

Languages of Architectural Description in Systems and Software Engineering

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Abstract. The article is devoted to the study of languages describing the architecture of systems used in systems and software engineering. The purpose of the article is to stimulate the interest of university teachers to use these languages in the disciplines of computer science. For this, methods for describing system architectures are considered, languages for describing architectures are distinguished from them, and their applications are described. To study bachelors and masters in IT areas, it is proposed to use the ArchiMate and SysML languages. The pre-property of languages used in the educational process is the visibility of the graphical representation of architecture, open documentation, support in various tools, including free cross-platform ones. Languages allow students to analyze and evaluate alternative implementations of the architecture of the system being developed, qualitatively draw up project documentation, provide a link between the parties involved in the development and deployment of the system. Examples are given. ArchiMate describes the architecture of the website. SysML describes a block diagram of an unmanned aerial vehicle. We used Archi and Modelio tools - free, open source and cross-platform. They are easy to install and operate. Therefore, these tools are recommended for students study.

Keywords: System, Architecture, Architecture Structure, Architecture Description Language, Computer Science, System and Software Engineering, University Teaching.

1 System Architecture

The system architecture as defined by ISO / IEC / IEEE 42010 [1] are the basic concepts or properties of a system in the environment, embodied in its elements, relationships, and specific principles of its design and development. To describe the architecture of a system, an architecture structure (architecture frame-work) and an architecture description language are used.

1.1 Architecture Frameworks

The architecture frameworks defines [1] conventions, principles and practices for the description of architectures established within the scope. Examples of the architecture frameworks are the architecture frameworks of Zachman [2], the architecture

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frameworks of open groups TOGAF [3], the Kruchten representation model “4 + 1” [4] and others. This paper discusses architecture description languages rather than architecture frameworks.

1.2 Architecture Description Language

An architecture description language (otherwise, an architectural description language) is another form of architecture description [1]. It provides one or more types of models for different points of view of stakeholders. As a rule, it has software tools for creating, analyzing and maintaining models.

The conceptual model of the architecture description language [1] is presented in Fig. 1 as a UML class diagram [5].

Let us explain some elements:

- Stakeholder (interested party) – a party, individual, team, organization or group having an interest in the system.
- Concern – a benefit or problem in a system related to one or more interested parties.
- Model kind – conventions for the type of modeling (for example, class diagram, data flow diagram, organizational structure, state transition model and others).
- An architecture viewpoint is a work product that establishes the conventions for constructing, interpreting, and using an architectural view to structure system interests.
- Correspondence rule – a rule that defines the relationship of architecture description elements.

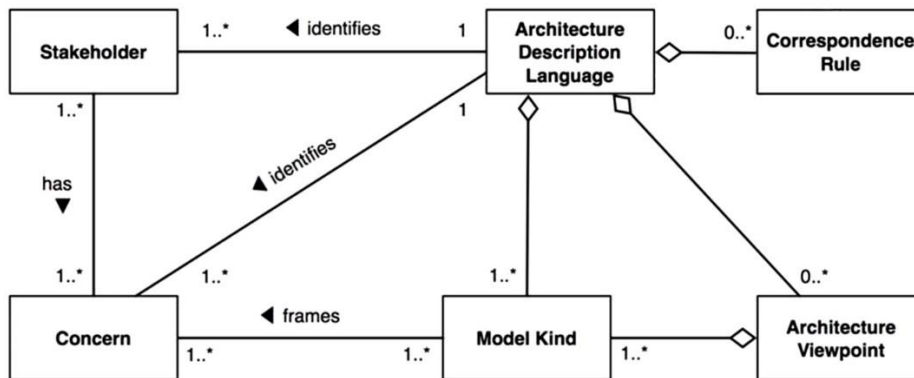


Fig. 1. Conceptual model of architecture description language [1]

1.3 Employments of the architecture description language

The architecture description language has the same employments as the architecture description itself. The following are some of the employments [1]:

1. As a basis for analysis and evaluation of alternative implementations of system architecture.

2. As elements of documentation in the development and maintenance of systems.
3. As input to automated modeling and analysis tools.
4. To ensure communication between stakeholders involved in the development, production, deployment, operation and maintenance of systems.

