

Blockchain (BlCh)

Admin

Thomas Bocek
13.09.2025

About Me

- General interests: distributed systems, blockchain, architecture, startups
- Distributed systems [\[link\]](#), Blockchains [\[link\]](#), AppArch (2nd half) [\[link\]](#)
 - Since Corona, also on youtube [\[link\]](#)
 - Focus: practical implementation – Challenge Task
 - Winner last year: implemented a stablecoin tied to Western Texas Intermediate crude oil prices.



BlCh Administration

- Module Description
- Website: <https://dsl.i.ost.ch>
- Exercises onsite **and** remote: Teams
 - Team code: 82yh8gm
- OST Chatbot (experimental)
- Lectures: pre-recorded, videos available on <https://dsl.i.ost.ch/lect> and Youtube
 - Videos and PDFs will be uploaded before the lecture starts on Monday 13:10
 - Youtube will only have the lectures videos, admin related videos & PDFs only via (VPN) <https://dsl.i.ost.ch/lect/hs25/>
 - Same as in previous semester **HS24**

Blockchain

Kürzel:

M_BlCh

Durchführungszeitraum:

HS/21-HS/24

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:

Dr. Bocek Thomas

Standort (angeboten):

Rapperswil-Jona

Empfohlene Module:

Distributed Systems (M_DSv, ES/22-ES/25)

Zusätzlich vorausgesetzte Kenntnisse:

Englisch

(Dieses Modul wird teilweise in Englisch gehalten.)

BlCh Administration

Kurzzeichen:

BlCh

Lernziele:

Plan und Lerninhalt:

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

- If there is interest in further topics (blockchain and distributed systems related), please talk to me.

BlCh 2025: Plan

Nr	Date	Lecture*	Lecturer
01	15.09.2025	Admin (lecture and challenge task), Repetition DSy (part 1) - no exercises	Bocek
02	22.09.2025	Repetition DSy (part 2), Introduction Blockchain	Bocek
03	29.09.2025	Ethereum Components / Architecture, Account Abstraction	Bocek
04	06.10.2025	1st hand-in , Solidity	Bocek
05	13.10.2025	DeFi, DEX	Bocek
06	20.10.2025	DAO, Fungible Tokens, Non-Fungible Tokens	Bocek
07	27.10.2025	2nd hand-in , Wallets and Seed Phrases, POAP	Bocek
08	03.11.2025	HTLCs, Cross-chain Atomic Swaps, Payment Channels	Bocek
09	10.11.2025	Algorithms/Mechanisms for Fully Distributed Systems	Bocek
10	17.11.2025	3rd hand-in , Guest	tba
11	24.11.2025	Ethereum Layer 2, Stablecoins	Bocek
12	01.12.2025	Exam Preparation	Bocek
13	08.12.2025	Final hand-in , Challenge Task Presentations	you
14	15.12.2025	Q&A and Challenge Task Award Winner Announcement - no exercises	Bocek

* topics may change

BlCh Exercises

- Challenge Task
 - Starts 22.09.2025 (lecture 2)
 - **No exercises on 15.09.2025!**
- Goal: practical application of distributed systems concepts and tools
- Onsite and remote (on request): via MS Teams
 - Monday exercise: 15:10 – 18:40

Plan und Lerninhalt:

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

In den Übungen entwickeln Studentengruppen eine verteilte 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.

BlCh Challenge Task

- Leistungsbewertung

Während der Prüfungssession:

Schriftliche Prüfung, 60 Minuten

Zulassungsbedingungen zur Prüfung:

Nach Ankündigung, Abgabe erfolgreich gelöste Übungsaufgaben.

- Must include a simple frontend (e.g., HTML, Vue, React, Svelte, Angular)
 - Gasless transaction user interface - users never see or pay gas fees
- Must run on public blockchain (Ethereum, Sui, ...)
 - Can use EVM chains with ERC-4337 OR chains with native account abstraction
 - Gasless transactions must work on chosen platform
- Your app needs to demonstrate gasless user experience
 - Platform sponsors transaction costs through account abstraction

• Challenge Task HS 2025

- Gasless application using account abstraction
- Ideally, the application is a decentralized application (DApp).

