



# Peer-to-Peer Networks

## 01: Organization and Introduction

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- Christian Schindelhauer
  - Prof. of the chair Computer Networks and Telematics
  - Coauthor of the book „Peer-to-Peer-Netzwerke – Methoden und Grundlagen“
- Amir Alsbih
  - Chief Information Security Officer (CISO) at Haufe
  - PhD in computer security
- Joan Bordoy
- Sebastian Sester
  - Scientific staff members

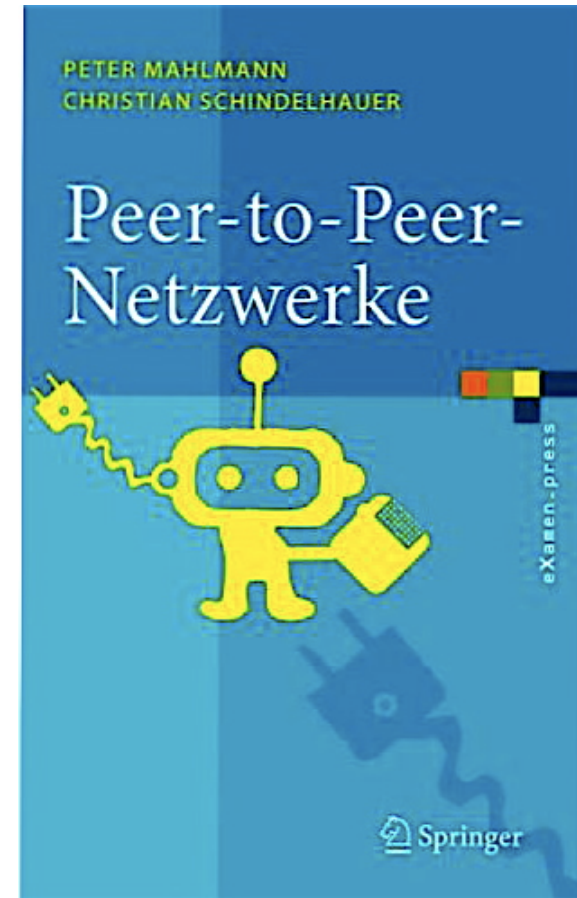


- Web page
  - <http://cone.informatik.uni-freiburg.de> (to do)
- Lecture
  - starts 19.10.2015
  - Monday, 4pm-6pm, 101-01-018
  - Wednesday, 12pm-1pm, 101-01-018
- Exercise classes
  - Wednesday, 1pm-2pm, building 101-01-018
- Oral exam
  - no prerequisites
  - register on-line (in time)

- Exercise class
  - Wednesday, 11am-12pm, building 101, 106-00-007
  - starts 28.10.2015
- Exercises
  - appear every Wednesday on the web-page
  - voluntary, but are the basis for the oral exam
  - solutions of the exercises are discussed in the following week

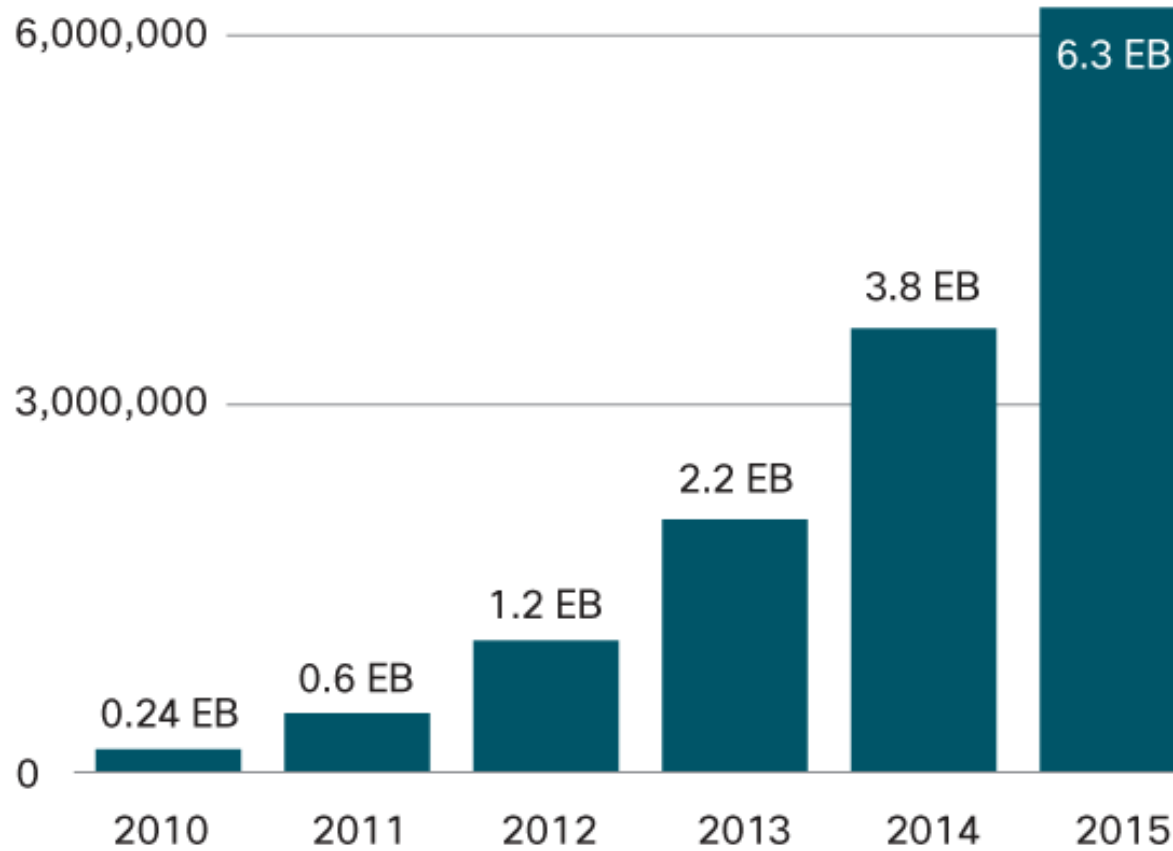
- Oral exam
  - based on the lecture and the exercises
  - register online for the exam
  - Mandatory registration

