



***Middleware for the communication between
Distributed Agents in JaKtA***

Project for the course "Intelligent Systems Engineering"

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Introduction - Agents

An "agent" in computer science is an independent computational entity with decision-making capabilities. These agents operate in specific environments, showcasing autonomy and collaborating in Multi-Agent Systems (MAS) to attain shared or individual goals. Emphasizing their contextual dependency, agents become inherently social through interaction.

The "Belief-Desire-Intention" (BDI) framework is a widely accepted model in agent technology. BDI agents maintain beliefs about their environment, possess desires representing system goals, and commit to intentions for specific actions aimed at goal achievement. This framework is pivotal for effectively managing complex systems.

Introduction - JaKtA

JaKtA is a library for developing agents in a shared environment with message-based communication. It supports building Multi-Agent Systems (MAS) based on the Belief-Desire-Intention (BDI) model. Agents autonomously observe and act in the environment, influencing its state and achieving goals. Users can customize agents, define environment actions, and enable agent communication through messages. The library allows flexible execution models for BDI agents, influencing reactivity. The Agent Life Cycle involves observing changes, updating beliefs, handling messages, and executing intentions, impacting the environment through MAS strategy.

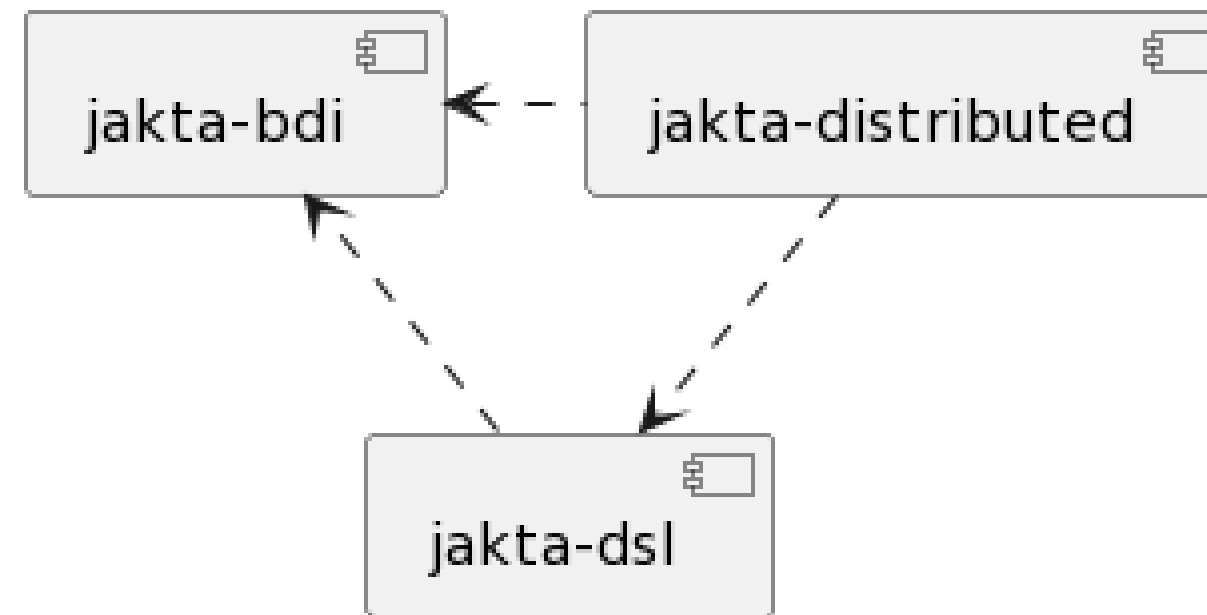
Project Goal

The main goal of the project is to extend the JaKtA library to allow the construction of distributed multi-agent systems over a network while avoiding the library user from having to deal with the complexities of network communications.

The team decided to reach this goal by allowing agents from different Mas' to exchange messages.

