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Modeling and analysis of value added services using message sequence charts

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Abstract

A value added service is an extension to the basic call/session establishment functionality of a network. Different teams develop services independently or in order to handle complexity, a service is often specified individually without any consideration to existing ones. These different services may behave correctly when they run separately, but may interact in a negative manner when they are integrated. This is known as service interaction. In this paper, we tackle the problem of service interaction detection in a formal setup. We use message sequence charts (MSC) to specify the behaviors of services as well as their properties. In our specification style, high-level MSC (HMSC) is used to describe the behavior of services from the user point of view, while basic MSCs (bMSCs) are used to describe these behaviors at an abstract network level. We describe service properties from a local point of view. The behavior of a service is first validated against its properties. For the detection of potential interactions between two services, instead of merging their behaviors and then check for the interactions, we first determine interaction-prone scenarios using known filtering techniques, then we verify whether the properties of one service are satisfied by the behavior of the other service without combining their behaviors. In the case of non-satisfaction, we conclude that an interaction has been detected.

Keywords: MSC; Feature interaction; Validation; Detection; Value added services; Internet telephony; Modeling; Service interactions

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1. Introduction

Nowadays, Telephone networks provide several dozens of value-added services or features[1] to users, such as Call Waiting, Call Forward (CF). A value-added service, or simply a service, is often specified, designed and implemented independently from other services already deployed in the network. This separation of concerns, which is appropriate for managing the complexity of the service development process, may lead to undesirable situations where the behavior of the new service is impacted in an unexpected manner by the behavior of existing services. This is known as feature interaction (Cameron and Velthuijsen, 1993). The interaction between Originating Call Screening (OCS) and (CF) is a well known case. The OCS service is used to prevent outgoing calls to numbers in a predefined list. The CF service is used to forward all incoming calls to a predefined number. Now, assume that user A subscribes to OCS, user B subscribes to CF, and B is not in the screening list of A, but user C is in that list. Assume user B decides to forward all incoming calls to C. When OCS and CF are activated simultaneously and user A calls B, OCS will not prevent that call because B is not in the screening list of A. The CF service of B will forward the call to C and user A will be connected to C. This specific scenario of combination of OCS and CF is defeating the purpose of OCS. We say that OCS and CF are interacting in an undesirable way.

Feature interactions also appear in Internet telephony, Internet multimedia services and web services. In Hall (2000) and Lennox and Schulzrinne (2000), feature interactions in electronic mail systems and Internet telephony have been investigated and discussed. Weiss and Esfandiari (2005) have investigated the problem of feature interactions among web services and their causes, which seem mainly related to the service description and the related assumptions.

The feature interaction problem hinders the rapid creation and deployment of new services. A lot of research have been carried out to avoid, detect or solve feature interactions (Calder et al., 2003; Keck and Kuehn, 1999). The different techniques (Calder et al., 2003; Keck and Kuehn, 1999) used a wide variety of notations and languages for modeling networks and features. The applicability and detection power of these techniques depends on the intuitiveness and expressiveness of the notations. In this paper, we propose an approach for modeling and analyzing services using Message Sequence Charts (MSC) (ITU-T, 1999a). MSC language is appropriate for describing interactions between a system and its environment, as well as between the different components in the system. It is graphical, intuitive, popular among practitioners and has a formal semantics. MSC can be used to describe systems at different levels of abstraction, which a necessary attribute for the modeling of telecommunications systems.

In our approach, we use MSC to specify both service behaviors and their properties. One straightforward approach to detect interactions between two services is to merge their behaviors and then check the resulting behavior against the properties of each service. In order to merge two MSCs, we need for instance to determine the relations between the different events in the MSCs. This procedure is complex and time-consuming. On the other hand, the merging of behaviors may result in a large and complex system behavior beyond the capabilities of current validation tools. In our approach, we first model the basic call/

[1] Features are atomic call functions provided to users. In this paper, we do not distinguish between features and services, although a service often means a package of several features.