F2OAS: Towards a Standard Framework to Organizing Software Architectural Styles

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Abstract

The selection or development of software architectural style is one of the most important issues in the software architecture. The number and variety of architectural styles are rising. There is not any proper and standard classification to organizing software architectural styles.

In this paper, a standard organization (F2OAS) to all software architectural styles has been provided. To obtain this aim, all previous classifications and categories for architectural styles have been collected. Then by analysis of existing approaches, all different aspect of a standard organization has been investigated. Finally a new process model to developing a standard organization has been provided.

F2OAS can help software architects to develop very powerful and robust architectures and the process of developing software architecture be done in less time. F2OAS can be used in software product line architecture or any intelligence and automatic software architecture projects.

Keywords: Software Architecture, Architectural Styles evaluating and documentation

1. Introduction

The most important steps in developing large-scale software is developing there architecture. Developing large-scale software systems need to provide a suitable and robust architecture. So providing a proper architecture for large-scale software systems is very critical.

Software Architecture is the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution [10].

There are many definitions for software architecture. In [22] other definitions and analysis of their elements cab be found.

Different styles of architecture shows the differences between different designs. Styles can be assumed like a set of rules on architecture. Software architecture style is set of rules for design various types of components and connectors in the architecture, with internal or external restrictions on how their composition and topology of them.

Architectural styles have many definitions like architecture. In [17], [19], [7] and [2] some definitions can be found.

Since a variety of architectural styles is presented. The first classification for architectural styles has provided by Garlan and Shaw in [19]. Data Centered Styles, Data Flow Styles, Virtual Machine Styles are examples of the classification.

A good software architect to developing a proper architecture, should be familiar all architectural styles that exist in him/his scope.

In other words, an architect should have sufficient mastery of architectural styles and advantages, disadvantages and applications, each of them.

New software architectural styles are provided every day by any groups and number and variety of them are being larger. So a good architect to learn the new provided architectural styles, should collect and investigate all new styles in a period of time, for example in every month.

Therefore the problems can be expressed as follows.

1. With the increasing of architectural styles, there is no central control unit for them and there is a scattering on provided architectural styles.
2. Lack of a complete catalog of software architectural styles.
3. There is no single method of selection and evaluation for the styles offered by different groups.
4. To provide a new software architectural style, there is no standard documentation method that to follow.
So, a new standard organization is necessary.

2. Investigating previous approaches

Different categories for architectural styles have been presented. The categories can be classified in two types. Some of the methods were categorized architecture styles based on their style type. We named them “Subject Base classifications”. Firstly, provides categories of styles types and then put architectural styles in these categories. Some other classification, categorize styles based on system types. We named them “System Base Classifications”. In the reminder two types of categories have been described.

2.1 Subject Base classifications

Classification that put architectural styles based on style types in the different groups.

Based on this approach, firstly a classification of styles types has been provided and then all styles put in these types.

[19], [20] and [8] are examples of this type. Latest classification is Component and connector method in [7]. In this classification, specific concept such as viewtype is presented. And three types of viewtypes that named Module viewtype, Allocation viewtype and Component and connector viewtype is given which is shown in table 1. This classification is also a type of subject base classification.

2.2 System Base classifications

In some books and papers different styles are presented for specific systems. In principle, these groups are not discussed as categories or classification for architectural styles. But some architectural styles are presented for a particular system.

For example the first paper in [6], categorized style based on system types which is shown in table 2.


In addition, all systems types which were provided styles for them are as following:
- Adaptable Systems
- Network Based & Distributed Systems
- Electronic Commerce Systems
- Event-Based Systems
- Information Systems
- Knowledge Based Database Systems
- Real Time Systems
- Web Services & Web Based Systems
- Resource Management Systems
- Interactive Systems

Questions that are raised in this context are that can these methods solve the problems? Certainly has not solved. Subject based or system based classifications will not solve the problems completely.

Consequently, other factors should be considered in these categories. For example there are not any standard for evaluating or documenting architectural style. In addition all provided styles have not been collected and categorized.