• Requirements

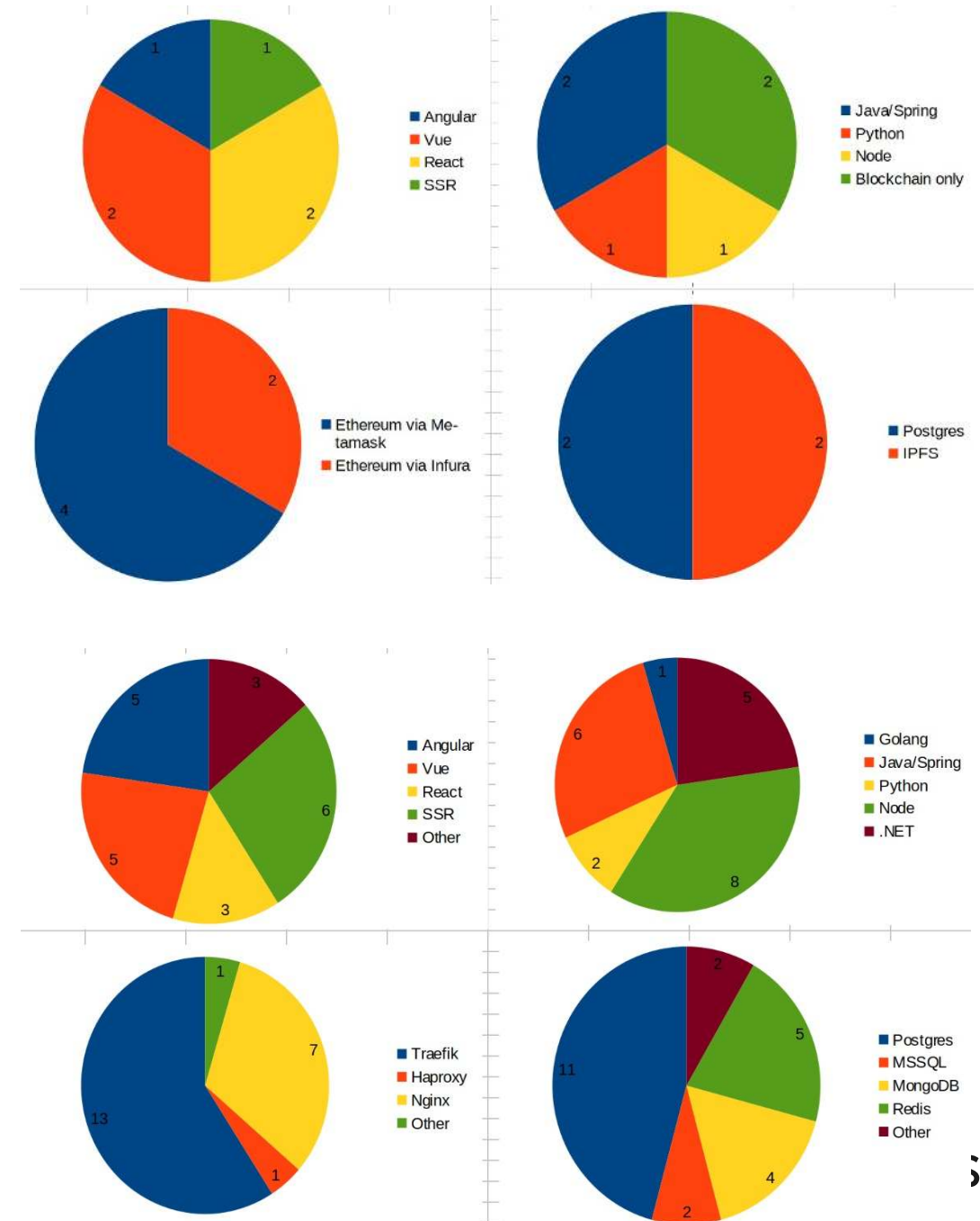
- A working prototype demonstrating gasless user interactions
- Use latest stable releases of chosen libraries and frameworks.
- Interaction with a public blockchain (can be testnet).
- At least 2 participants need to be involved.
- Gasless transaction implementation using account abstraction
- Status and process need to be shown in the frontend