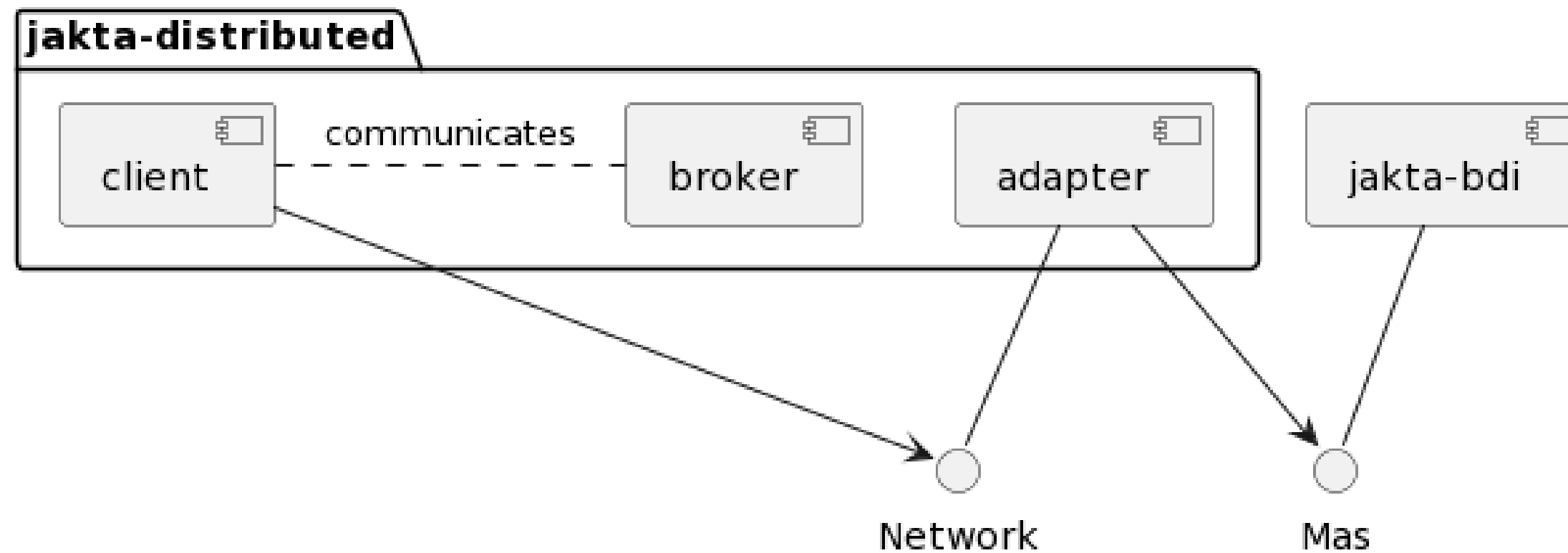
Design - Architecture

From an architectural point of view, the project is a standalone module dependent on jakta-bdi and jakta-dsl.

