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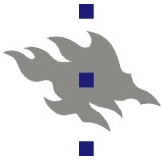
# Overlay and P2P Networks

## Introduction

**Prof. Sasu Tarkoma**

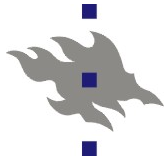
**20.9.2010**





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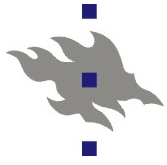


## Course Overview

- Overlay networks and peer-to-peer technologies have become key components for building large scale distributed systems.
- This course will introduce overlay networks and peer-to-peer systems, discuss their general properties, and applications.

The course will cover the following topics:

- Currently deployed peer-to-peer systems and how they work
- Distributed Hash Tables as a base for structured peer-to-peer systems
- Peer-to-peer storage systems
- Performance issues, legal aspects, and privacy issues
- Peer-to-peer content distribution algorithms



## General Info

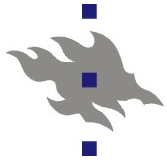
Advanced course, 4 credits

The course replaces the P2P Networks course

You cannot take this course if you took the old course

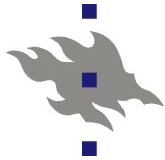
Requirements: basics of networking

Assignments/exercises done as group work (1-3 persons),  
idea is to keep the same group structure (but do tell  
about freeriders!)



## Lectures

- Lectures
  - Monday 12-14 in D122 20.09-13.10.
  - **Tuesday 10-12 in C222 21.09-21.09.**
  - Wednesday 12-14 in D122 29.09-13.10.
- Assignments
  - Thursdays 12-14 D122 27.09-15.10.
    - **First session on 30.9.**
  - Assignment topic given one week before, done for the next assignment session
- Course based on book
  - S. Tarkoma. Overlay Networks: Toward Information Networking. 260 pages. CRC Press / Auerbach, February 2010.



# Overlay Networks Book

## Introduction

- Overview
- Overlay Technology
- Applications
- Properties of Data
- Structure of the Book

## Network Technologies

- Networking
- Firewalls and NATs
- Naming
- Addressing
- Routing
- Multicast
- Network Coordinates
- Network Metrics

## Properties of Networks and Data

- Data on the Internet
- Zipf's Law
- Scale-free Networks
- Robustness
- Small Worlds

## Unstructured Overlays

- Overview
- Early Systems
- Locating Data
- Napster
- Gnutella
- Skype
- BitTorrent
- Cross-ISP BitTorrent
- Freenet
- Comparison

## Foundations of Structured Overlays

- Overview
- Geometries
- Consistent Hashing
- Distributed Data Structures for Clusters

## Distributed Hash Tables

- Overview
- APIs
- Plaxton's Algorithm

- Chord
- Pastry
- Koorde
- Tapestry
- Kademlia
- Content Addressable Network
- Viceroy
- Skip Graph
- Comparison

## Probabilistic Algorithms

- Overview of Bloom Filters
- Bloom Filters
- Bloom Filters in Distributed Computing
- Gossip Algorithms

## Content-based Networking and Publish/Subscribe

- Overview
- DHT-based Data-centric Communications
- Content-based Routing
- Router Configurations
- Siena and Routing Structures
- Hermes
- Formal Specification of Content-based Routing Systems
- Pub/sub Mobility

## Security

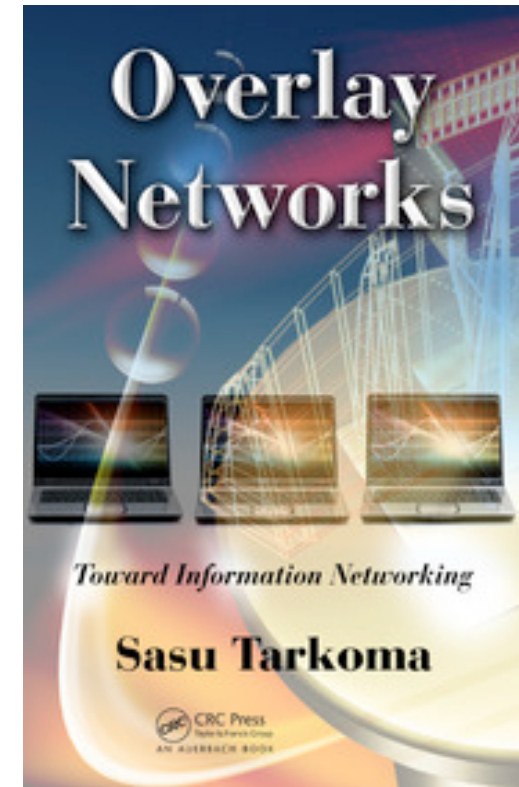
- Overview
- Attacks and Threats
- Securing Data
- Security Issues in P2P Networks
- Anonymous Routing
- Security Issues in Pub/Sub Networks