- Slides
  - appear before the lecture on the web-page
- Book
  - ~60% of the lecture can be found in *Mahlmann, Schindelbauer, Peer-to-Peer-Netzwerke — Methoden und Algorithmen, Springer 2007*
- Further Literature
  - Research papers will be presented during the lecture on the slides and on the web-page

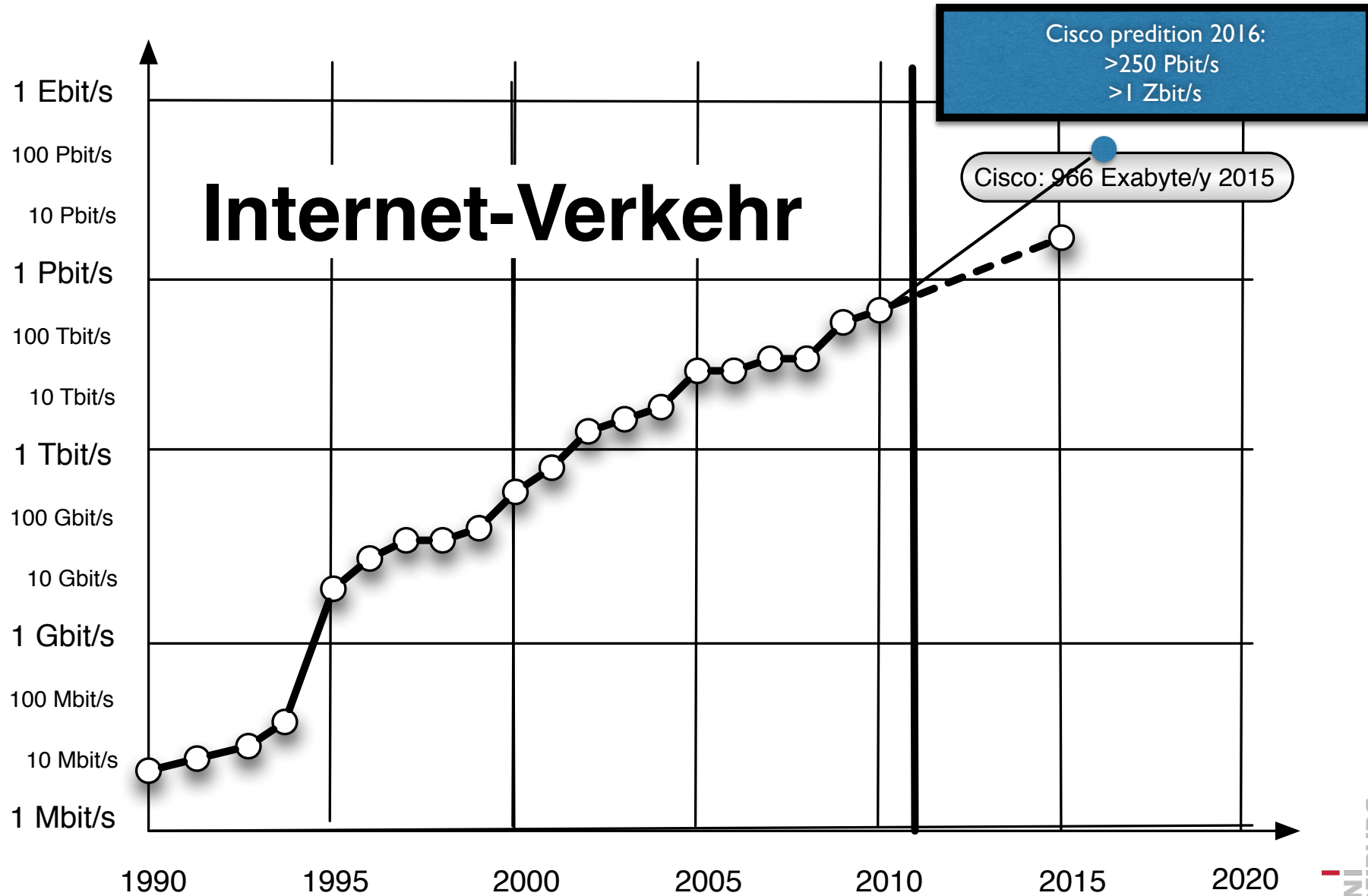


Terabytes per Month

92% CAGR 2010-2015

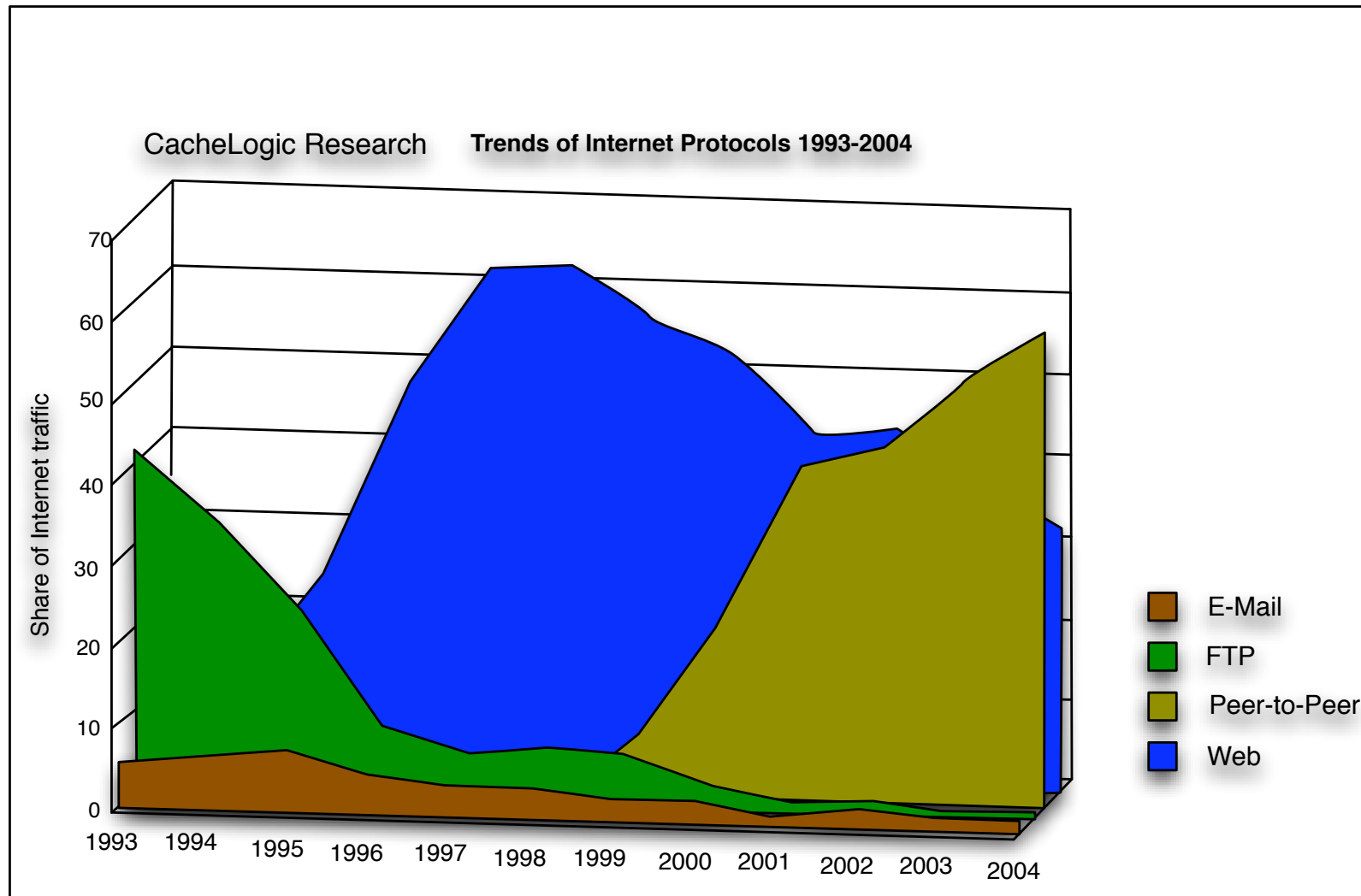