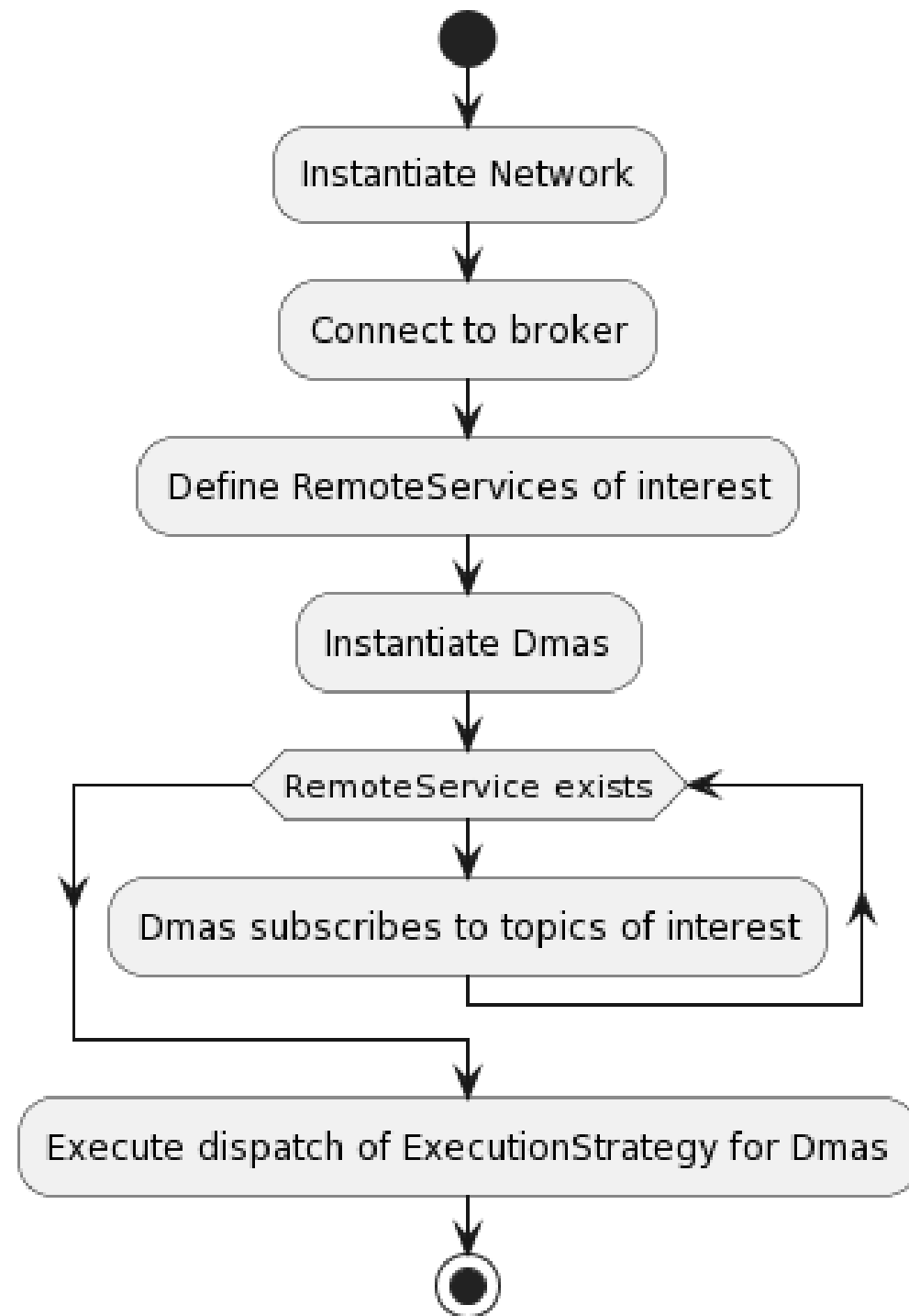


Design - Architecture