BlCh 2025: Plan / Challenge Task

Nr	Date	Lecture*	Excercise
01	15.09.2025	Admin (lecture and challenge task), Repetition DSy (part 1)	Group forming, idea for (d)app
02	22.09.2025	Repetition DSy (part 2), Introduction Blockchain	Group forming done, setup dev env
03	29.09.2025	Ethereum Components / Architecture, Account Abstraction	
04	06.10.2025	1st hand-in , Solidity	Hand-in 1 , initial plan
05	13.10.2025	DeFi, DEX	
06	20.10.2025	DAO, Fungible Tokens, Non-Fungible Tokens	
07	27.10.2025	2nd hand-in , Wallets and Seed Phrases, POAP	Hand-in 2 , first version (initial commit)
08	03.11.2025	HTLCs, Cross-chain Atomic Swaps, Payment Channels	
09	10.11.2025	Algorithms/Mechanisms for Fully Distributed Systems	
10	17.11.2025	3rd hand-in , Guest	Hand-in 3 , current progress
11	24.11.2025	Ethereum Layer 2, Stablecoins	Testing, testing, testing
12	01.12.2025	Exam Preparation	
13	08.12.2025	Final hand-in , Challenge Task Presentations	Final Hand-in (07.12.2025, 23:59 CET)
14	15.12.2025	Q&A and Challenge Task Award Winner Announcement	

BlCh Challenge Task

- Final deliverables, 07.12.2025, 23:59 (CET)
 - Source code
 - Presentation (slides) and demo of the application, also showing the architecture and design decisions
- Libraries and tools
 - Allowed to use any language, framework, and platforms. However, the supervisors are familiar with those: Golang, Java, JavaScript, Linux (see FS25, HS24)
- If you **fail** the CT, you fail this course



BlCh Challenge Task 2018

- Design and implementation of a fully-distributed, P2P messaging application with an integrated, blockchain-based notary service
- Requirements
 - Full decentralization and P2P
 - Send messages between peers
 - Quickly and easily verify messages
- Each winner: 0.01311 BTC (50CHF)
 - They used the IOTA blockchain as a signaling layer for WebRTC.
 - Everything decentralized



BlCh Challenge Task 2019

- Design and implementation of a fully-distributed, P2P gambling game
- Requirements:
 - Fully decentralization and P2P communication
 - Waiting room with chat
 - Fully decentralized gambling
- Each winner: 0.0075 BTC (~50CHF)
 - Simple yet efficient design
 - Blockchain-based four-in-a-row
 - Technology: Ethereum with web3.js and WebRTC



