

Chapter 44

Spatial Subscriptions in Distributed Event- Based Systems

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ABSTRACT

One of the common approaches to specify locations is by indicating their spatial relationships to other, more well-known, locations. This chapter aims at analyzing the feasibility of expressing this kind of spatial relations in subscriptions of Distributed Event-based Systems (DEBSs). On one hand, the spatial relation expressions consist of various location-level abstractions, which have to be interpreted by the location models used in the systems. On the other hand, existing DEBSs are categorized by their filter models, and each category is merely capable of supporting a subset of all location models. The chapter presents ways to express different location-level abstractions by using different filter models and introduces the option of overlaying an extra mapping layer in systems to enhance their expressiveness of spatial relations in subscriptions.

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1. INTRODUCTION

Lightweight mobile devices, such as smartphones, PDAs and other portable handheld devices in conjunction with wireless network access can serve as platforms for mobile-networked applications. Distributed Event-based Systems (DEBS), also known as Publish/Subscribe systems, are push-based middleware that support the exchange of information in this scenario (Huang & Garcia-Molina, 2004).

DEBSs are composed of three major components: publishers, subscribers and event brokers. Publishers are information providers that issue events, and subscribers consume these issued events. Events are the data, or information, transmitting from one agent to other interested agents. Subscriptions, issued by subscribers, specify the types of events in which subscribers are interested. Middleware, also known as an event broker, is responsible for providing a bridge between publishers and subscribers. When a publisher issues an event, the event broker notifies the corresponding subscribers who have specified their interest in the published event.

Subscriptions describe events of interest, which are composed of at least one knowledge domain. For example, expressing an event *bus arrives at the central terminal at 6PM* involves transportation, spatial and time domains. This paper focuses on the spatial domain, which is essential to the provision of Location-based Services (LBS).

Jiang and Bao (Jiang & Yao, 2006) propose that the descriptions of locations should be expressed in natural ways, as end users of LBS are people who do not usually have the expertise to specify complicated expressions related to locations. A common scenario is of a moving person who wants to refer to his/her current location but he/she does not know its name. Huang and Garcia-Molina (Huang & Garcia-Molina, 2007) have already proposed a parameterized subscription approach, using the keyword *current location*, to solve this problem.

We address another common scenario in this paper. In existing DEBSs, locations can be referenced by their defined names (referred to as primary identities), but not by their relative positions to other locations (referred to as secondary identities). In fact, users may occasionally be unable to express some locations because they do not know their primary identities, as they may not be familiar with some locations. A more intuitive way is to reference a location by its secondary identity, specifying its relative position to a more well-known location. For example, Canada is a primary identity defining a country's name, yet it can be also be referenced by its secondary identity – the country north of the USA. In addition, there might be more than one secondary identity for a location.

The capability of expressing secondary identities in spatial subscriptions depends on the ability of the deployed location model to resolve location-level abstractions. Location models determine the represented data structure of locations. Most DEBSs employ geometric location models or string-based location models to handle spatial expressions (Burcea & Jacobsen, 2003; F. Chen, Yang, Yu, Le, & Yang, 2005; Y. Chen, Rao, Yu, & Liu, 2003; Huang & Garcia-Molina, 2004; Leung, Burcea, & Jacobsen, 2003). However, the former is not practical for use by ordinary users, as it requires users to express a location as a point or geometric figure in Euclidean space. The latter uses abstract labels to represent locations. Two locations are regarded as equivalent only if their labels are exactly the same. Hence, it is also hard to handle the secondary identities of locations. In Geographic Information Systems (GIS), significant amount of research has been done on investigating sophisticated location models which are capable of handling various spatial relations between locations (Becker & Dürr, 2005; Leonhardt, 1998). The problem to be investigated is whether existing DEBSs are capable of handling these location models.

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