# Increase of Internet Traffic



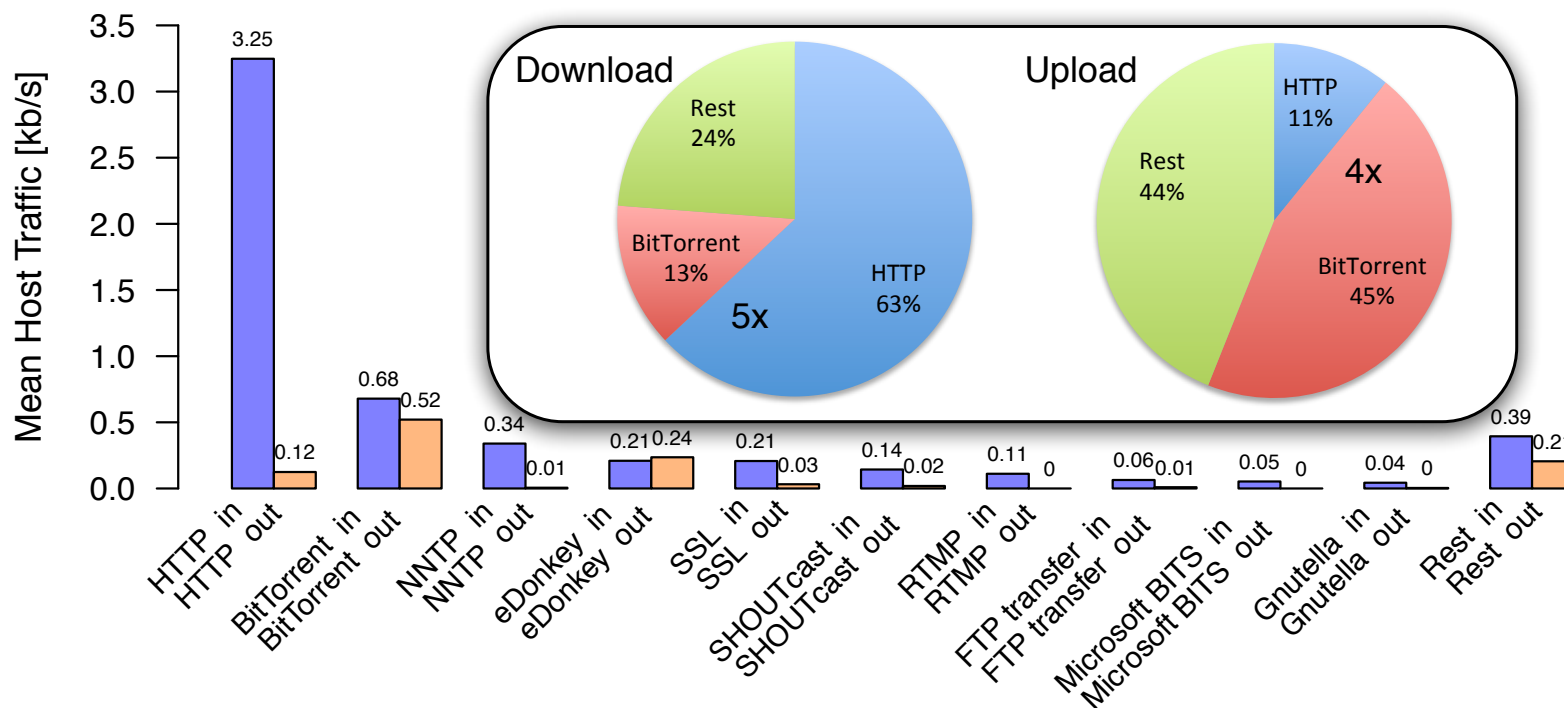


# Global Internet Traffic Shares 1993-2004

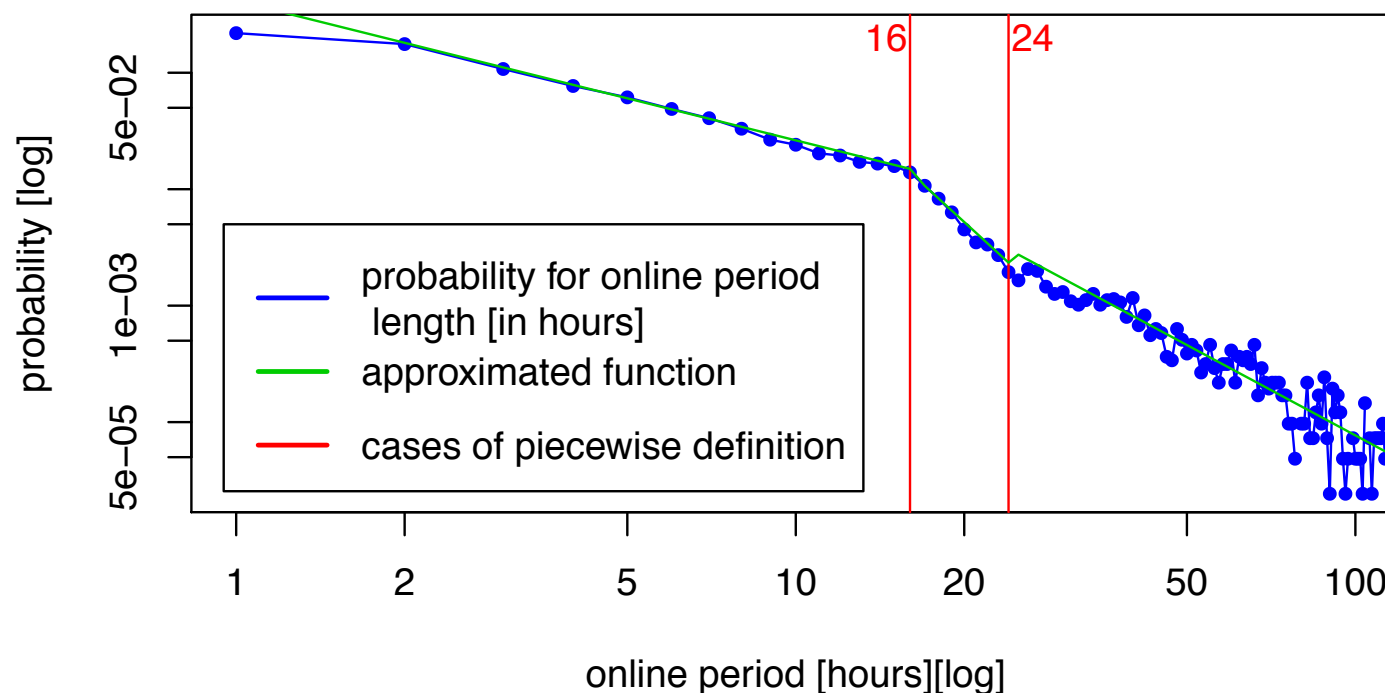


- HTTP most traffic
- BitTorrent most upload

### Top ten services of the average user

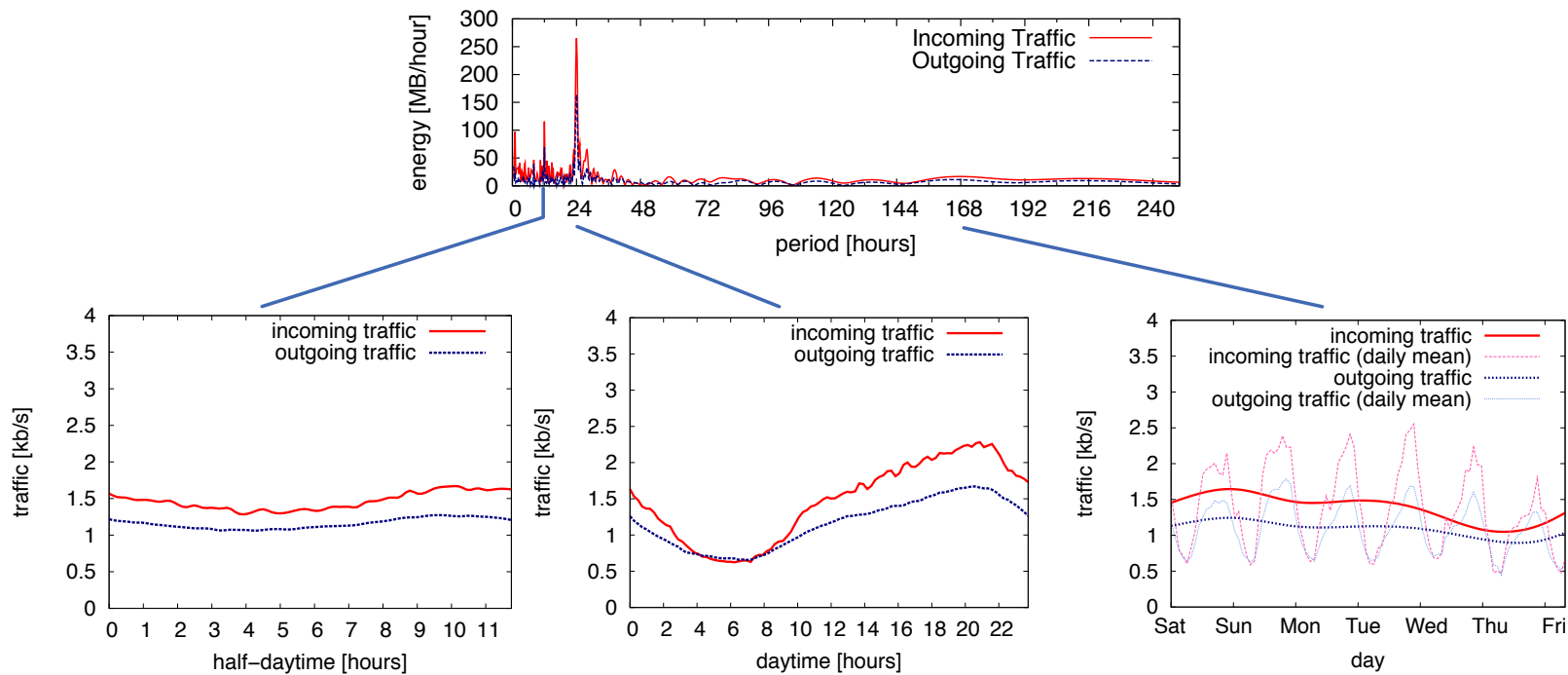