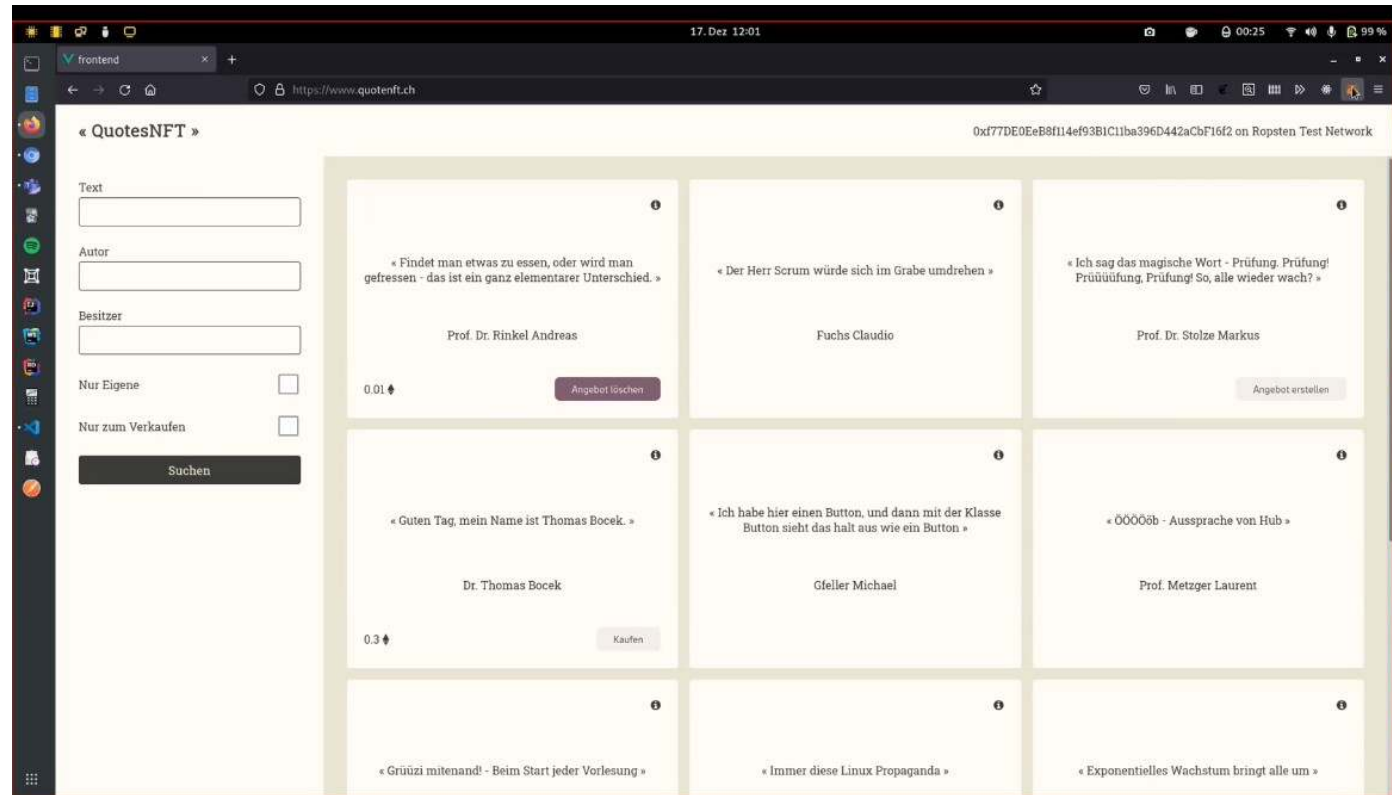
BlCh Challenge Task 2020

- Design and implementation of a decentralized financial application
- Requirements
 - Full decentralization and P2P mechanisms for the financial product (e.g., WebRTC, TomP2P, libp2p) or use scalable mechanisms ready to be deployed on the cloud
 - Graphical (GUI/Web-based) frontend
 - Public blockchain based
- Each winner: 2.625 mBTC (0.002625 BTC)
 - Donation platform and used the blockchain to keep track of donations



BlCh Challenge Task 2021

- This semester's challenge task (CT) is the design and implementation of an application including NFTs. Ideally, the application is a decentralized application (Dapp). Requirements:
 - A working prototype for your use-case
 - Use latest stable releases of chosen libraries and frameworks
 - An NFT stored on a public blockchain (can be testnet)
 - Transfer of an NFT triggered directly or indirectly via the frontend/backend (can be testnet)
- Each winner: 1 mBTC (0.001 BTC)
- QuoteNFT is a platform to trade NFT quotes. The trading happens on a smart contract and is fully decentralized. Their project uses Vue.js for the frontend, node and express with TypeScript for the backend, and MetaMask to connect to Ethereum. Their QuoteNFT platform uses Traefik as a reverse proxy and docker-compose to orchestrate the services