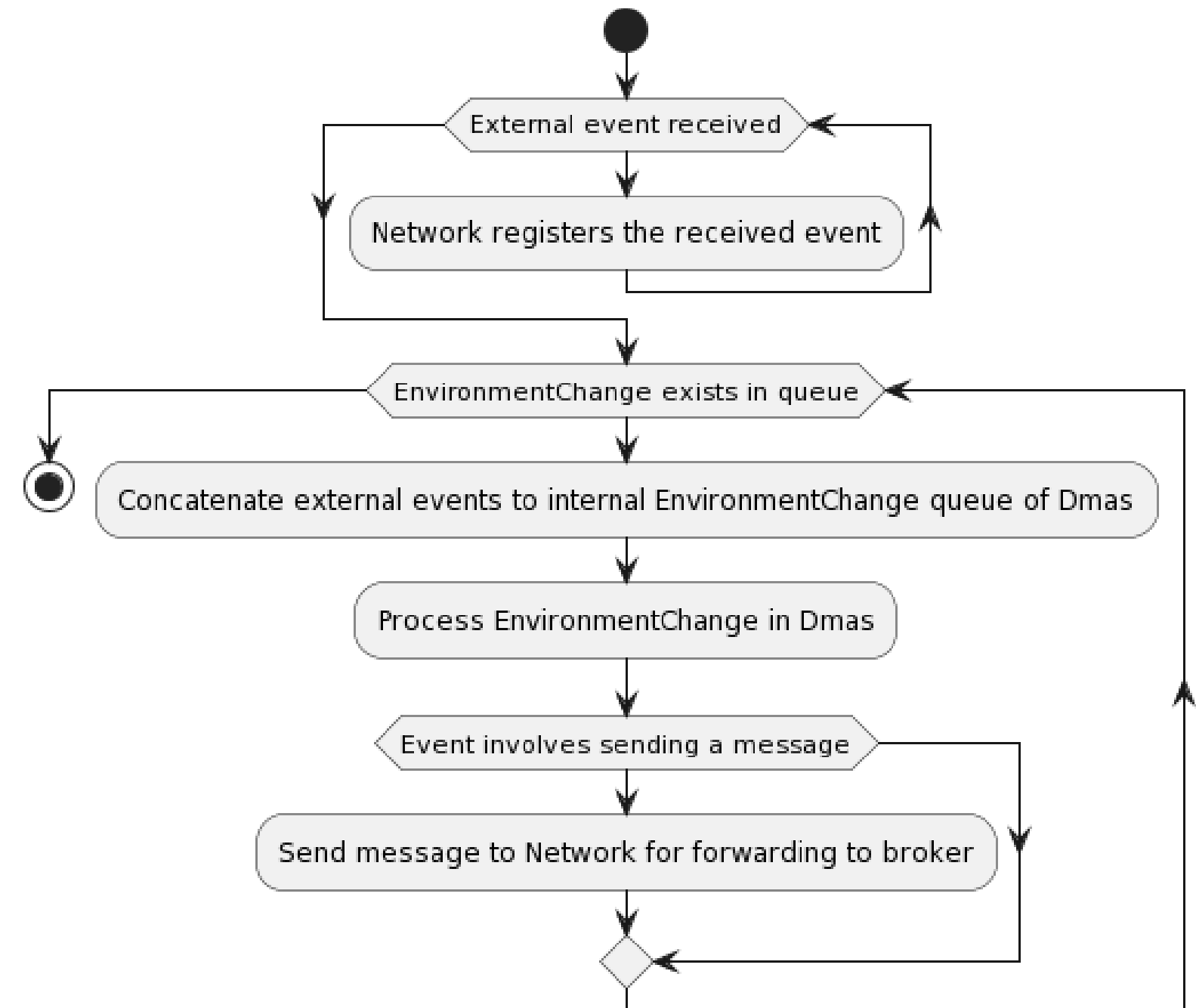
The developed module is comprised of three main components.