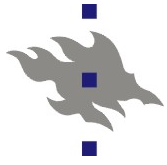
## Applications

- Amazon Dynamo
- Overlay Video Delivery
- SIP and P2PSIP
- CDN Solutions

## Conclusions

- References
- Index





## Lectures

20.9. Introduction. Unstructured networks.

21.9. Modelling P2P protocols. Guest lecture by prof. Samuli  
Aalto / Aalto University

27.9. Unstructured networks continued

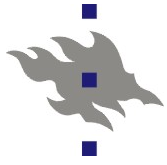
29.9. Structured networks

4.10. Distributed Hash Tables (DHTs)

6.10. Probabilistic algorithms. Performance and Reliability.

11.10. Security

13.10. Applications and summary

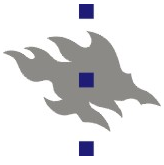


## Grading

Course grading will be based on the final exam and the assignments.

The exam will be held on 20.10. 16-19 in A111.

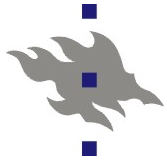




## Assignments/Excercises

- Assignments are given about one week before the session, due date is the day before the assignment session 4pm
- Assignments can be done in a group (or alone), groups can change between assignments
- Assignments give bonus points for the exam
  - Max 20%
- Thursdays 12-14 D122 27.09-15.10.
  - 30.9. General questions and BitTorrent
  - 7.10. DHT questions
  - 14.10 DHT, security, and reliability questions

<b>Main theme</b>	<b>Prerequisites</b>	<b>Approaches learning goals</b>	<b>Meets learning goals</b>	<b>Deepens learning goals</b>
Overlay and peer-to-peer networks: definitions and systems	Basics of data communications and distributed systems (Introduction to Data Communications, Distributed Systems)	Knowledge of how to define the concepts of overlay and peer-to-peer networks, and state their central features  Ability to describe at least one system in detail	Ability of being able to compare different overlay and p2p networks in a qualitative manner  Ability to assess the suitability of different systems to different use cases	Ability to give one's own definition of the central concepts and discuss the key design and deployment issues
Distributed hash tables	Basics of data communications and distributed systems (Introduction to Data Communications, Distributed Systems) Big-O-notation and basics of algorithmic complexity	Knowledge of the concepts of structured and unstructured networks and the ability to classify solutions into these two categories Knowledge of the basics of distributed hash tables Ability to describe at least one distributed hash table algorithm in detail	Ability of being able to compare different distributed hash table algorithms Ability of designing distributed hash table-based applications Knowledge of key performance issues of distributed hash table systems and the ability to analyze these systems	The knowledge of choosing a suitable distributed hash table design for a problem Familiarity with the state of the art
Reliability and performance modelling	Basics of probability theory Basics of reliability in distributed systems	Ability to model and assess the reliability of overlay and peer-to-peer networks by using probability theory Knowledge of the most important factors pertaining to reliability	Ability of analytically analyzing the reliability and performance of overlay and peer-to-peer networks Understanding of the design issues that are pertinent for reliable systems	Familiarity with the state of the art
Content distribution	Introduction to Data Communications	Knowledge of the basic content distribution solutions Ability to describe at least one overlay and p2p network based content distribution solution	Knowledge of different content distribution systems and the ability to compare them in detail Knowledge of several content distribution techniques	Familiarity with the state of the art
Security	Basics of computer security	Knowledge of the basic security issues with overlay and p2p networks Knowledge of the sybil attack concept	Ability to discuss how security problems and limitations can be solved Knowledge of how to prevent sybil attacks	Knowledge of how to prevent sybil attacks Familiarity with the state of the art

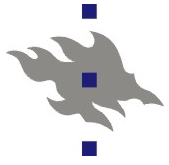


## Contact information

Lecturer prof. Sasu Tarkoma (contact info on homepage)

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Course homepage can be found: [www.cs.helsinki.fi/courses](http://www.cs.helsinki.fi/courses)



**Questions?**