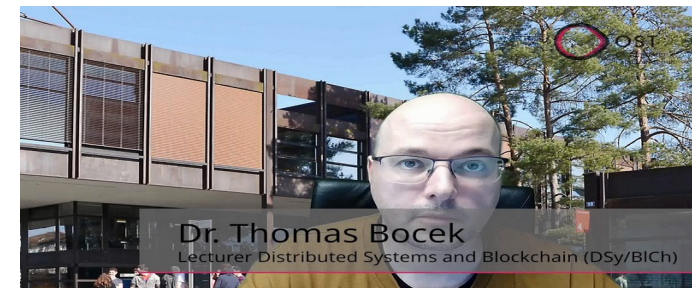
BlCh Challenge Task 2022

- This semester's challenge task (CT) is the design and implementation of an onchain voting application. Ideally, the application is a decentralized application (Dapp).
- Requirements
 - A working prototype for your use-case
 - Use latest stable releases of chosen libraries and frameworks
 - Submission of a voting proposal, with previously known consequences and recipients (can be testnet)
 - Onchain voting on proposal with at least 2 participants / identities (can be testnet)
 - Successful vote needs to trigger something onchain. Can be an ERC20 or an NFT transfer (can be testnet)
 - Voting status and process need to be shown in the frontend
 - The solution may use existing libraries and code, but those must open software software
- Winners built a decentralized autonomous organization (DAO), using soul-bound tokens (SBT) to vote on documents and its changes. They used Solidity with the OpenZeppelin Governor, for the backend next.js, PostgreSQL to store metadata, and to connect to the Ethereum, they used ethers.js.



BlCh Challenge Task 2023

- This semester's challenge task (CT) is the design and implementation of a blockchain-based solution to a specific problem that you have identified in your own life or community. Ideally, the application is a decentralized application (Dapp).
 - 1) A working prototype
 - 2) Use latest stable releases of chosen libraries and frameworks
 - 3) Interaction with a public blockchain (can be testnet)
 - 4) At least 2 participants need to be involved.
 - 5) Transparent Audit Trail
 - 6) Status and process need to be shown in the frontend
- Winners built a dual deposit system that has a mutually assured destruction mechanism that discourages fraudulent activity from both buyers and sellers. For the backend they used Golang, in the frontend they used Rust that was compiled to WebAssembly. For the blockchain environment they used ICP where canisters (~smart contracts) were written in Motoko.



BlCh Challenge Task 2024

- This semester's challenge task (CT) is the design and implementation of a stablecoin with rebalancing on decentralized exchange (DEX). Ideally, the application is a decentralized application (Dapp)
 - A working prototype with your stablecoin
 - Use latest stable releases of chosen libraries and frameworks
 - Interaction with a public blockchain (can be testnet).
 - Must be tradable on a decentralized exchange (DEX)
 - Stablecoin needs to rebalance on DEX to remain stable
 - Status and process need to be shown in the frontend
- Winners implemented a stablecoin tied to Western Texas Intermediate crude oil prices, implemented on Arbitrum and utilizing Uniswap for decentralized exchange.



BlCh 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
- 10 lectures
 - (30h = 20h + 10h; ca. 3h / week)
 - ~1 h frontal teaching
 - ~2 h post-processing
- 12 exercises / challenge task
 - (72h = 60h + 12h ca. 6h / week)
 - ~5h challenge task
 - ~1h post-processing
- Exam
 - ~18h exam preparation
- 4 ECTS = 120h
- Prüfung:
 - Closed book 60min, no coding, Hilfsmittel: none

Summary

- Lectures videos online before Mondy – 13:10
- Challenge task, group members: send to thomas.bocek@ost.ch until next week
 - Work on challenge task during exercises and/or at home
- 6 requirements to be met
 - A working prototype demonstrating gasless user interactions
 - Use latest stable releases of chosen libraries and frameworks
 - Interaction with a public blockchain (can be testnet)
 - At least 2 participants need to be involved.
 - Gasless transaction implementation using account abstraction
 - Status and process need to be shown in the frontend
- All 6 requirements must be fulfilled to pass this course

- 4 Deliverables
 - 06.10.2025, initial plan
 - 27.10.2025, first version (initial commit)
 - 17.11.2025, current progress
 - 07.12.2025, **23:59 (CET)** - documented infrastructure, source code, and presentation
- Presentations on the 08.12.2025 onsite (1.257)
- OST B1Ch Challenge Task Winner HS 2025
 - 15.12.2025

