Chapter 8
Context-Based Grouping and Recommendation in MANETs

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ABSTRACT

The authors propose in this chapter a context grouping mechanism for context distribution over MANETs. Context distribution is becoming a key aspect for successful context-aware applications in mobile and ubiquitous computing environments. Such applications need, for adaptation purposes, context information that is acquired by multiple context sensors distributed over the environment. Nevertheless, applications are not interested in all available context information. Context distribution mechanisms have to cope with the dynamicity that characterizes MANETs and also prevent context information from being delivered to nodes (and applications) that are not interested in it. The authors’ grouping mechanism organizes the distribution of context information in groups whose definition is context based: each context group is defined based on a criteria set (e.g. the shared location and interest) and has a dissemination set, which controls the information that can be shared in the group. They propose a personalized and dynamic way of defining and joining groups by providing a lattice-based classification and recommendation mechanism that analyzes the interrelations between groups and users, and recommend new groups to users, based on the interests and preferences of the user.

INTRODUCTION

Context distribution is a key aspect for successful applications in mobile and ubiquitous computing environments. Such applications typically need context information that is acquired by multiple context sensors distributed over the environment. Context-aware applications collect and react to this information, exploiting it through predefined adaptation mechanisms. Such mechanisms may vary from content adaptation to resource-driven adaptation and application deployment (Preuve-
Context information on which these adaptation mechanisms rely is also extremely varied, being potentially any information that can be used to characterize the situation of an entity (a person, place, or object) considered as relevant to the interaction between a user and an application (Dey et al. 2001). Context-aware applications adapt their operations to such context information in order to increase usability and effectiveness by taking environmental context into account (Baldauf et al. 2007).

The success of such adaption mechanisms depends then on the availability of context information, which is disseminated in Mobile Ad Hoc Networks (MANETs). However, in practice, only a fraction of all the observable context information is of interest for the user or application. For instance, in a metro station, a wide variety of information can be available: temperature and humidity, available computing infrastructure, network status, etc. Each context-aware application running in such an environment will use a subset of all available information. A travel guide application requires available computing infrastructure, network status and user profile information, but does not need temperature and humidity information, which is context information exploited by maintenance and control applications. Context distribution, which is defined as the capability to gather and deliver context information to interested entities (Bellavista et al., 2013), has to cope with this reality and adapt the distribution process to application needs.

In previous work (Kirsch Pinheiro et al., 2008), we designed a context-based grouping mechanism in which groups of peers were defined based on a criteria set (e.g. the shared location and interest) and a dissemination set (i.e. which information can be shared in the group). This approach relied on a rather static perception of groups, being defined explicitly by the developer at design time. Inference or recommendation of new groups taking into account the interests and preferences of the user was not considered. We supposed that the initiative to search for a specific group and the decision to join it was the responsibility of the user. In this chapter, we propose a more personalized and dynamic way of joining groups by providing a mechanism that makes it possible for the system to analyze the interrelations between groups and users, and recommend new groups to users, based on the situation and profile of the user, and representing concepts and groups by Galois lattices. Galois lattices are well defined and exhaustive representations of concepts embedded in data sets (Ventos & Soldano, 2005), which can be used to represent conceptual hierarchies that are inherent in data (Stummer et al 2001).

In this chapter, we present a context-based grouping mechanism, which allows the definition of groups based on contextual characteristics shared among members of the group. Each group is defined by these characteristics and specifies which context information can be distributed among group members. New groups can be inferred from existing ones by the incorporation of conceptual clustering with Galois lattices. This allows us to discover and analyze relations between different groups and the nodes contained in them. Based on a user profiles’ similarity with the elements specifying the group and the current situation of the user, the system can decide to give a recommendation to the user to join a group. This leads to a dynamic, proactive, and personalized user experience.

This chapter is organized as follows: Section 2 presents an overview of related work; Section 3 introduces a motivating scenario that illustrates the application of the proposed context grouping mechanism; Section 4 introduces the basic context grouping definition, after which the use of Galois lattices to automatically infer these groups is explained in section 5; Section 6 presents the context grouping mechanism’s applicability to MANETs, including a lattice-based approach for joining suitable groups. Finally we discuss future work directions and conclusions.