

# Contextual Variability Management of Multi-Software Product Line

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## Abstract

Software Product Line (SPL) is used for the development of multiple products from same domain with reusability of existing resources. Feature model is used to manage the existing resources of SPL with predefined notations and relationships such as mandatory and variable features. Multiple SPLs that have common features with own contextual presence in domain repository needs to be managed efficiently to increase the reusability and development process. In this paper, we have proposed effective approach for the composition of multiple SPLs that have common resources in repository. Our proposed composition process follows the three steps procedure. The impact of composition on application development is less cost and time, and increase the reusability.

**Index Terms:** Software Product Line, Feature Model, Variability Management, Multi-SPLs.

## I. INTRODUCTION

Software Product Line (SPL) is used to develop the multiple products that share some common goals with some variations. SPL is extensively used for quick development with low cost and time to market due to high reusability of existing resources. Existing resources need to be modeled and developed on initial stages of development process [1]. SPL development is consisting on two main processes, 1) Domain Engineering (DE): consists of all initial features such as common, optional and alternative. Common features are must to be selected for development of products and variable features create the variations on some points according to end user requirements. 2) Application Engineering (AE): consists of all features that are required for development of specific application according to end user requirements [2].

Feature model is used to manage the common and variable features of SPL from DE to AE. DE level feature model defines the scope of SPL i.e. number of products and type, and AE level feature model defines the specific features and relationships for the development of products in the context of end user requirements. Common features are easy to handle and highly reusable in every product. However, variable features are hard to manage due to complex relationships and contextual reusability [3]. In single SPL, all features are defined with predefined constraints and relationship with feature model, as shown in fig. 1. However, in multi-SPLs that share common and variable features is hard to manage and reuse. Variability in multi-SPLs has global impact and increases the

variation points that make it difficult to reuse in various aspects and multiple product development such as mobile and tablet devices have many common features e.g., screen, camera etc. However, in mobile device, call is a mandatory feature, but in tablet device call is an optional feature.

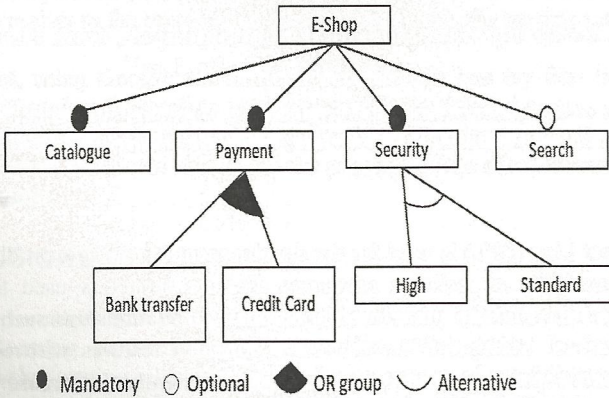


Fig. 1. E-Shop Feature Model [4]

In this paper, we have proposed variability management of multi-SPLs by identifying the variation points to increase the reusability of features in different domains of SPL. Our proposed method consists of three steps:

- 1) Convert feature model to variability feature model where only variable features exist.
- 2) Identify the variation points that are common in all SPLs variability feature model.
- 3) Model the variation points to increase the reusability in different SPLs product development.

The remainder of the paper is organized as follows: section II is related work, section III discusses about Multi-SPLs Variability Management and section IV gives conclusions and future work.

## II. RELATED WORK

Rosenmuller et. al. [5] proposed the automatic configuration of Multi-SPLs with composition model. Sensors' feature models, where multiple sensors are used in different domain perspective such as indoor and outdoor heat sensors. Manual composition of different feature models is challenging task due to high complexity of relationships between features in their own domain. Therefore, in this study, composition model is used to compose common and variable feature in single domain to increase the reusability.

Zheng et. al. [6] has proposed the variability management of SPL on domain level i.e. resource repository. Resource repository consists on all common and variable features that are reusable in applications development. Well managed resource repository increases the reusability of features in multiple products. With XML query, variable features can be identified and manage in application development.

Two interdependent processes proposed domain architecture and application architecture of SPL for variability management with high reusability of existing resources.



However, the proper transformation of variable features for application development is problematic task due to complex relationships between features. Focus of this study is on variability architecture decision to trace and identify the impact of variable features on all SPL products [7].

Our proposed approach is managing the variability of multi-SPLs that increase the reusability of feature in diverse products from different domain SPLs.

### III. MULTI-SPLs VARIABILITY MANAGEMENT

Variability management of multi-SPLs that share some common and variable features is challenging task due to relationship constraints between features of individual SPL. Individual development of features for all product lines is time consuming task and increases the development cost. Compositions of multiple SPLs that have some common goals reduce time to market and cost for each product. Fig. 2 shows the composition process of mobile phone and tab SPLs feature models. Following are steps taken in our approach:

First step is to identify the variation point of every SPL feature model and then common features in all SPLs. As shown in example in fig. 2, call feature is a mandatory feature in mobile phone feature model however, optional feature in tabs. Therefore, by composition of both SPLs features reusability of resource repository is increased with less cost and development time.

Second step is to compare the common and variable features from domain and find the common variation points of multiple SPLs.

Finally, third step maps the common variation points in single repository for initial development and reuse in further products' developments.

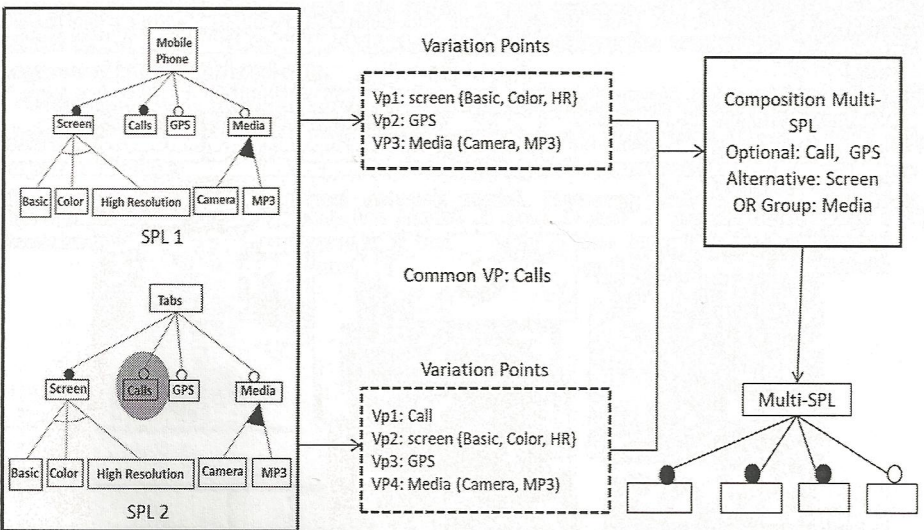


Fig. 2. Multi-SPLs composition model

## IV. CONCLUSIONS and FUTURE WORK

SPL is highly used in software development industry due to the reusability of existing resources and less development cost. Feature model is used to manage the commonalities and variability of SPL application development. Variability management is a challenging task due to complex relationships between features from different domains of SPL. In this paper, we have proposed an effective approach to manage the variability of multi-SPLs with composition processes. Compositions of multi-SPLs that share common variable features reduce the development effort, time and cost with high reusability of resources.

In future work we will apply the given approach on real time case study and enhance the development process with different SPL variability management tools.

## ACKNOWLEDGMENT

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