FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Diplomarbeitspräsentation

DISTRIBUTED SYSTEMS GROUP

Edge Blockchain Provisioning for Mobile Edge Computing Applications

Masterstudium:

Software Engineering & Internet Computing

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Problem Statement & Research Objectives

- Blockchain in Mobile Edge Computing (MEC) has brought new challenges for developers when implementing blockchain-based applications in MEC.
- How to choose a suitable deployment of blockchain features to MEC components, which include resource-restricted Internet of Things (IoT) devices, edge and cloud services.

Research Objectives

- Identify patterns of interaction among MEC components.
- Map blockchain features into executable blockchain artefacts.
- Benchmark blockchain interactions in the identified patterns. Evaluate different deployments of blockchain artefacts to the components and various configurations of infrastructure, consisting of compute resources and networks.
- Provide knowledge gathered by the benchmarks to the developers.

Solution

To address the research objectives we propose a **benchmark framework** and **Experiment Knowledge Service**.

- **Benchmark framework**
  - Benchmark blockchain interactions among MEC components in application's topology.
  - Measure quality metrics: transactions acceptance rate and time, scalability, utilization of infrastructure resources.
  - Interface with providers of resources (virtual machine (VM), networks) to emulate unavailable MEC components.
- **Experiment Knowledge Service**
  - Store data related to benchmarks (topologies, infrastructures, software artefacts, measured quality metrics).
  - Enable the reuse of knowledge gathered by benchmarks to help developers during design phase of the application.

Prototypes of the framework and the service are available in the GitHub repository: `https://github.com/rdsea/blockchainbenmarkservice`.

Benchmark framework

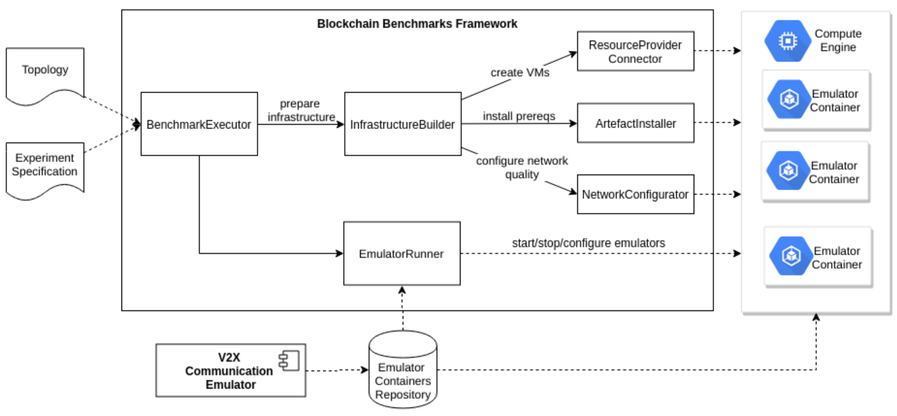

Figure: Component diagram of the benchmark framework

- Dockerized NodeJS application, developed in Typescript.
- Generate and benchmark experiments based on a specification.
- Build emulated MEC infrastructure.
- Deploy blockchain artefacts into a specified topology.
- Emulate and benchmark blockchain interactions among MEC components in the topology.
- Customize a blockchain interaction.

