Chapter 64

Mission–Aware Adaptive Communication for Collaborative Mobile Entities

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ABSTRACT

Adaptation of communication is needed to maintain the connectivity and quality of communication in group-wide collaborative activities. This becomes quite a challenge to handle when mobile entities are part of a wireless environment, in which responsiveness and availability of the communication system are required. In this chapter, these challenges are addressed within the context of the ROSACE project where mobile ground and flying robots have to collaborate either between them selves or with remote artificial and human actors during save and rescue missions in the event of disasters such as forest fires. This chapter presents our first results. The final goal is to propose new concepts, models and architectures that supports cooperative adaptation which is aware of the mission being executed. Thus, the communication system can be adequately adapted in response to predictable or unpredictable evolutions of the activity requirements and to the unpredictable changes in the communication resource constraints.

INTRODUCTION

The ROSACE ("Robots and Embedded Self-adaptive communicating Systems") project aims to study and develop the necessary means to design, specify, implement and deploy a set of mobile autonomous communicating and cooperating robots and software entities with well-established properties, particularly in terms of safety, self-healability, ability to achieve a set of missions and self-adaptation in a dynamic environment. A typical case study may consider the context of mobile entities cooperating in a critical operation for crisis management (i.e. to put out fires in a dynamic environment), dealing with heterogeneous and unstable ubiquitous communications resources.

In this context, communication is essential to achieve the mission objectives since it allows the exchange of information between participants. The dynamicity of the environment and the deployment of communication resources will affect communication integrity. The need to adapt communications is one of the main challenges of the ROSACE project. The communication system is designed as an organisation of autonomous entities in charge of managing the communication resources available for the mission in order to provide communication service with the best quality of service (QoS) to actors participating in the operating scenario. Specific goals of the communication system are as follows:

- to set up a local network to provide permanent connectivity among ROSACE actors;
- to manage communication resources to guarantee a permanent connectivity among mission participants;
- to provide best-adapted QoS in accordance with communication goals and available resources (performance and consistency with activity requirements). For example, communication priorities have to be taken into account depending on the actors' role or the kind of data exchanged,

To achieve the afore mentioned goals, adaptation will require to manage the different communication layers (transport and middleware) taking into account the priorities of actors (possibly identified by their roles) and those of the exchanged data. Adaptation should also modify the behaviour of the communicating entities involved (e.g. to operate as a communication relay, or more generally to maintain the QoS). This can be accomplished by activating predefined functions, acquiring new functions, or delegating to external dynamically discovered services. Managing adaptation calls for monitoring crisis management activities of the communication system, and monitoring the supported activity in order to handle the evolution of these requirements. It also requires cooperation among monitoring layers by receiving change notifications and sending alarms when adaptation cannot be performed.

This chapter presents the challenges and solutions for building up adaptive mission-aware communication components within the context of ERCMS (Emergency Response and Crisis Management Systems). Adaptive Communication entities are embedded software components deployed on mobile robots and other communicating devices. They are used to ensure connectivity and quality of communication in group-wide collaborative activities while taking into account mission objectives.

The chapter is organized as follows. Section 2 surveys existing communication adaptation techniques. Section 3 describes the ROSACE project as well as the challenges related to communication adaptation. Section 4 specifies ontology-based model needed to support ROSACE entities with adaptive communication properties. Then, in section 5 details of the architecture of the ROSACE communication component providing communication management and adaptation are given. In section 6, we emphasis on multi-agents models

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