Design - Behavior

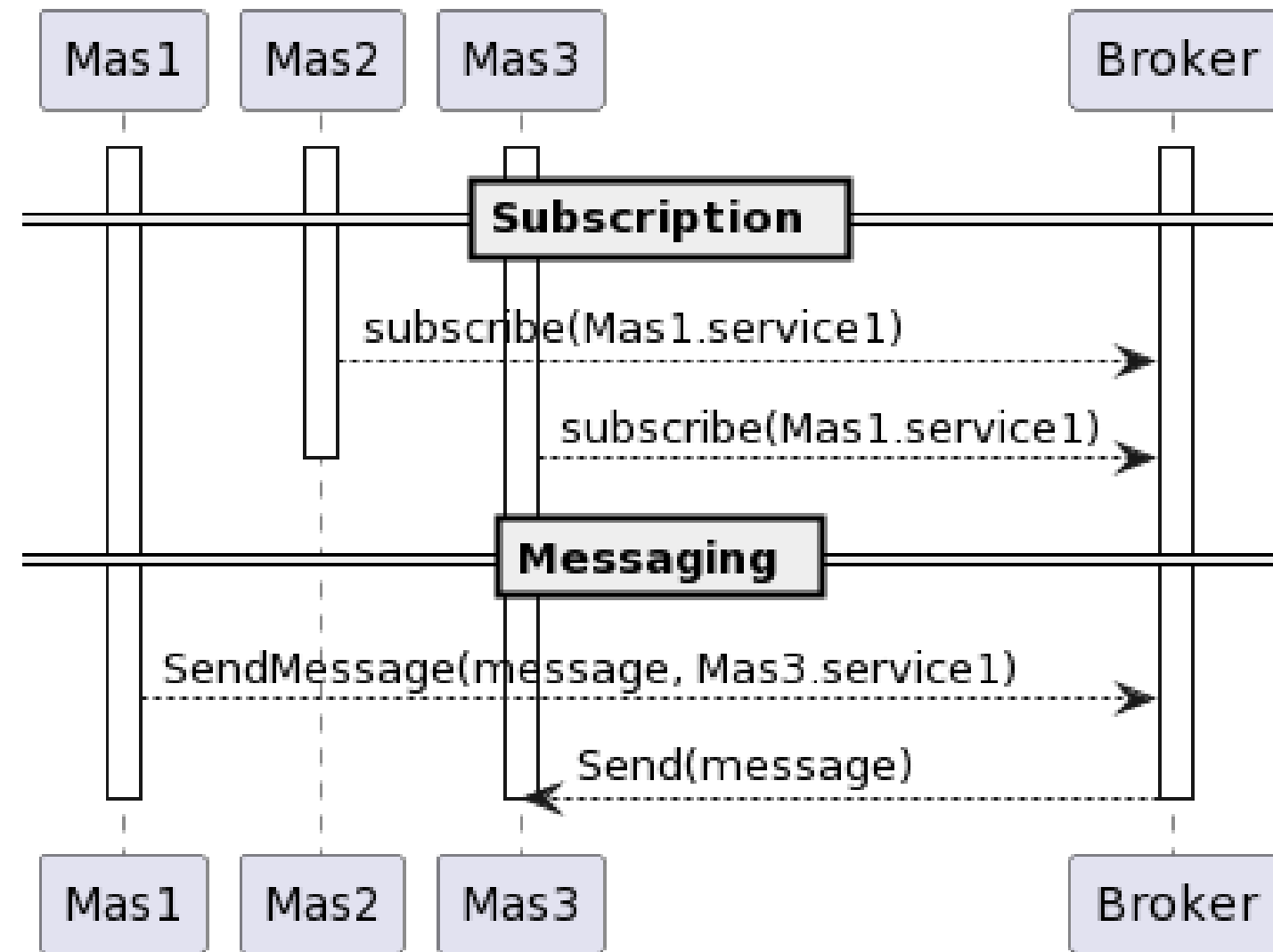


System initialization



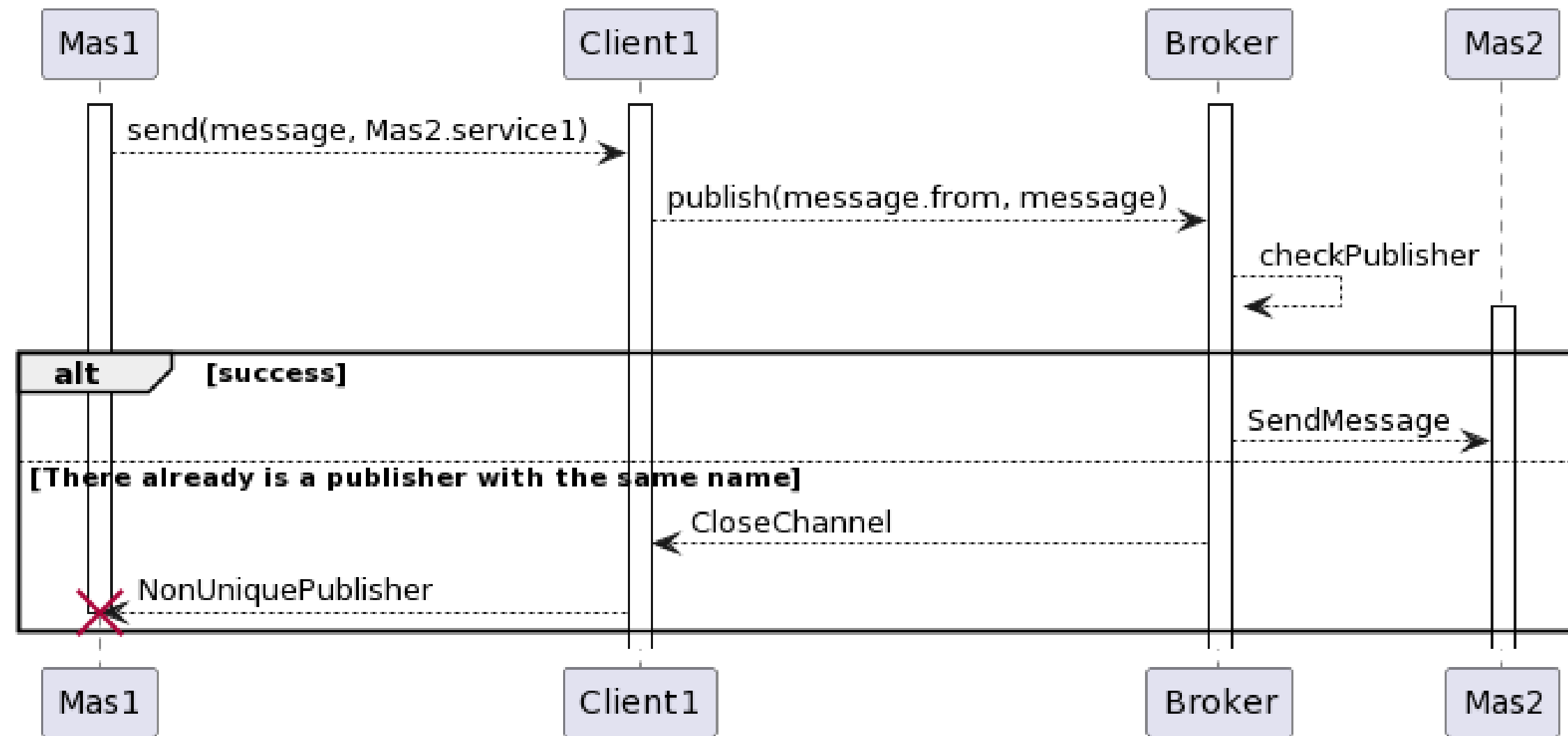