### Online period length probability



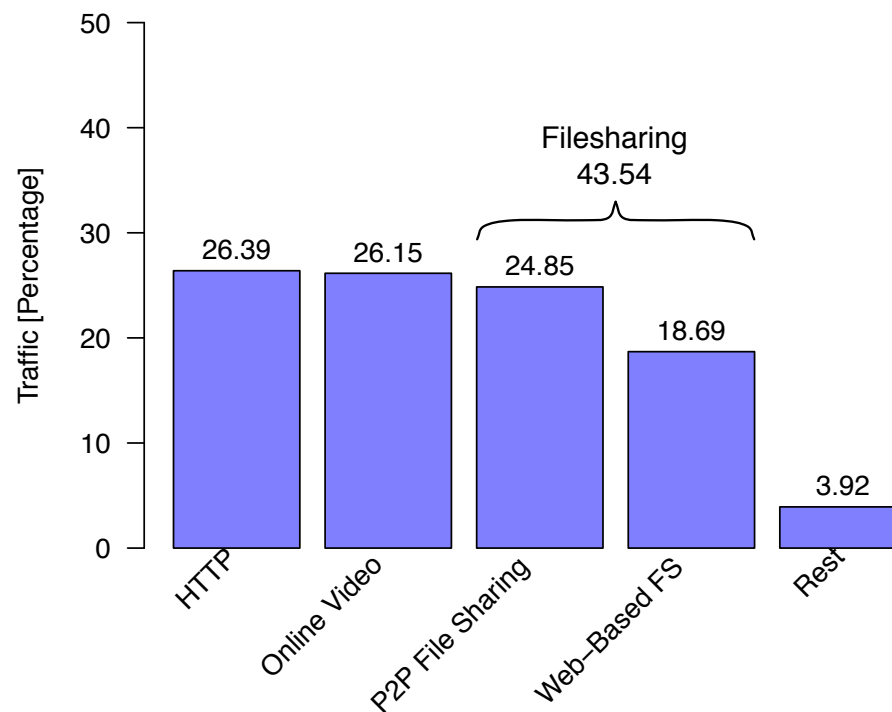
- Fourier analysis shows 12h and 24h peak
- 24h periodicity roughly resembles sin curve

