OST
Eastern Switzerland
University of Applied Sciences

Distributed Systems Advanced & Blockchain

Administration

Thomas Bocek

13 September 2020

ADSB Administration

- Module Description
- «Die Themengebiete in diesem Modul können variieren und werden in der ersten Vorlesung bekanntgegeben»
- Website: dsl.hsr.ch

Modulbeschreibung

Advanced Distributed Systems & Blockchain

Kurzzeichen:
M_ADSB

Durchführungszeitraum:
HS/20

ECTS-Punkte:
4

Lernziele:
Verteilte Systeme sind allgegenwärtig in beruflichem und privatem Alltag; sie führen Konzepte und Technologien aus unterschiedlichen Bereichen der Informatik zusammen. Die Themengebiete in diesem Modul umfassen:

- Synchronization in Distributed Systems (Causality, Lamports Clock, Vector Clocks)
- Blockchain Security Considerations and Cryptography
- DHTs (Chord, Kademlia)
- Distributed Systems with WebRTC
- Distributed Batch Processing with Apache Spark
- Ethereum, IOTA, NEO
- Consensus Mechanisms, Atomic Swaps

Verantwortliche Person:
Bocek Thomas

Empfohlene Module:
Distributed Systems & Blockchain (M_DS1, FS/21)

Zusätzlich vorausgesetzte Kenntnisse:
Englisch
(Dieses Modul wird teilweise in Englisch gehalten.)

ADSB Administration – VSS Retrospect FS20

- Protocols, Basics, Scalability
- Application Protocols
- Distributed Applications: load balancing
- Distributed Applications: CORS, gRPC, git
- Authorization (basic auth, digest auth, session-based, JWT), message queues
- Containers and VMs
- Blockchain, Bitcoin, Ethereum
- Docker, Docker Compose

Modulbeschreibung

OST Ostschweizer Fachhochschule

Distributed Systems & Blockchain

Kurzzeichen:
M_DS1

Durchführungszeitraum:
FS/21

ECTS-Punkte:
4

DS1/VSS knowledge is good to have

Lernziele:

Verteilte Systeme sind allgegenwärtig in beruflichem und privatem Alltag; sie führen Konzepte und Technologien aus unterschiedlichen Bereichen der Informatik zusammen. Die Themengebiete umfassen:

- Protocols for Distributed Systems
- Fully Distributed Systems and NAT issues
- BitTorrent, Tor, Rsync
- RPC and Queues
- Blockchain Introduction
- Smart Contracts and Cryptocurrencies

https://studien.hsr.ch/allModules/36700_M_DS1.html

Nr	Date	Vorlesung*	Dozent
01	16.09.20	Admin, Challenge Task, Introduction, Repetition VSS	Bocek
02	23.09.20	Repetition VSS	Bocek
03	30.09.20	P2P Basics, WebRTC	Bocek
04	07.10.20	P2P and DHTs	Bocek
05	14.10.20	Blockchain, Bitcoin, Ethereum III	Bocek
06	21.10.20	Blockchain, Bitcoin, Ethereum IV	Bocek
07	28.10.20	IOTA, NEO, BFT, PoS, and Bazo	Bocek
08	04.11.20	Virtualization Details	Bocek
09	11.11.20	Applied Cryptography and Exam Preparation	Bocek
10	18.11.20	tbd	Guest: tba
11	25.11.20	tbd	Guest: tba
12	02.12.20	Challenge Task Presentations – 1st part	Students
13	09.12.20	Challenge Task Presentations – 2nd part	Students
14	16.12.20	Fragestunde und Feedback	Bocek
15	06.01.21	Beratungswoche	Bocek

* topics may change

ADSB

- Lectures
  - Online
  - I will upload slides and video at the latest when lecture starts (same as VSS in FS20) – 10:10, Wednesday
  - Recorded lectures, you can watch them whenever you want
- Exercises
  - Challenge Task II
  - I will be online during exercise hours, but you are **not required** to be **present**
  - Starts 23.09.2020 (lecture 2), no exercises today!
  - Goal: practical application of P2P concepts and tools

- Leistungsbewertung

Während der Prüfungssession:

Schriftliche Prüfung, 60 Minuten

Zulassungsbedingungen zur Prüfung:

Nach Ankündigung, Abgabe erfolgreich gelöste Übungsaufgaben.

