

Internet and traffic engineering



Source: Arbor Networks
2009

Internet and traffic engineering

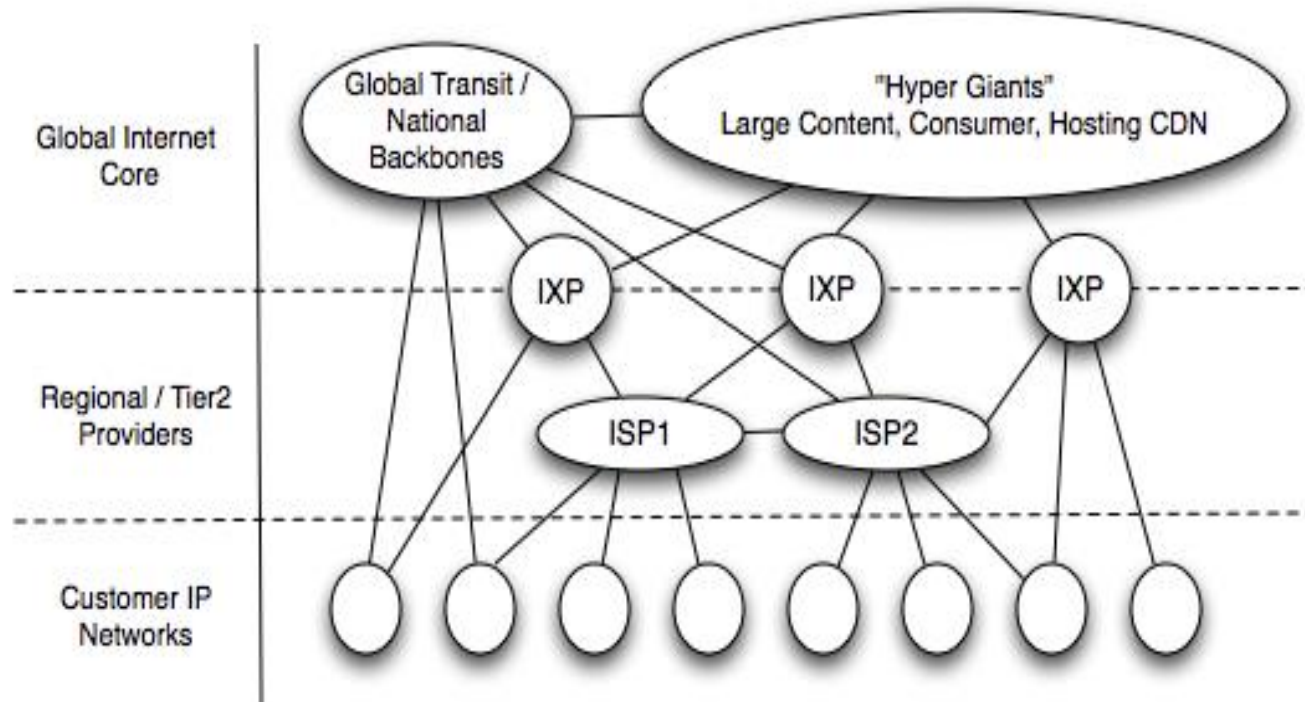


Traffic Engineering:
Adjust routing or peering,
dimension the network

→ **Offline Process**