2 Examples of architecture description languages

Wright [6]. The language was used in the design of distributed simulation systems [7]. It allows you to represent components and their bundles in the form of parameterized processes described in the CSP notation (Communicating Sequential Processes, [8]). It also allows you to verify non-functional requirements for component compatibility using set theory.

Rapide [9]. The language was used in the design of the X / Open DTP standard [7], which regulates the processing of transactions in distributed information systems. Unlike Wright, the ligaments here are represented by sets of communication events.

AADL [10]. The language of the formal description of the architecture of software and hardware systems. Widely used in the automotive and aerospace industries [11]. It has means for describing entities and relations between them at the hardware, functional and virtual level.

ArchiMate [12]. The language of architectural graphic description of both information, corporate, and engineering systems [13]. It allows you to link together high-level descriptions of various layers: strategies, business, applications, technologies, production, sales and transitions.

SysML [14]. The language is a subset of UML. It removes program-oriented limitations of UML by introducing additional types of diagrams [15]: block diagrams, requirements diagrams, and others. Supports architecture design, analysis, and validation for a wide range of systems.

3 Suggestions for use in the educational process

To study with bachelors and masters in IT areas, it is proposed to use the ArchiMate and SysML languages. The advantages of languages for use in the educational process are the visibility of the graphical representation of architecture, open documentation, support in various tools, including free cross-platform ones [16, 17]. Both languages are systems engineering tools.

Using the ArchiMate architecture description language is facilitated by the fact that it is easy to understand (it has a small number of element types and the relationships between them). It was most widely used to describe the architecture of information systems. To educate students, it makes sense to use the Archi tool. The advantages of the tool are that it is free, open source and cross-platform. There is a package of Russification of menus and tips made by A. Levenchuk [18]. There are also drawbacks: there is no way to parallelize work on large projects (only one user can work with a project); limited reporting capabilities.

In Fig. 2 shows, for example, a simplified web site architecture, broken down into three levels: the business level, the application level, and the technology level. At the first level, stakeholders are identified, their roles and functions. The second level defines software components and their functionality, as well as the data used. At the third level, the equipment used and the resources allocated to it are determined.

The use of the SysML language is facilitated by the fact that it is a subset of the UML language [5] and most of the diagrams are common to them. Diagrams using object-oriented methodologies are excluded or modified. Added block diagrams (instead of class diagrams) and requirements. The language is mainly used to develop the architecture of software and hardware systems for various purposes.