Kurse in diesem Modul

- Advanced Distributed Systems & Blockchain

Kurzzeichen:

ADSB

Lernziele:

Plan und Lerninhalt:

Die Themengebiete in diesem Modul können variieren und werden in der ersten Vorlesung bekanntgegeben.

In den Übungen entwickeln Studentengruppen eine verteile Applikation (Challenge Task II), welche diverse Requirements erfüllen muss. Das Erfüllen dieser Requirements ist Voraussetzung für das Bestehen der Übungen und für die Zulassung zur Prüfung. Ein Beispiel eines Challenge Tasks aus dem HS18 war es, eine vollständige verteilte P2P Applikation zu erstellen, welche mithilfe einer Blockchain Nachrichten notariell beglaubigen kann.

Kursart:

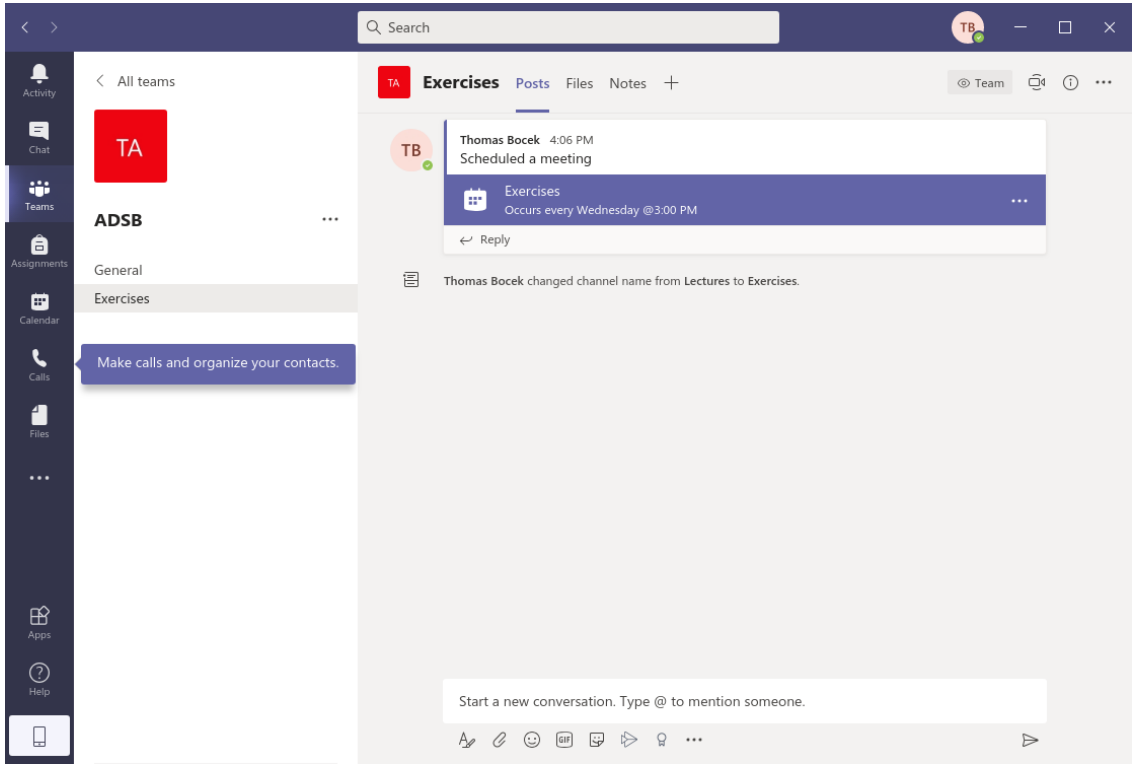
(Durchführung gemäss Stundenplan)

Vorlesung mit 2 Lektionen pro Woche
- Max. Teilnehmer: 126
- Harte Grenze: ja

Uebung mit 2 Lektionen pro Woche
- Max. Teilnehmer: 18
- Harte Grenze: ja

Exercises

- From 15:10 to 18:40
- Join ADSB in Microsoft Teams: iz0y31j
- https://teams.microsoft.com/l/channel/19%3aece70feff61d45f3bd875c19101f1762%40thread.tacv2/Exercises?groupId=61eeef82-c51d-44c8-9f88-545e5f44b8ac&tenantId=a6e70fa3-1c7a-4aa2-a25e-836eea52ca22
  - Exercise goal: work on your challenge task
    - Architectural questions
    - Technical questions
    - ADSB questions