Source: Arbor Networks
2009

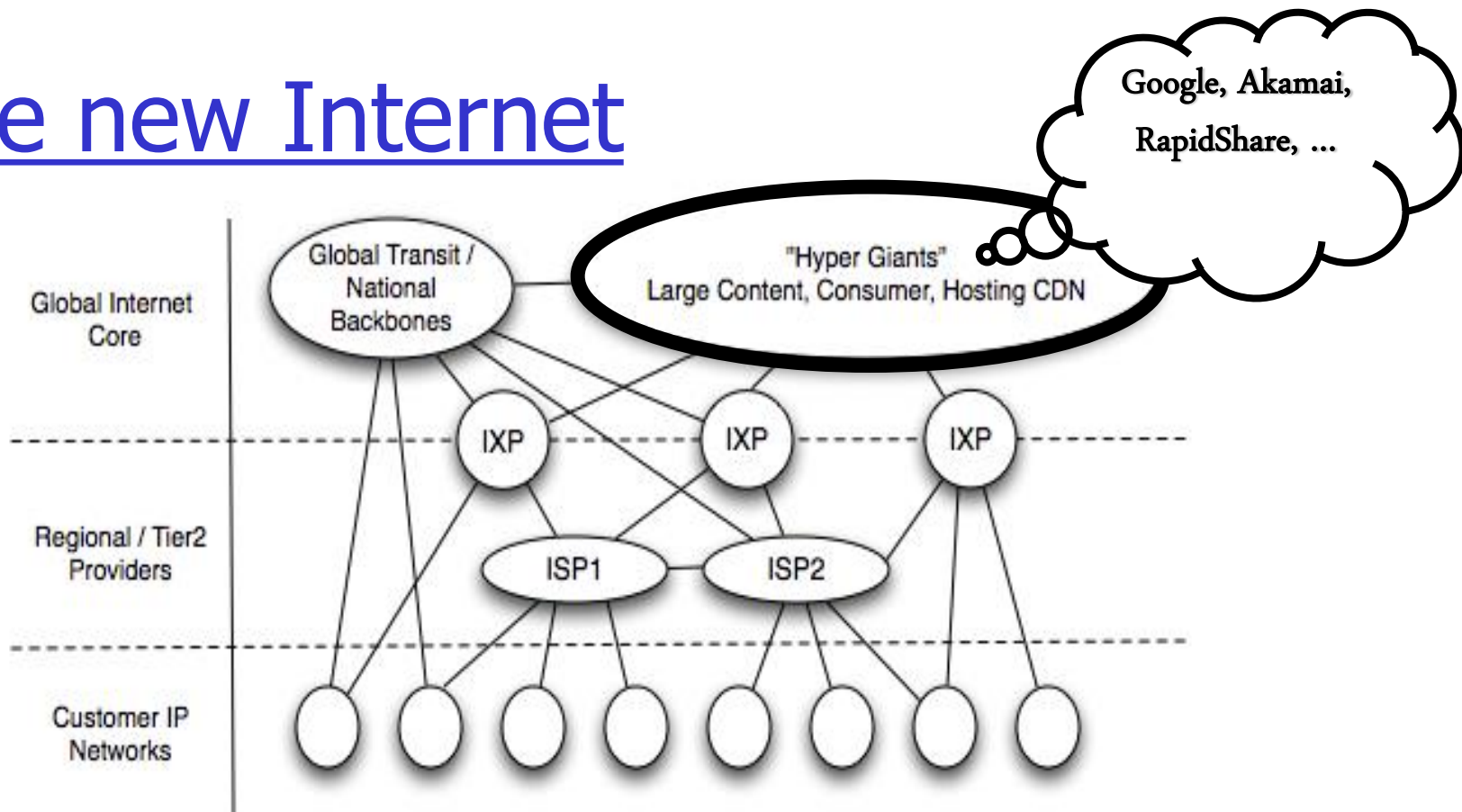
The new Internet



Source: Arbor Networks
2009

→ **New core of interconnected content and consumer networks**

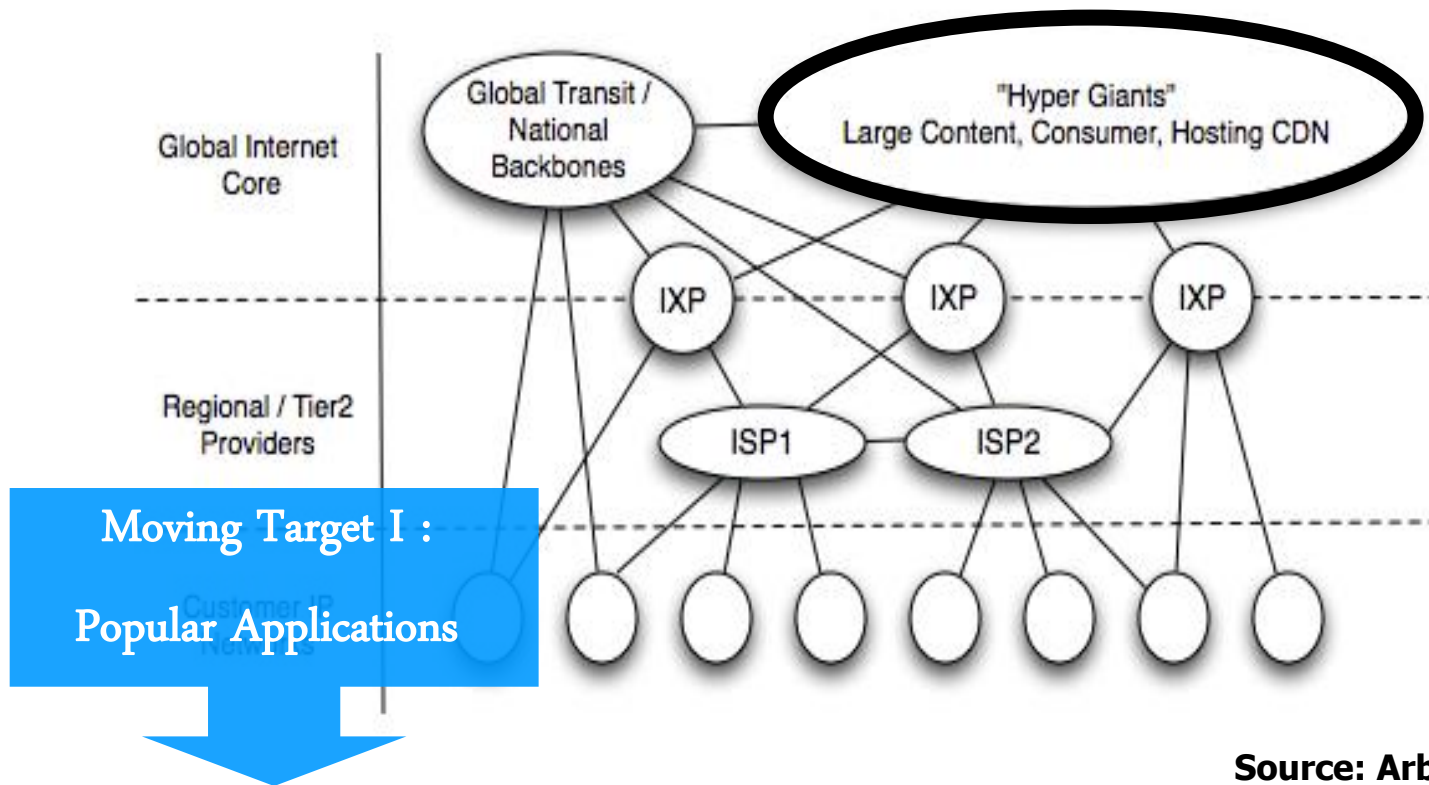