### Fourier analysis of traffic & periodicity



- Cisco Visual Networking Index Usage
- contains data of 20 anonymous service providers

## Traffic Study

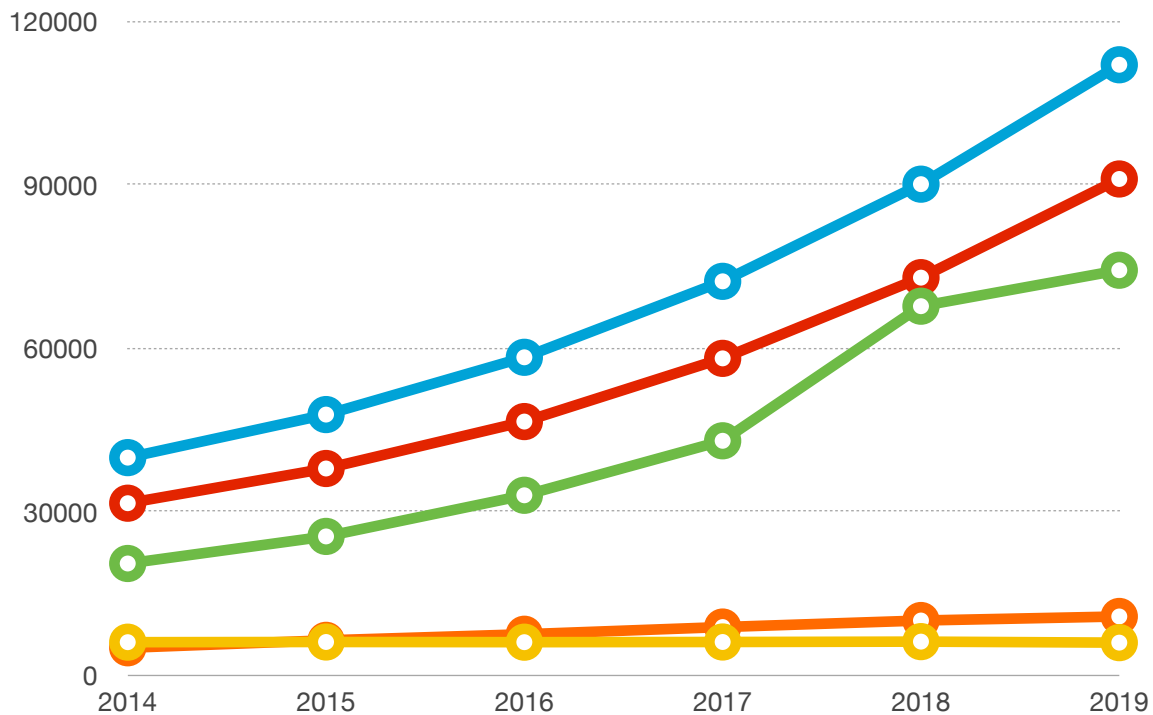


[ "Cisco Visual Networking Index: Usage", White Paper, 2010 ]