Dmas execution cycle

Design - Behavior



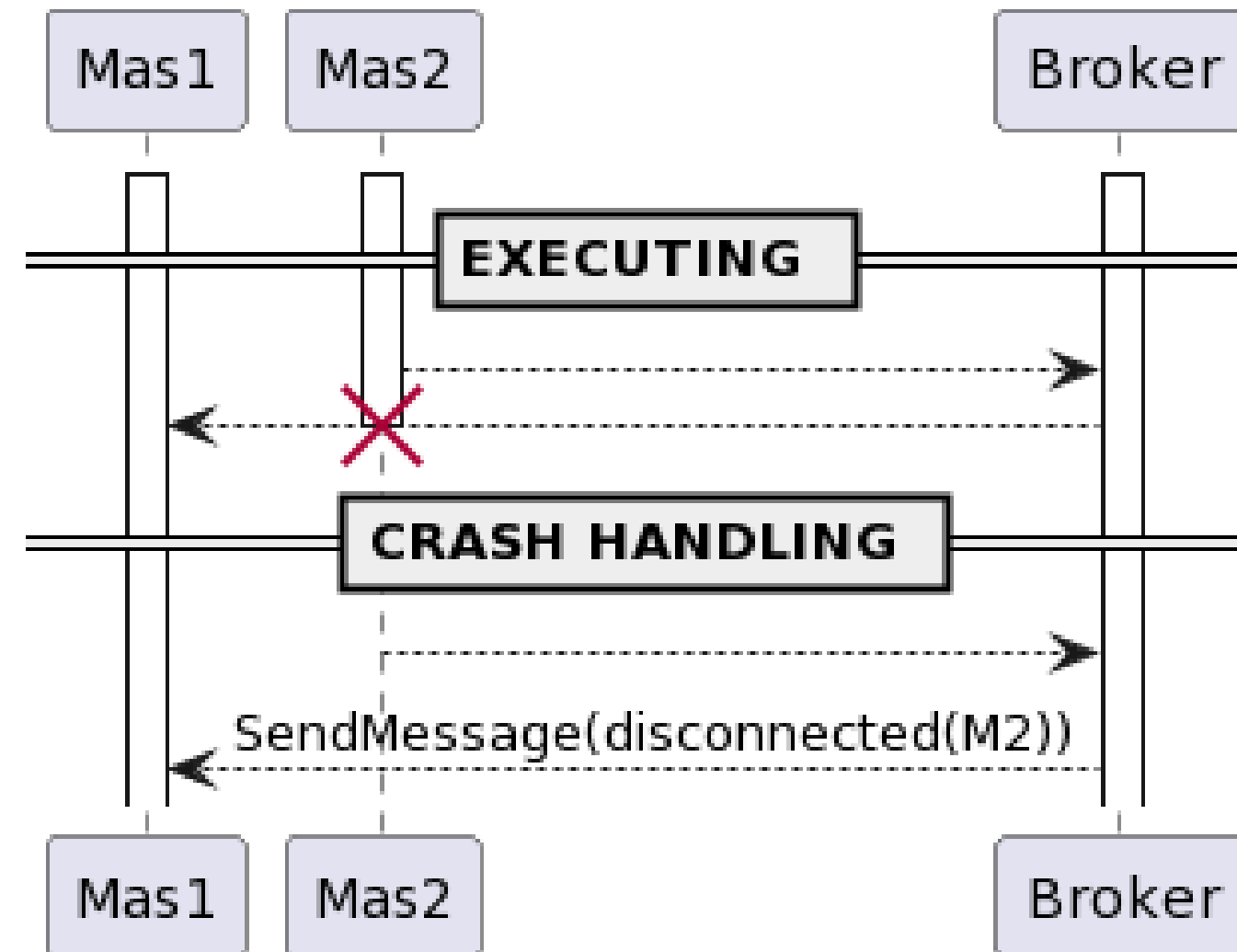
Sending a message from 1 to 3