The new Internet



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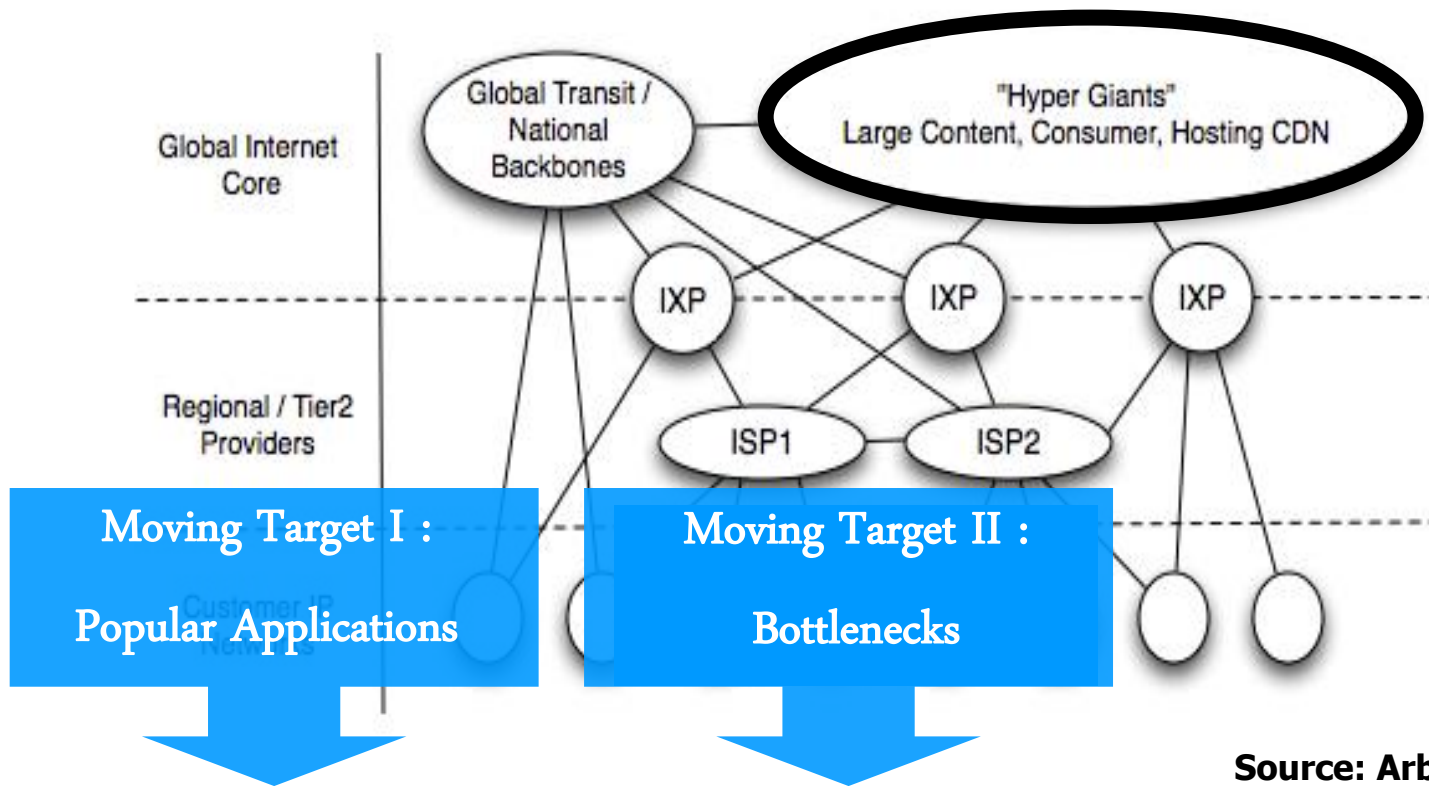
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→ **New core of interconnected content and consumer networks**