ADSB Administration / Challenge Task II HS20

- Design and implementation of a decentralized financial product
  - E.g., Transferable IOU, asset tokenization, insurance, crypto currency exchange, utility token, donation platform, shares on the blockchain
  - It needs to run on a public blockchain
- Milestone: 04.11.2020
  - Send initial code to me, include instructions on how to bootstrap
  - Resubmit 1 week later, if I cannot run your code, challenge task not passed → **cannot write exam**

- Each student's group is free to decide about specifics of building the decentralized financial product and how to organize the information within the distributed network.
- Requirements
  1. Public blockchain based
  2. Full decentralization and P2P mechanisms for the financial product (e.g., WebRTC, TomP2P, libp2p)
     or
     Scalable mechanisms ready to be deployed on the cloud
  3. Graphical (GUI/Web-based) frontend (can be simple)

  - The solution may use existing libraries and code, but those must be allowed to be published under an open software license.
  - The final presentation shall outline the application and architecture.
- Requirements not met → **cannot write exam**

ADSB Administration / Challenge Task (29 Students)

- Deliverables, 02.12.2020
  - Well documented code of the application
  - Presentation (slides) and demo of the application, also showing the architecture and design decisions
- Libraries and tools
  - Backend: golang, Spring Boot, node.js…
  - Frontend: vue.js, React, Svelte, …
  - GUI: Electron, …
  - Ethereum is the most popular public blockchain for smart contracts (Remix)
  - P2P: TomP2P in Java, GoP2P is wip, WebRTC, libp2p
  - Allowed to use any language or framework. However, the supervisors are familiar with those: Java, Golang, and a bit JavaScript
- Organization
  - n groups of 2-3 people, if group members found, send email to thomas.bocek@ost.ch
  - During the challenge task, the group shall meet every week e.g., online during exercise hours to work on the task and discuss the next steps.
  - The groups shall utilize their homework times to work on the CT, besides the exercise time slots assigned on Wednesday.
  - You do not have be present at the exercises. Supervisors will be online **on Wednesday.**
  - The groups shall determine and set-up an internal project plan
  - Distribute the workload so that each group member gets a fair load of work

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Winner Group of CT in 2012

- Fully-distributed, P2P online radio with recommendation
- Group 4 – Radiommender

- Submitted research result to P2P12 in Tarragona, Spain
- Radiommender: P2P on-line radio with a distributed recommender system
  - http://www.csg.uzh.ch/csg/en/news/p2p12.html

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Challenge Task 2013

- Winner Group of CT in 2013
- Fully-distributed, P2P synchronization application
- Group 2: Box2Box - A P2P-based file-sharing and synchronization application

- Submitted research result to P2P13 in Trento, Italy
- Demo paper
  - https://ieeexplore.ieee.org/document/6688736/

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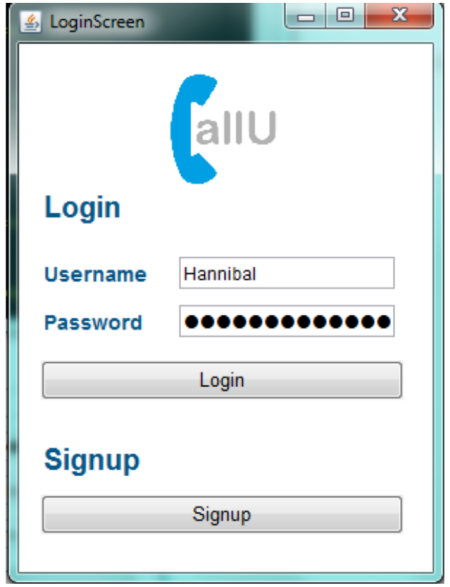
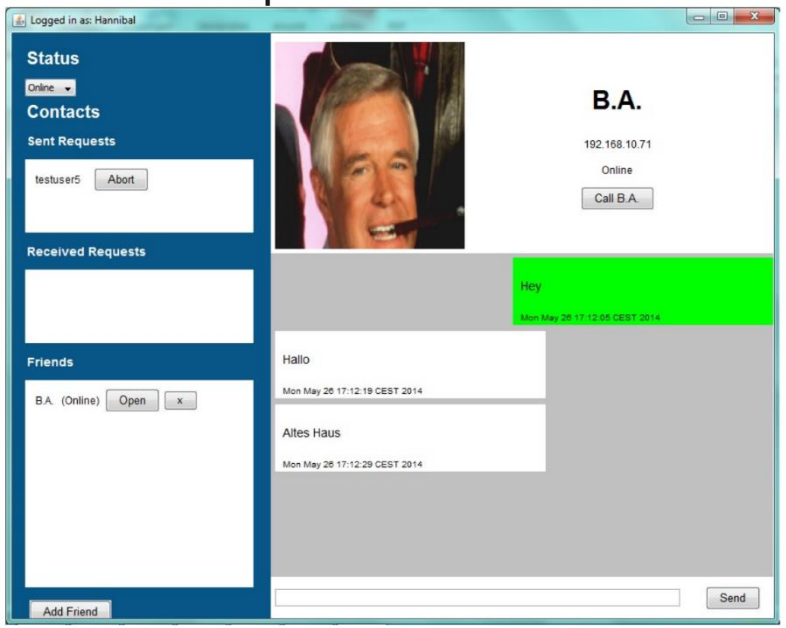
Challenge Task 2014

