

Comparison of Tools for Software Architecture Extraction of Asynchronous Microservice Systems

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English abstract.

Keywords

1 Introduction

This chapter will provide a motivation of why a systematic literature review about tools for architecture extraction of asynchronous systems is necessary.

In chapter 2, we will provide some foundation knowledge. In chapter 3, we will talk about the design and goal of this literature review and the selection of the papers. In chapter 4, we will present the results and compare them using five different aspects. We will discuss these results in chapter 5 and talk about related work in chapter 6, before drawing conclusions in chapter 7.

2 Foundation

In the following sections, we will provide some foundation knowledge for the rest of the paper.

2.1 Microservice Architecture

In a microservice architecture, the software is partitioned into many small components (“microservices”), which operate independently of each other and communicate via messages [Dra+17]. This software architecture style allows the construction of highly reusable components which focus on a single task (e.g. applying a watermark to a video). This loose coupling allows for independent teams to work on different components or even the use of off-the-shelf components. Also, scaling the application can be achieved by

simply duplicating the bottlenecked microservices [Dra+17]. A microservice is defined by its provided- and required-interfaces, which allow for the message-exchange with other components [SKK21].

2.2 Asynchronous RESTful Communication

Microservices that communicate asynchronously are typically realized in one of two kinds. Either using a RESTful pattern or using message-based communication.

Some systems use microservices that communicate asynchronously via asynchronous HTTP REST interfaces. There are two interaction scenarios for this kind of asynchronous communication. One possibility is that the initial HTTP request returns an HTTP code 202 (Accepted) and provides a location where the microservice can query the status of the operation. Once the operation on the server has finished, the provided location will return the results of the query. [MW18]

Alternatively, the microservice may be required to provide a callback method (e.g. a web hook, [Lin]) where the server can send the results once the operation has finished [MW18].

We will refer to both of these communication methods as RESTful asynchronous communication in the following paper.

2.3 Message-based Communication

Contrary to RESTful asynchronous communication, other microservice systems use message-based asynchronous communication. These systems deploy a message broker, a component that other components dynamically bind to. This message broker is then used to send and receive messages and is responsible for the distribution of these messages. Using a message broker allows for better system performance. [SKK21]

2.4 Software Architecture Extraction (SAR)

Software Architecture Extraction (SAR) is the process of reverse engineering a software architecture from a given system. Vital for building this architecture is information about the communication between the different components. This information is extracted using either a static (using only static inputs, e.g. source code), dynamic (using runtime information, e.g. logs) or hybrid (using both) approach. In the context of asynchronous communication, a static extraction algorithm would in the case of a RESTful asynchronous communication, analyze the HTTP calls made in code to determine the relationships between the components. In the case of message-based communication, a static approach is unable to extract a useful architecture, since message-based systems exchange those messages only at runtime and thus the required information about which components communicate with each other can only be retrieved as part of a dynamic or hybrid analysis. [SKK21; MW18]

2.5 Palladio Component Model

The Palladio Component Model (PCM) is a meta-model for the description of component-based software [BKR09]. It is used to predict the performance properties of component-based software at design-time by specifying a model of the system, its components and how the system is going to be used. *[TODO: extend]*

3 Study Design

This chapter will explain the design of the systematic literature review and how it was executed.

3.1 Study Aim

The aim of this paper is to find and compare the tools available for the extraction of the architecture of asynchronous microservice systems. For this purpose, we define two research questions.

[TODO: combine 3.1 and 3.2 into one section?]

3.2 Research Questions

The two research questions we want to answer in this paper are

RQ1. What are the tools available for the extraction of asynchronous architectures of microservice systems?

RQ2. To what extend do the tools support software architecture extraction?

3.3 Selecting the Papers

The search for research papers was performed by performing several queries using Google Scholar. The following queries were used to search for papers:

- architecture (extraction OR reconstruction) (dynamic OR logs OR asynchronous) microservice
- ("architecture extraction" OR "architecture reconstruction") (dynamic OR logs OR asynchronous) microservice
- reverse engineering (dynamic OR logs OR asynchronous) (microservice OR mixed-technology)

Additionally, the references of the found results were used to look for further papers. For a paper to be selected, it had to match our selection criteria depicted in Table 1

In total, we will look at five papers, which each present an approach for the extraction of asynchronous architecture of microservice systems.

The papers are

1. ARCHI4MOM [SWK22], [SKK21]

Inclusion	<i>[TODO: inclusion-criteria]</i>
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Exclusion	<i>[TODO: exclusion-criteria]</i>
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Table 1: Inclusion and exclusion criteria for selecting the papers

Name	Input	Output	Approach	End User	Evaluation	Year	Type
ARCHI4MOM	tracing data	PCM	Extend PMX	SA	Comparison Precision/Recall/F1	2022	tool

Table 2: Results

2. MiSAR [AAE18]
3. — [BHK11]
4. MICROLYZE [Kle+18]
5. — [MW18]

4 Results

This chapter will answer the research questions formulated in 3.2 and analyze the papers selected in 3.3. This chapter will also feature a table comparing the papers in different aspects:

1. **Input** (e.g. source code, artifacts, logs, ...)
2. **Output** (e.g. PCM, UML, ...)
3. **Approach** (how the tools extract the architecture)
4. **End user** (who the result is intended for)
5. **Evaluation metric** (how were the results evaluated, e.g. precision/recall or comparison)

5 Discussion

This chapter will discuss the results of the previous chapter.

6 Related Work

This chapter presents other papers which are similar to my work. For example [DP09], which compares different SAR approaches to formulate a state-of-the-art approach or [GIM13], which compares different SAR tools. We will also talk about the fact that [Gra+17] and [Lan+16] could be extended to support asynchronous communication in the future.

7 Conclusion

In this chapter, we will recap the findings that we made and finish the paper with concluding remarks.

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