11 Intelligent Agents in Telecommunications

R. Weihmayer
GTE Laboratories Incorporated

H. Velthuijsen
KPN Research

11.1 Introduction

The underlying fabric for communication among intelligent agents will in many cases be provided by telecommunication networks. But telecommunication networks have been seen as a natural domain for the investigation and application of intelligent agents technology as it emerged from the area of Distributed Artificial Intelligence (DAI). Telecommunication network administrations are vast organizations dedicated to operating and managing networks with broad functional segmentations: telephone network outside plant, switching and transmission plants, public network, all supporting different layers of specialized customer or service networks. These networks are organized into multiple physical and logical layers built with large quantities of repeated network elements and subnetwork structures. All these elements need to be configured, monitored, and controlled. In the future, this will preferably be done by automated operation support systems and without substantial human intervention.

Although many recent efforts in applying DAI techniques have come from the telecommunications industry, the legacy information infrastructure that services internal operations in this industry has so far dampened immediate attempts at introducing DAI-based systems in the field. Consequently, the experimental DAI-based systems that have been developed for telecommunications have been primarily aimed at future networks and laboratory environments.

This chapter presents a brief survey of recent efforts in applying DAI to telecommunications including some of our specific experiences with such applications. Applications and domain descriptions thus take precedence over focused analytical study of the corresponding agent systems and their theoretical justifications.

---

1 This is a condensed and updated version of another paper: Distributed AI and co-operative systems for telecommunications (Weihmayer and Velthuijsen, 1995).
Our communication engineering and automated 'coarse-grained' co-operative agent perspective leads us to omit treatment of human-computer interaction themes, 'information agents,' etc. Thus, we do not consider here applications based on mobile agents and scripting languages such as offered by Java and TeleScript, which lack explicit support for co-operative behavior, even though these types of agents have received a lot of attention in the telecommunications domain over the last couple of years. This is not to say that this technology is not promising. In fact, the commercial application of mobile agents and scripting languages may be closer than that of intelligent, co-operative agents.

Sections 11.2 and 11.3 form the core of our discussion of current applications to telecommunications. Section 11.2 emphasizes general coverage by describing current attempts in connecting DAI and telecommunication problems. Section 11.3 describes four systems in more detail. These systems were chosen because they are the result of sustained domain analysis and justification efforts and of advanced implementation and testbed construction, and because we were familiar with two of them, as major contributors in their development. Section 11.4 assesses the relative success of DAI in telecommunications and speculates on perspectives for DAI applications in telecommunications for the future. This chapter is both a reduced and updated version of a more extensive survey of the field (Weihrmayer, 1994).

### 11.2 Overview of DAI and Telecommunications

After providing the basic rationale for DAI and telecommunications, this section briefly surveys the field with a small classification that also serves to ground the bibliography.

#### 11.2.1 Rationale for DAI in Telecommunications

Inherent distribution and interconnectedness of telecommunication networks and their constituent components provide the basic rationale for DAI approaches to the solution of telecommunication problems. DAI approaches address a number of dimensions of this distribution:

- Along the geographical or functional boundaries of administrative domains, e.g., (Liempd, 1990; Sugawara, 1992b; Weihrmayer, 1992).
- Along the functional boundaries of management and operations support tasks, e.g., (Garijo, 1992; Huhns, 1994; Rao, 1990).
- Between the different roles and responsibilities in a hierarchical network management organization, e.g., (Gaçi, 1993; So, 1992)
- Between the physical and/or logical layers of network organizations, such as the network control and transmission layers.