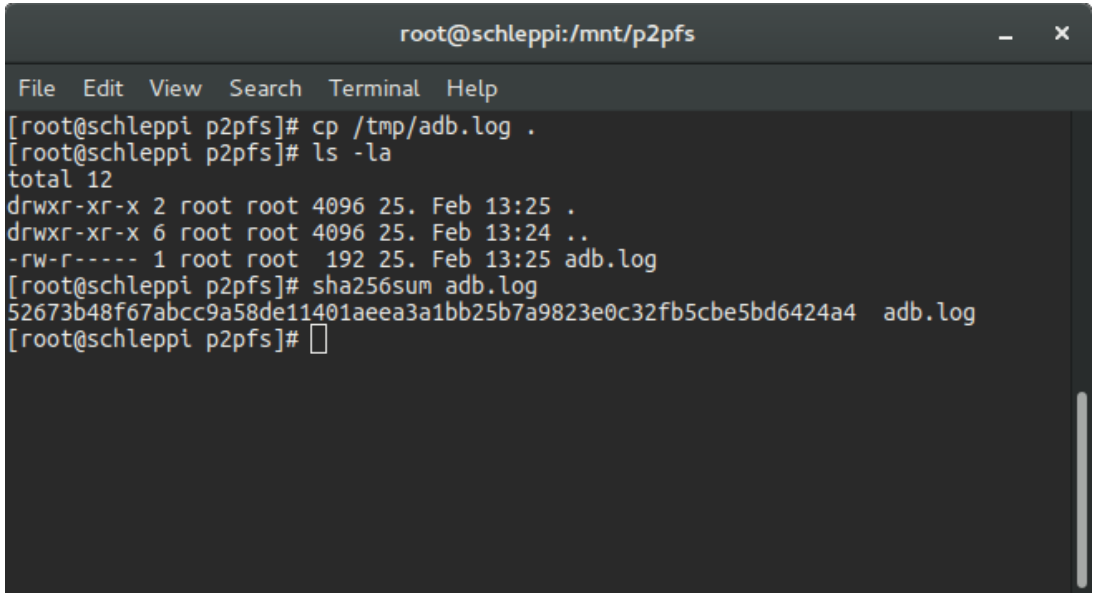
- Fully decentralized Skype clone
  - Codec: Opus
  - Every group could establish a phone call, all groups passed the 3 requirements





Challenge Task 2015

- P2P-based file system
- Idea: scale up/down by adding/removing peers
- Mount with FUSE (Mac/Linux), no Windows ☹
- Challenges: consistency, availability (churn)
- Deployment: 10-15 ODroid U1 with attached USB storage
- Only one group managed to store/retrieve file with churn (winner)
  - One group failed completely



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Challenge Task HS 2018

- Design and implementation of a fully-distributed, P2P messaging application with an integrated, blockchain-based notary service

- Requirements
  1. Full decentralization and P2P
  2. Send messages between peers
  3. Quickly and easily verify messages

  - Each winner: 0.01311 BTC (50CHF)
    - They used the IOTA blockchain as a signaling layer for WebRTC.
    - Everything decentralized