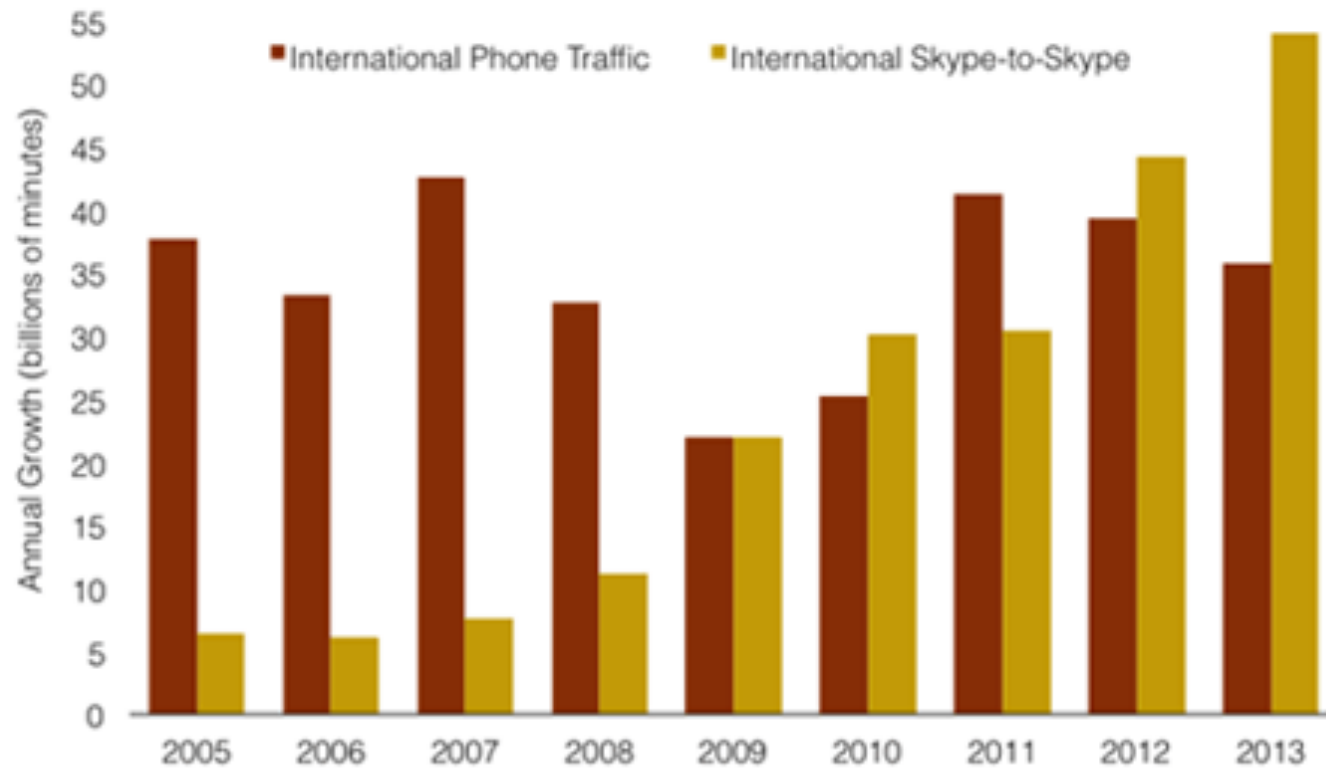
# Internet Traffic 2014-2017

Cisco Prediction 2014 (PB/mo)	2014	2015	2016	2017	2018	2019
Internet Traffic	39912	47811	58321	72261	90090	112000
Internet Video	20485	25452	33000	43000	67700	74300
Filesharing	6044	6081	6046	6080	6147	5961
Web, Email, Data	5018	6382	7500	8820	10019	10763
Consumer IP Traffic	31548	37916	46527	58125	72938	91043

● Internet Traffic  
 ● Internet Video  
 ● Filesharing  
 ● Web, Email, Data  
 ● Consumer IP Traffic