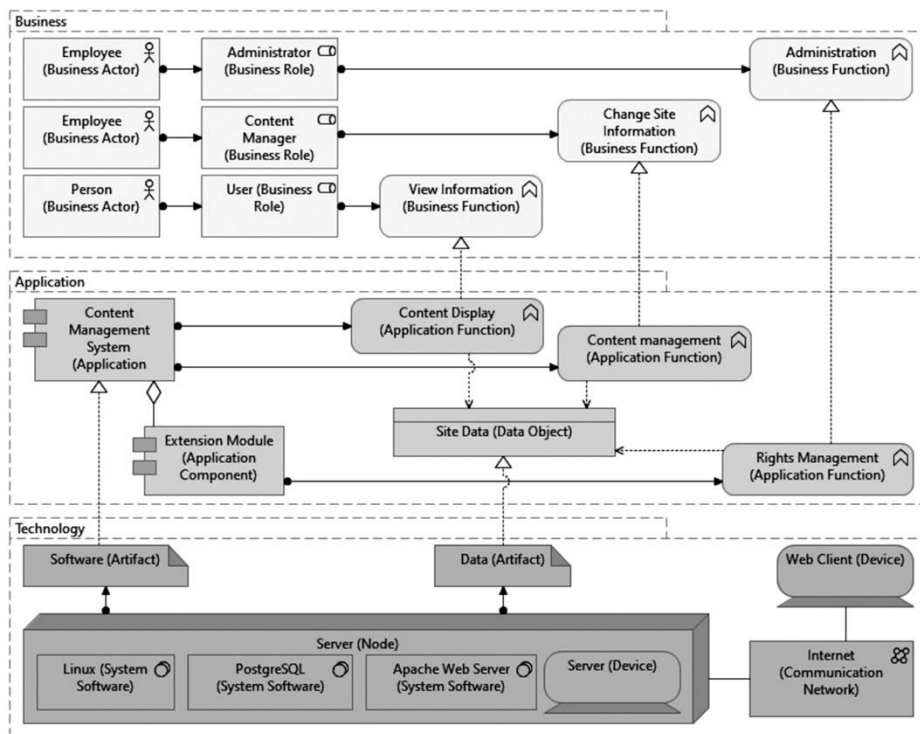


Fig. 2. The architecture of the web site in the ArchiMate language

In Fig. 3 shows an example of a block diagram (one of the SysML diagrams), which depicts the subsystems of an unmanned aerial vehicle intended for observing terrain. The diagram is built in the Modelio programme [17], which has a module for creating diagrams in SysML. Like Archi, Modelio is free, open source, and cross-platform.

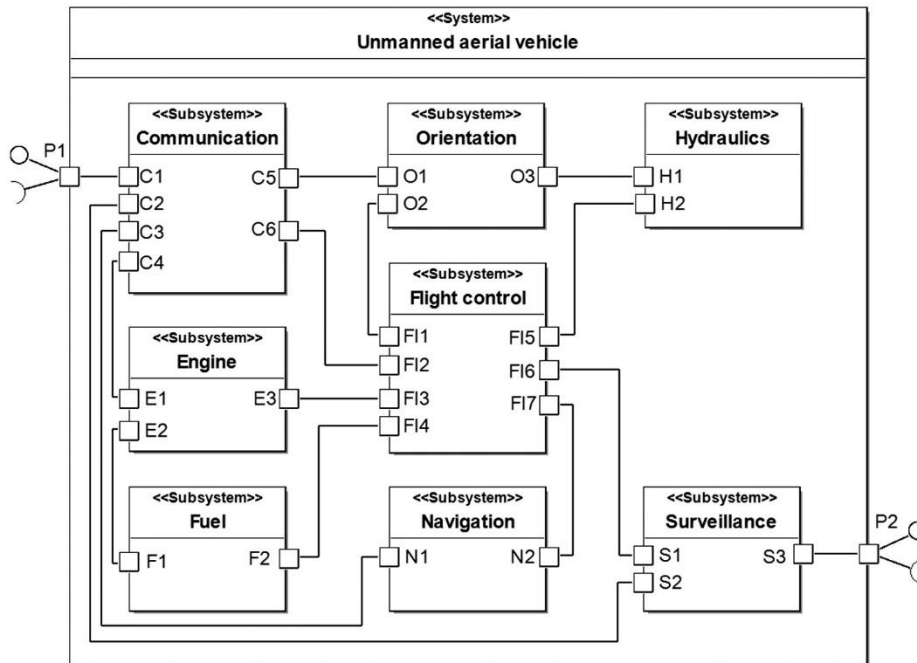


Fig. 3. SysML Block Diagram
(unmanned aerial vehicle subsystems)

Thus, the student's choice of a particular architecture description language depends on the type of system being developed. The use of the ArchiMate and SysML languages in the execution and design of projects allows:

1. To analyze and evaluate alternative implementations of the architecture of the developed system.
2. Qualitatively issue project documentation.
3. To provide communication between the stakeholders involved in the development and deployment of the system being developed.

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