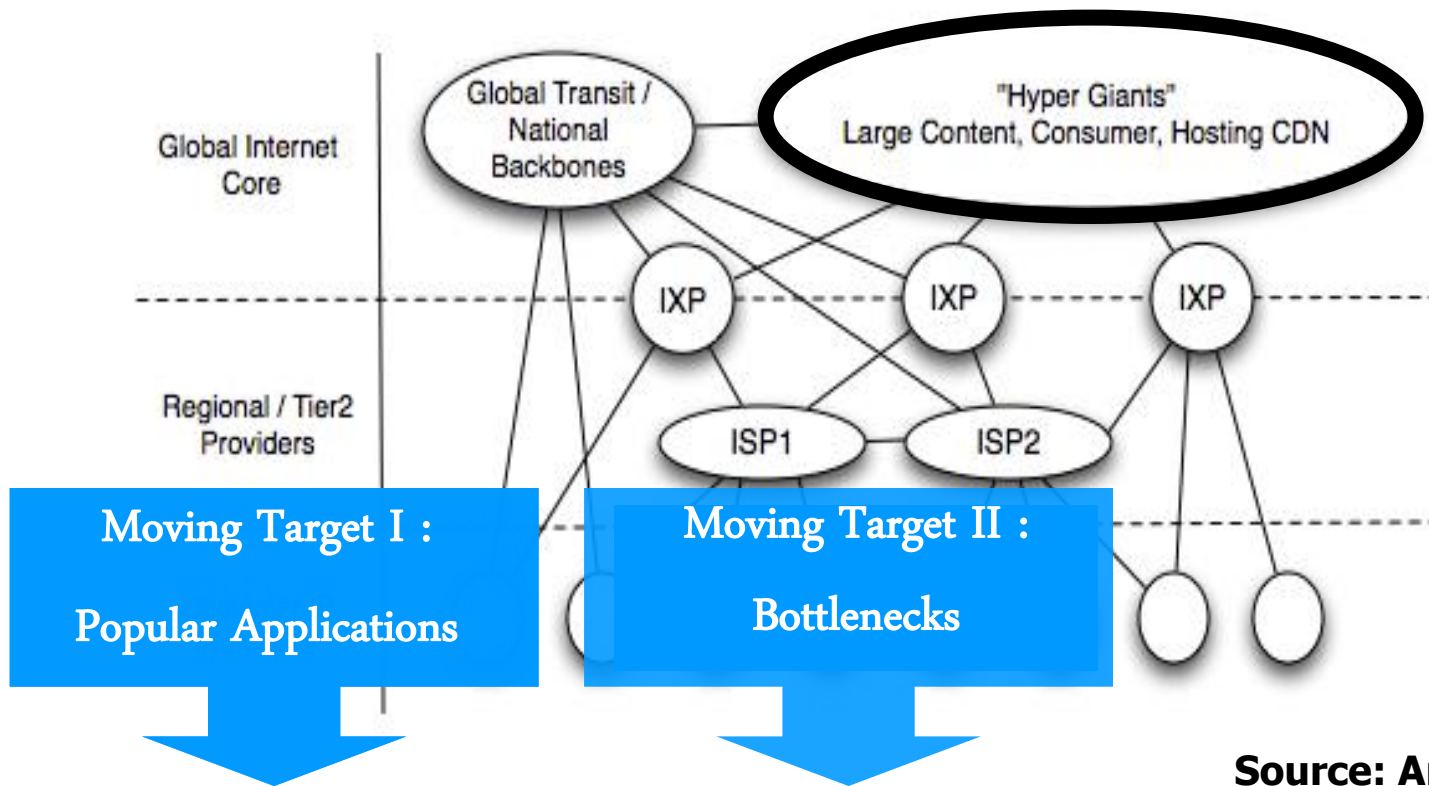
The new Internet



Source: Arbor Networks
2009

→ **New core of interconnected content and consumer networks**

The new Internet



→ **New core of interconnected content and consumer networks**

→ **ISPs lost control of their traffic**

The new Internet

Global Internet Core

Regional / Tier2 Providers

Moving Target I :
Popular Application

→ New content
→ ISPs

The screenshot shows the Financial Times website on a Mozilla Firefox browser. The main article is titled "Google accused of YouTube 'free ride'" and discusses the dispute between Google and European telecoms groups over bandwidth usage. A sidebar on the left lists various categories, with "Technology" selected. A large blue arrow points from the "Popular Application" text to the "Technology" category. Another blue arrow points from the "New content" and "ISPs" text to the bottom of the page. A large white text box is overlaid on the bottom right of the screenshot, containing the quote: "Telekom's chief executive, said Google and others should pay telecoms groups for carrying content on their networks".

FT.com / Technology - Google accused of YouTube 'free ride' - Mozilla Firefox

File Edit View History Bookmarks Tools Help Now: Partly Sunny, 15 °C Wed: 20 °C Thu: 19 °C

http://www.ft.com/cms/s/2/8f5d6128-4400-11df-9235-00144feab49a.html

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Google accused of YouTube 'free ride'

By Andrew Parker in London and Richard Waters in San Francisco
Published: April 9 2010 22:42 | Last updated: April 9 2010 22:42

Some of Europe's leading telecoms groups are squaring up for a fight with Google over what they claim is the free ride enjoyed by the technology company's YouTube video-sharing service.

Telefónica, France Telecom and Deutsche Telekom all said Google should start paying them for carrying bandwidth-hungry content such as YouTube video over their networks.

It underlines how Google's relationship with leading telecoms groups is becoming increasingly fractious, partly because YouTube video is fuelling an explosion of data traffic on their networks.

EDITOR'S CHOICE

Backlash as data traffic explodes - Apr-09
Agencies and developers welcome Apple's iAd - Apr-09
Lex: Apple v Google - Apr-09
In depth: Apple - Jul-16
In depth: Google - Mar-22

Apple to battle with Google for mobile ads - Apr-09

Some European telecoms groups fear Google will reduce them to "dumb pipes" because the internet search and advertising company pays the network operators little or nothing for carrying its content.

Telecoms groups are spending billions of euros on fixed-line and mobile infrastructure to increase broadband capacity, but some fear they may struggle to secure a return on their investment.

Global mobile telecoms market

Broadband users (m)

300

Transferring data from markets.ft.com...

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Mad Money Lightning Round: Stick With Ford

Obama Needs to Ad (Final)

Reaching Bottom?