Experiment Knowledge Service

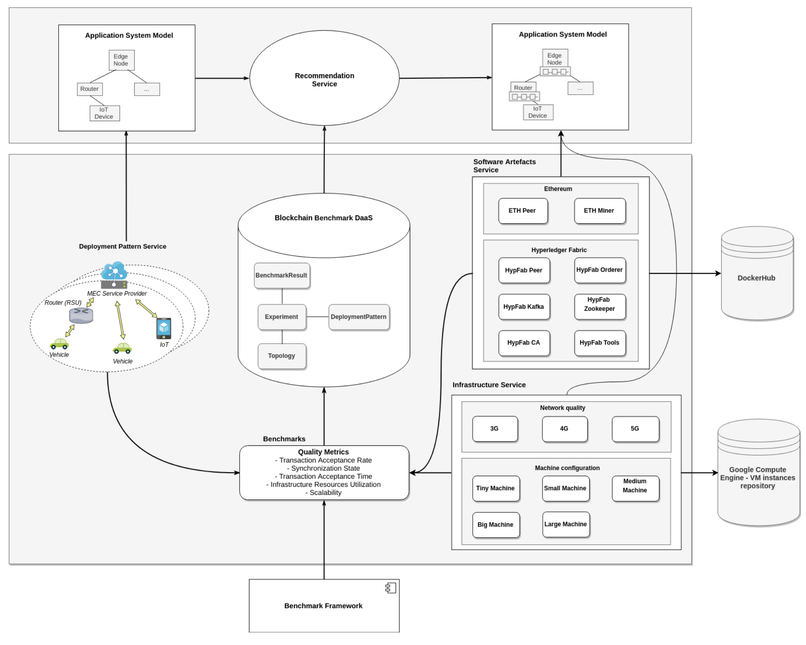

Figure: High-level architectural overview of Experiments Knowledge Service

- Dockerized NodeJS application, developed in Typescript, stores data in MongoDB and Neo4J.
- Search benchmarking interactions, topologies or infrastructures.
- Recommend a deployment of blockchain artefacts into a model of application in MEC.

Experiments

- 324 experiments, based on scenarios from Vehicle-to-Everything (V2X) domain, have been generated and benchmarked by the **benchmark framework**
- Figure 3 and Figure 4 depict performance and reliability, measured in benchmarks of interaction 3 (vehicle - edge node - vehicle), among all utilized infrastructures and deployments of blockchain.

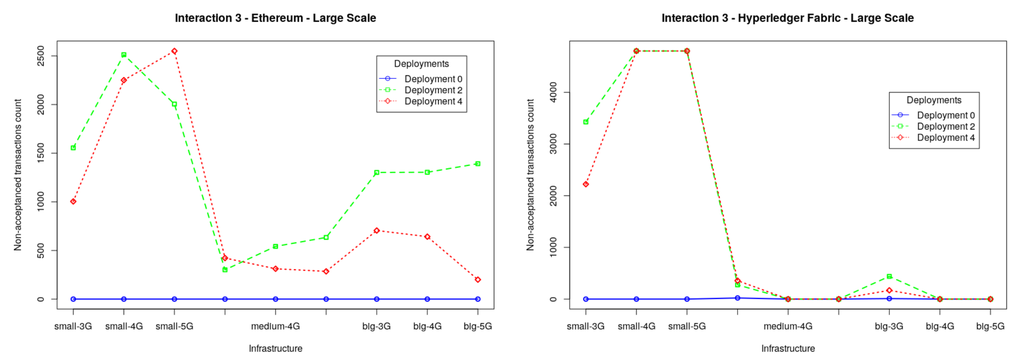

Figure: Number of rejected transactions for interaction 3 (vehicle - edge node - vehicle)

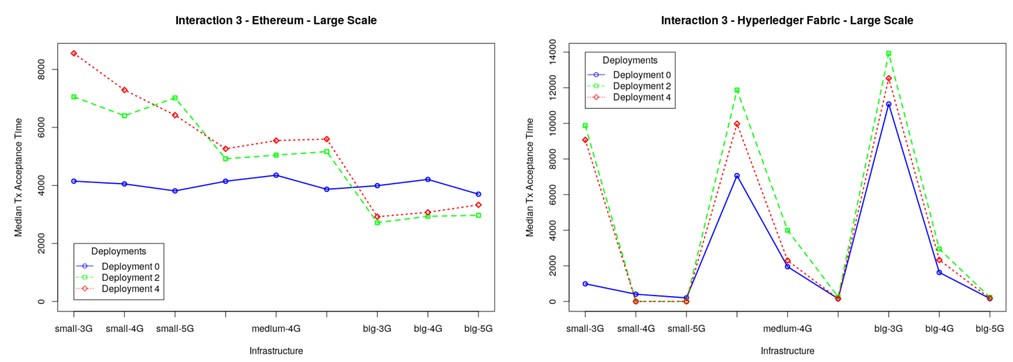

Figure: Medians of transactions acceptance times for interaction 3 (vehicle - edge node - vehicle)

Findings from benchmarks of interaction 3:

- Blockchain deployment 0 (all blockchain features in edge node, creator feature in vehicle), medium computing power of resources and 5G network performed the best concerning reliability and performance

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