Chair of Connected Mobility
School of Computation, Information, and Technology
Technical University of Munich

# Bridging the Gap: Decentralized Grassroots Networks for Disaster Relief and Education

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Monday 28th April, 2025

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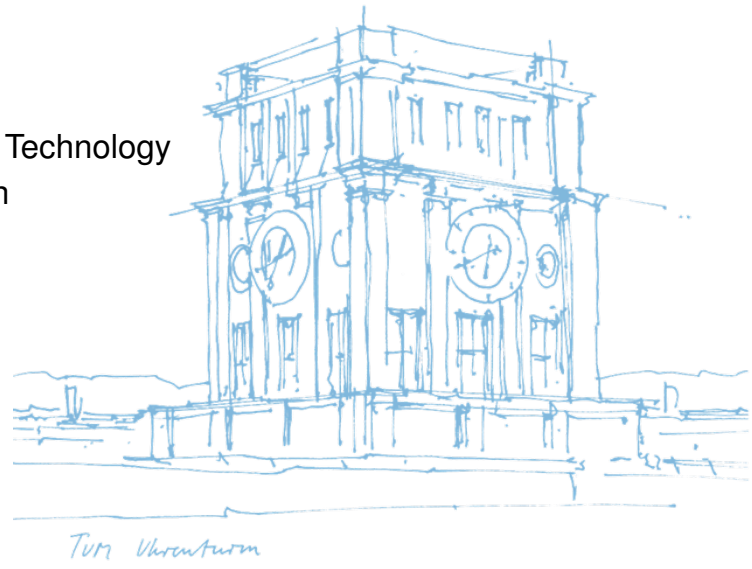

# Motivation

- Lack of resilient decentralised infrasture for social networks
- Centralised networks prone to censorship that restricts democratic communication

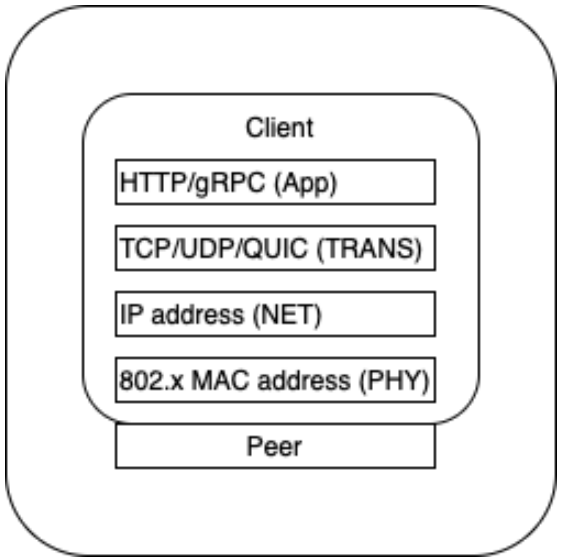


Figure 1: Single client

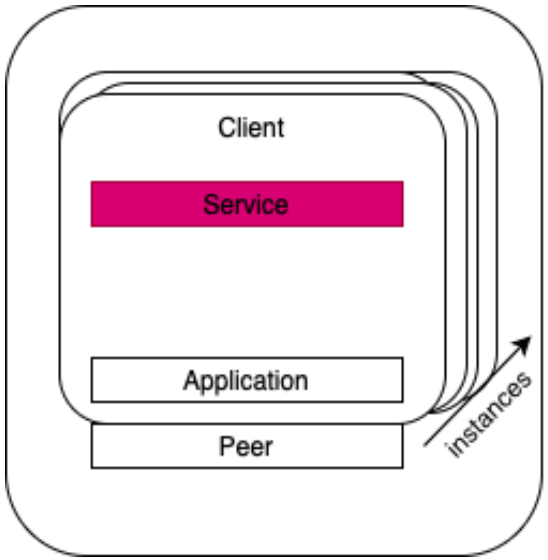


Figure 2: Multiple clients with coordination service

# Background

- Grassroots networking (ad-hoc networking)
- IEEE 802.15.1: Bluetooth
- IEEE 802.11: WLAN

# Related Work

## Decentralized Physical Infrastructures

- **Internet communication**: Handley, M. (2006). Why the internet only just works. BT Technology Journal, 24(3), 119-129. https://doi.org/10.1007/s10550-006-0084-z
- **Energy providers**: Ballandies, M. C., Wang, H., Chee Law, A. C., Yang, J. C., Gösken, C., Andrew, M. (2023). A taxonomy for blockchain-based decentralized physical infrastructure networks (DePIN). 2023 IEEE 9th World Forum on Internet of Things (WF-IoT), 1-6. https://doi.org/10.1109/wf-iot58464.2023.10539514

## Decentralized Communication

- Blockchains
  - Ripple
  - Bitcoin p2p RPC
  - Ethereum RLPx

## Mobility Models

- Guzman, D., Trossen, D., Ott, J. (2024). Communication cost for Permissionless distributed consensus at internet scale. Proceedings of the ACM Conext-2024 Workshop on the Decentralization of the Internet, 28-35. https://doi.org/10.1145/3694809.3700743

# Related Work

## Communication Mobility Models

- Torkamandi, P., Kärkkäinen, L., Ott, J. (2024). Privacy-preserving crowd estimation using multiple Wi-Fi sensors. 2024 IEEE 21st International Conference on Mobile Ad-Hoc and Smart Systems (MASS), 314-320. https://doi.org/10.1109/mass62177.2024.00049

## Algorithms for Non-Mobile Networks

- Perigee
- Mercury
- BlockP2P
- Kadcast

## Security Enablers

- Multiparty Computation : https://github.com/coinbase/cb-mpc
- Threshholds Signatures/Keys: google Filip Rezabek
- Public Key Cryptography

## Communication Enablers

- AT protocol
- OpenSwarm Lakers (cryptography)
- DotBots Blink BLE
- Cryptography on STM32WBA55CG
- OpenSwarm DotBots

# Related Work

**Distributed Consensus**

- Paxos
- Netpaxos
- Raft

**Decentralized Consensus**

- Proof of Work
- Proof of Stake
- Proof of Authority
- Proof of Transit

# Objectives

- Identify critical enablers of resilient decentralized communication for minimal grassroots social networks

# Research Question

1. **Communication**: How are messages broadcast in a distributed network?
   - 1.1 **Methodology**: Investigate the efficiency of traditional p2p unicast communication and explore multipoint communication alternatives.
   - 1.2 **Goal**: Enhance network resilience to faults and improve efficiency in terms of latency, storage, and bandwidth.

# Vision

- Create infrastructure for grassroots, information-centric networking
- Enable large-scale offline communication
- Facilitate access to education contents in areas without centralized infrastructure