Therefore to solve above mentioned problems, a standard organization to all architectural style is needed.

Table 2. System base classification [6].

3. Toward a new standard (F2OAS)

In this part a new method to classify and organize all architectural styles has been provided that named F2OAS. F2OAS is combination of previous methods and a style will classify from both style type and system type. In F2OAS, all aspects of software architecture and architectural styles will be considered.

3.1 Inputs and outputs of F2OAS

The first point to provide a standard for organizing styles is that, what the inputs of standard are and what the outputs to the architects are.

First of all, system type and style type are necessary as an input. May be for one type of style and one type of system there is more than one style candidate.
So, software architects must give quality attributes of their requested style as well. Therefore inputs and outputs of F2OAS will be as in figure 1.

**Figure 1. Inputs and outputs of F2OAS.**

### 4. Aspects of providing F2OAS

In this section, aspects and issues of providing a standard organization for architectural styles have been investigated. This standard must consider all aspect of software architecture.

Firstly, system categories or system types should consider and support by F2OAS and for any given systems type, F2OAS must return a list of styles.

Secondly, styles types should consider and support by F2OAS and for any given style type, F2OAS must return a list of styles.

Thirdly, F2OAS must be able to give some quality attributes and filter style list. To obtain this aim, F2OAS must support all quality attributes and evaluation methods of them.

Fourthly, F2OAS must have a standard method to documenting architectural styles and all styles must catalog based on that standard documentation.

Finally all aspect that F2OAS must consider and support which are shown in figure 2.

### 5. F2OAS Structure

F2OAS should be two main parts. Firstly, a standard category for all architectural style likes a table. This category must support systems based and subject based categories and must support all quality attributes. Secondly, a standard catalog to documenting all architectural styles. This catalog must include all styles documenting with their evaluation methods.

#### 5.1 Standard category

Well-known standards like Zachman, examined elements of system with two dimensions, Observer and Perspective. Rows can be Observers and columns can be Perspectives. Following the Zachman Framework, in architectural styles Observers are the architects of systems, so Observers can be systems types. With the same way, Perspectives are the perspectives of architects that want to choose a style. So perspectives of each architect can be the style types. Therefore a standard category can be as figure 3.

**Figure 3. Observers and Perspectives of new category.**

#### 5.2 Standard catalog

A catalog needs to document all architectural styles. This catalog must consider all aspect of a style and must be in related with the standard category.

Process of developing this catalog is described in figure 4.

### 6. Process Model of F2OAS

To developing F2OAS, a process model such as waterfall, phased model or unified process can be used. The proposed process model of F2OAS is described as following:

(For some steps instances of previous attempts has been collected.)

**Phased 1:** To provide required standards.

- Step 1: To provide a standard category for all software system types
  - Such as: [1]
- Step 2: To provide a standard category for all architectural style types
  - Such as: [7] or [18].
- Step 3: To provide a standard to documenting any architectural styles
  - Such as: [7].
- Step 4: To provide a standard category for all software quality attributes

**Phased 2:** To provide a standard category and standard catalog

- Step 1: To provide a standard category for all architectural styles
Step 2: To provide a standard documentation catalog for all architectural styles

Phased 3: To collect and documenting all architectural styles and evaluation methods
   Step 1: To collect and add all existing subject based architectural styles
   Step 2: To collect and add all existing system based architectural styles
   Step 3: To collect or provide an evaluation method for any style

Phased 4: To provide guidelines to applications and evolution of standard
   Step 1: To provide a standard for developing new style
   Step 2: To provide evolution principles of standard

Figure 2. Aspects of developing F2OAS.
7. Conclusion and future works

F2OAS as a new standard has been proposed to organizing all software architectural styles and a process model has been provided based on all aspects of software architecture and previous works and can be a standard to developers of new styles.

F2OAS can defined as a widely project in any research centers. F2OAS can be use in any large-scale software development and any software product line projects and software architects can develop architecture in less time.

The approach of this paper can be used in any aspects of software engineering. For example a standard for business pattern, analysis pattern, design patterns and etc can develop based on F2OAS approach.
8. References