Design - Behavior



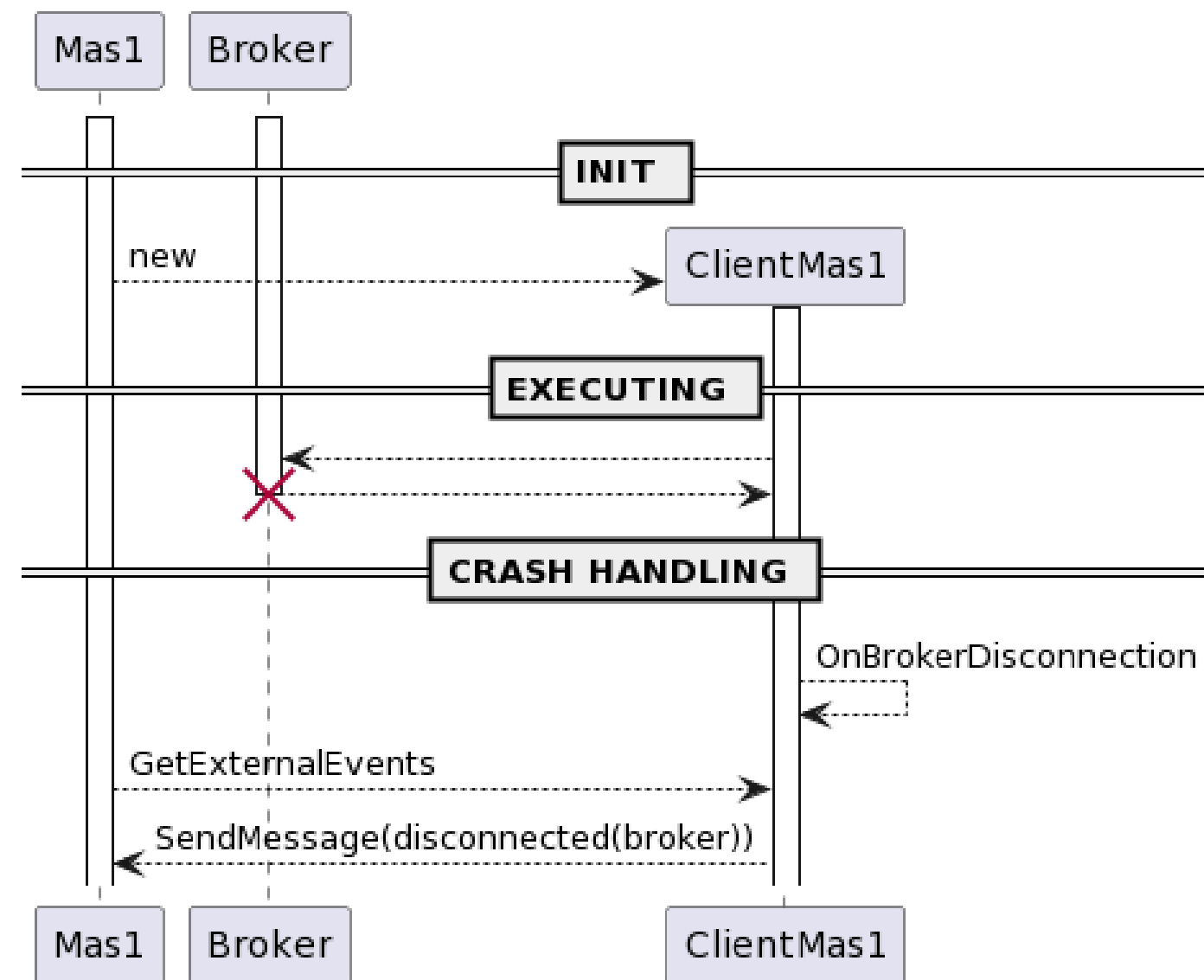
Sending a message from a particular Dmas' viewpoint