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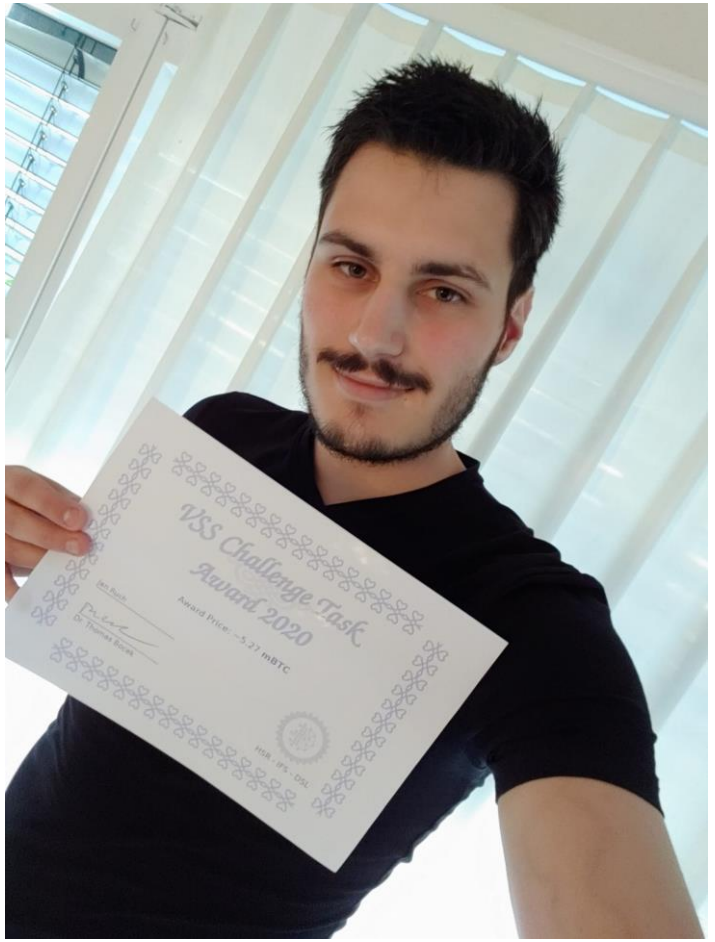
Challenge Task HS 2019

- This semester's challenge task (CT) is the design and implementation of a fully-distributed, P2P gambling game
- Requirements
  1. Full decentralization and P2P for the board game (e.g., WebRTC, TomP2P, libp2p)
  2. Waiting room with chat (groups with 3 members need to implement random numbers)
  3. Fully decentralized and P2P mechanisms for gambling (e.g., Bitcoin/Ethereum)
- Each winner: 0.007 BTC (50CHF)
  - Simple design: four-in-a-row
  - Users can stake and platform provider also gets a cut

Challenge Task FS 2020

- This semester's challenge task (CT) is the design and implementation of a simple distributed system, with the following components
- Requirements
  1. Use at least one text protocol, at least one binary protocol
  2. Load balancing
  3. Scalable service with authentication
- Gather weather data from multiple locations
  - Used many concepts:
    - ActiveMQ
    - Eureka discovery services
    - Kibana
    - Docker compose – easy setup
    - Self-hosting of gitlab



ADSB Recommendation

- Follow the lecture closely
  - Lecture slides contain relevant
  - Reading further literature is recommended
    - Link are provided in the slides
- Post-processing the lecture
  - If topics or statements from the lecture are not clear, research and resolve them
- Actively participate in the challenge task
  - Trying to understand it theoretically is not enough – hands-on is key!
  - If its not working, **read logs**, try to figure it out by yourself. If its still not working, ask.
  - Do not miss the opportunity of discussing details with your supervisor

- 12 lectures
  - (30h = 18h + 12h; ca. 2.5h / week)
  - ~1.5h video material
  - ~1h post-processing
- Exercises / challenge task
  - (54h = 48h + 6h, ca. 4.5h / week)
  - ~4h challenge task
  - ~0.5h post-processing
- Exam
  - ~36h exam preparation
- 4 ECTS = 120h
- Prüfung:
  - Closed book 1h, no coding, Hilfsmittel: none

Summary

- Lectures: Online until Wednesday Morning – 10:10, you can watch it later (or sooner)
- Challenge task, 2-3 group members: send to thomas.bocek@ost.ch until next week
  - Work on challenge task during exercise hours and at home
  - Supervisors will be online
- 3 requirements to be met
  1. Uses public blockchain
  2. Fully decentralized or cloud ready
  3. GUI / Web-based frontend
- To write exam all 3 requirements must be fulfilled
- Milestone 1: send source code to until 04.11.2020
- Final hand-in with presentation and demo: 02.12.2020
- OST Challenge Task Winner 2020
  - 16.12.2020