Challenge

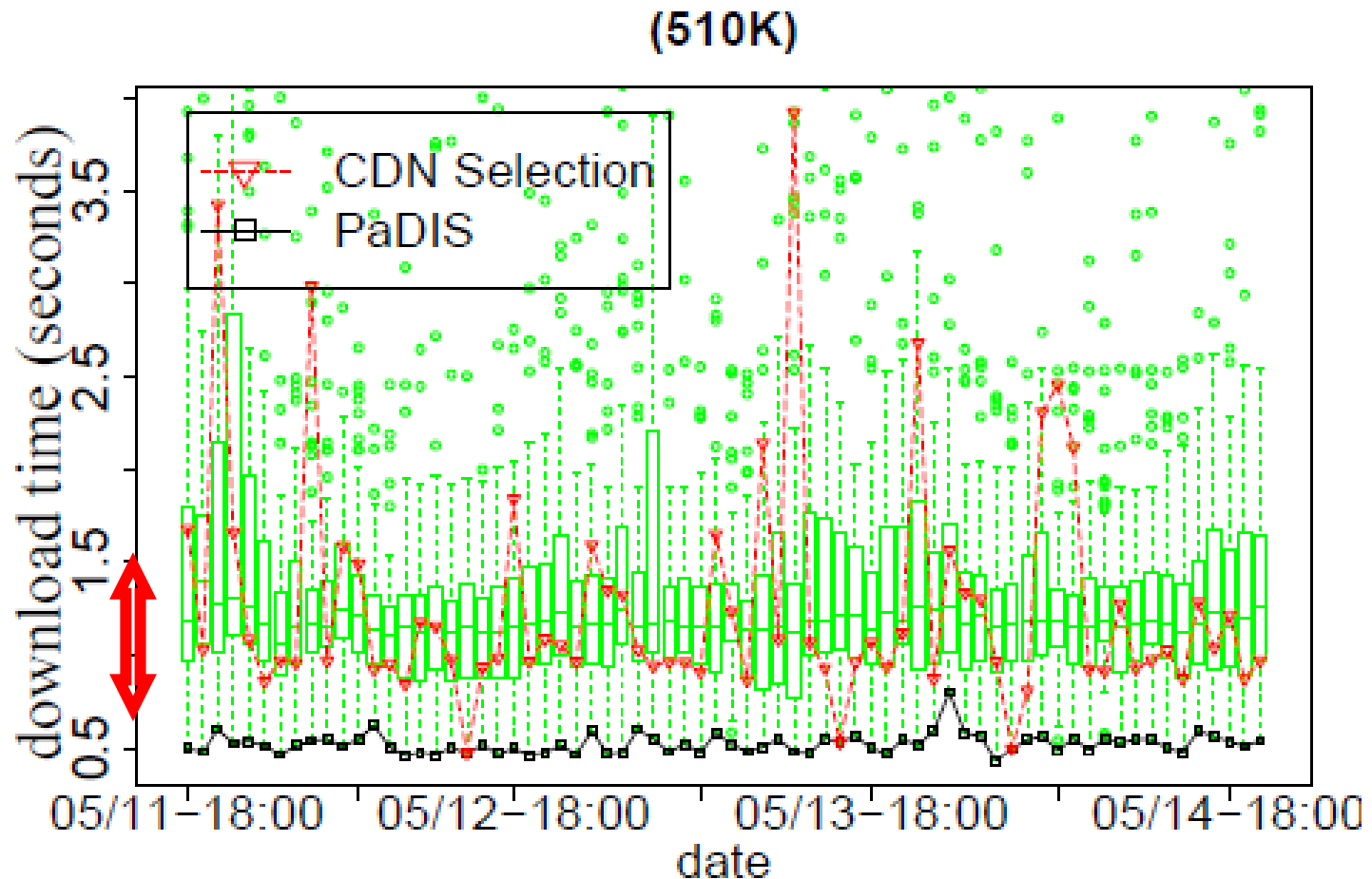
Content-aware

Traffic Engineering