Design - Failure Management



Handling a client crash

Design - Failure Management



Handling the broker crash

jakta:java

```
[filippognixos:~/Documents/repositories/jakta]$ ./gradlew :jakta-distributed
:jakta-distributed-broker:run
> Task :jakta-bdi:checkKotlinGradlePluginConfigurationErrors
> Task :jakta-state-machine:checkKotlinGradlePluginConfigurationErrors
> Task :jakta-state-machine:compileKotlin UP-TO-DATE
> Task :jakta-state-machine:compileJava NO-SOURCE
> Task :jakta-state-machine:processResources NO-SOURCE
> Task :jakta-state-machine:classes UP-TO-DATE
> Task :jakta-state-machine:jar UP-TO-DATE
> Task :jakta-bdi:compileKotlin UP-TO-DATE
> Task :jakta-bdi:compileJava NO-SOURCE
> Task :jakta-bdi:processResources NO-SOURCE
> Task :jakta-bdi:classes UP-TO-DATE
> Task :jakta-bdi:jar UP-TO-DATE
> Task :jakta-distributed:jakta-distributed-broker:checkKotlinGradlePluginCo
nfigurationErrors
> Task :jakta-distributed:jakta-distributed-common:checkKotlinGradlePluginCo
nfigurationErrors
> Task :jakta-distributed:jakta-distributed-common:compileKotlin UP-TO-DATE
> Task :jakta-distributed:jakta-distributed-common:compileJava NO-SOURCE
> Task :jakta-distributed:jakta-distributed-common:processResources NO-SOURC
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> Task :jakta-distributed:jakta-distributed-common:classes UP-TO-DATE
> Task :jakta-distributed:jakta-distributed-common:jar UP-TO-DATE
> Task :jakta-distributed:jakta-distributed-broker:compileKotlin UP-TO-DATE
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> Task :jakta-distributed:jakta-distributed-broker:processResources UP-TO-DA
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> Task :jakta-distributed:jakta-distributed-broker:classes UP-TO-DATE
[]
```

BROKER

jakta: bash

```
[filippo@nixos:~/Documents/repositories/jakta]$ ./gradlew jaktaBroadcastSend
er
```

I

BROADCAST
SENDER

jakta: bash

```
[filippo@nixos:~/Documents/repositories/jakta]$ ./gradlew jaktaBob[]
```

BOB

jakta: bash

```
[filippo@nixos:~/Documents/repositories/jakta]$ ./gradlew jaktaAlice[]
```

ALICE

Conclusions

Conclusions

The goal of this project was to give users of the framework JaKtA the possibility to create distributed multi-agent systems.

Therefore, an extension of the framework was developed, providing a new implementation of the multi-agent system concept capable of communicating with other systems using an asynchronous publish-subscribe communication model.

Future works

- *Support for Multiple Communication Protocols.*
- *Support for the distribution of the entire Environment.*