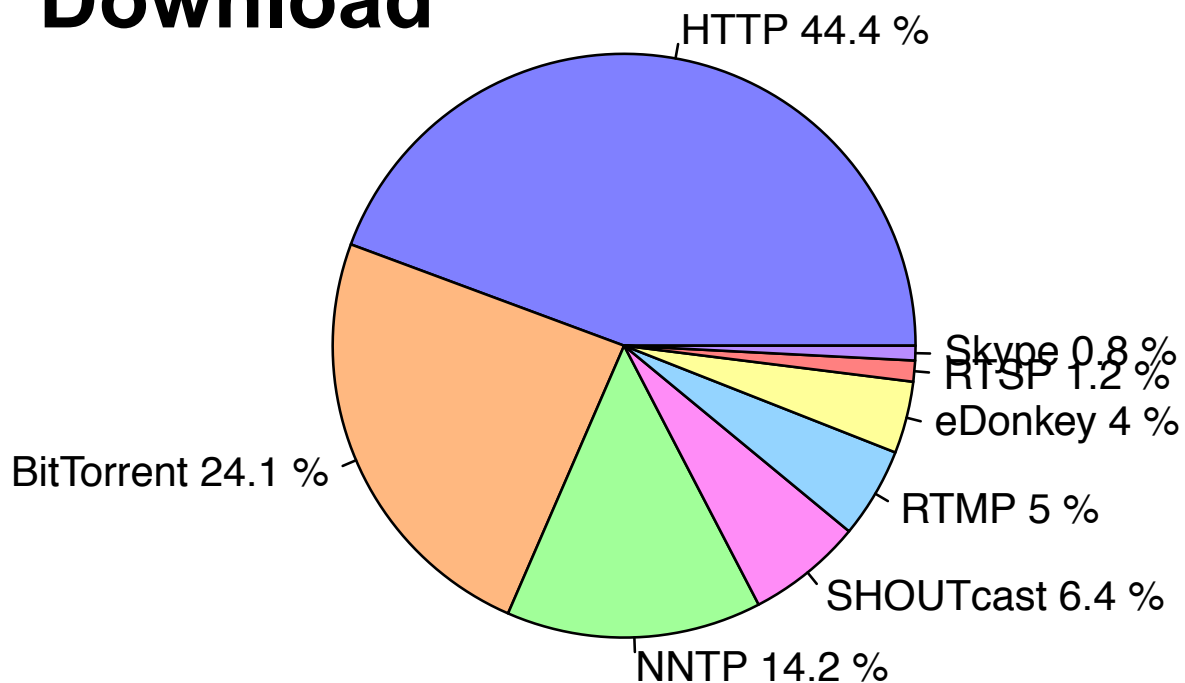
Increase in International Phone and Skype Traffic



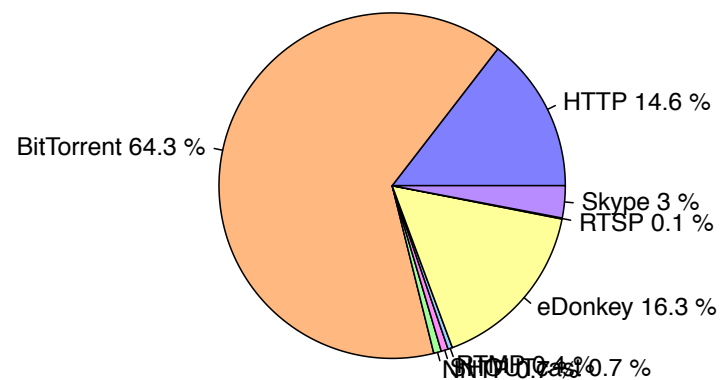
Source: TeleGeography

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### Download



### Upload



Source: Alsbih, Janson, S. Analysis of Peer-to-Peer Traffic and User Behaviour ITA 2011



- Napster (1st version: 1999-2000)
- Gnutella (2000), Gnutella-2 (2002)
- Edonkey (2000)
  - later: Overnet uses Kademia
- FreeNet (2000)
  - Anonymized download
- JXTA (2001)
  - Open source P2P network platform
- FastTrack (2001)
  - known from KaZaa, Morpheus, Grokster
- Bittorrent (2001)
  - only download, no search
- Skype (2003)
  - VoIP (voice over IP), Chat, Video

- Distributed Hash-Tables (DHT) (1997)
  - introduced for load balancing between web-servers
- CAN (2001)
  - efficient distributed DHT data structure for P2P networks
- Chord (2001)
  - efficient distributed P2P network with logarithmic search time
- Pastry/Tapestry (2001)
  - efficient distributed P2P network using Plaxton routing
- Kademlia (2002)
  - P2P-Lookup based on XOr-Metrik
- Many more approaches
  - Viceroy, Distance-Halving, Koorde, Skip-Net, P-Grid, ...
- Further Developments
  - Network Coding for P2P
  - Anonymity, Security
  - P2P Streaming

# What is a P2P Network?

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- What is P2P NOT?
  - a peer-to-peer network is not a client-server network
- Etymology: peer
  - from latin par = equal
  - one that is of equal standing with another
  - P2P, Peer-to-Peer: a relationship between equal partners
- Definition
  - a Peer-to-Peer Network is a communication network between computers in the Internet
    - without central control
    - and without reliable partners
- Observation
  - the Internet can be seen as a large P2P network

- Short history
- First Peer-to-Peer Networks
  - Napster
  - Gnutella
- CAN
- Chord
- Pastry und Tapestry
- Game theory
- P2P traffic
- Codes
- P2P in the real world



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