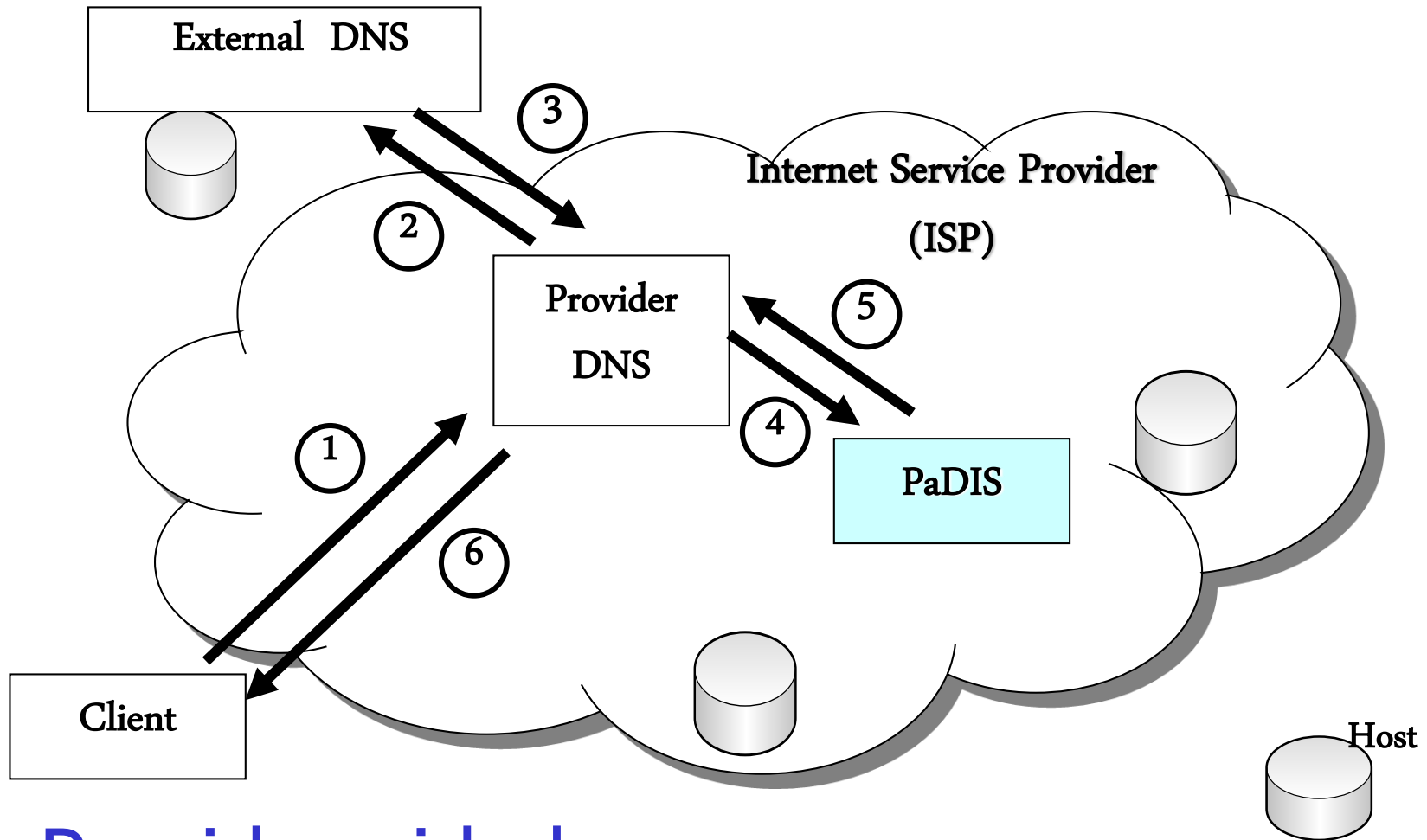
**ISPs re-gain control of their traffic
by biasing host selection**

Improving content access time

Case study: CDN



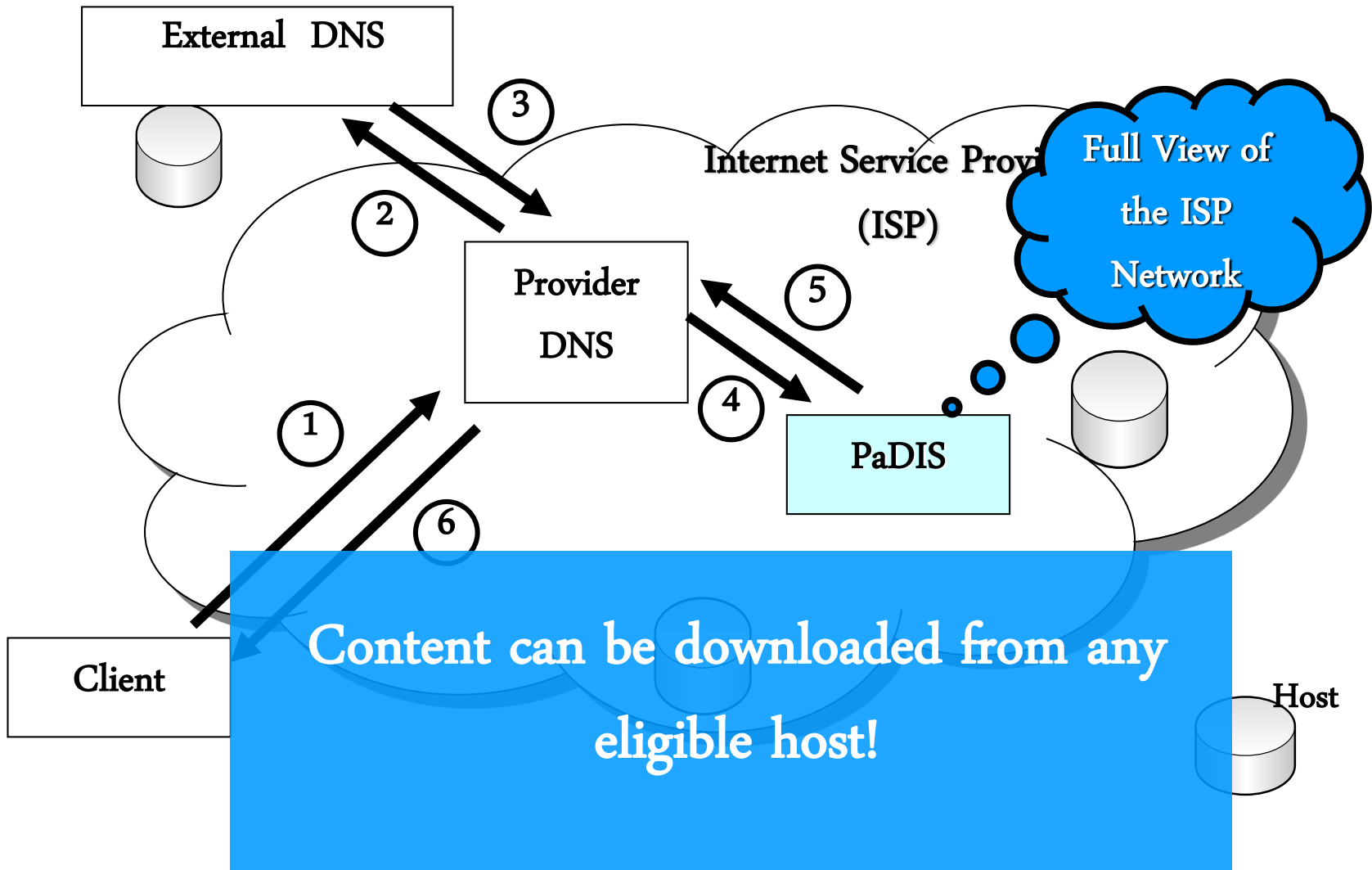
PaDIS



Provider-aided

Distance Information System

PaDIS



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:

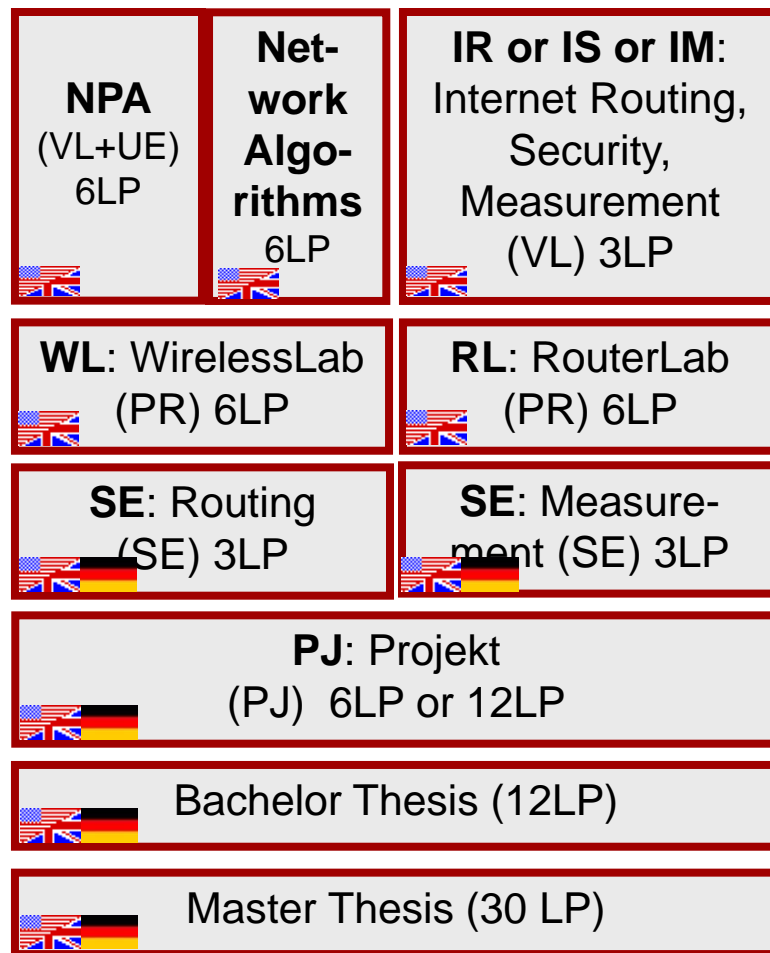
- Routing and IP
- Transport (TCP/UDP)
- Applications
- Future Internet

- Traffic Measurement
- Workload Modeling
- Wireless
- Performanceanalysis
- Network Security

Course Overview

WiSem

SoSem



Example Module Paths

