Assistance Layer in a P2P Scenario

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Abstract. Usually, MAS design and implementation involves a coordination model that structures agent interactions and an infrastructure in charge of enacting it. We propose the term Coordination Support to denote the services offered by this infrastructure. Such services can be grouped in different layers. We propose an additional Assistance layer devoted to assist coordination rather than just to enable it. This layer is illustrated by means of a Peer-to-Peer sharing network (P2P) scenario, so that the benefits of our proposal can be empirically evaluated.

1 Introduction

As a general illustration of the proposed Coordination Support concept¹, with an accent on the Assistance Layer, we present a P2P sharing network scenario. In this scenario, a set of computers connected to the Internet (peers) share some data. The performance is evaluated in terms of time and network consumptions during the sharing process. We model this scenario as a MAS where peers are agents with a certain organisation. Its role capabilities and their net of relationships constitute its social structure. Also, we assume they are organised to pursue the following goal: all peers get the data by consuming minimum time and network. Moreover, they follow some social conventions. Specifically, peers use a simplified version of the BitTorrent protocol² to interact and a norm to limit their network usage. This norm can be expressed as: norBW_DL = “a peer cannot use more than max_bw bandwidth to share data”.

2 Assistance Layer

To provide assistance functionalities, we have implemented our proposed 2-LAMA architecture³, which places a meta-level (ML) on top of a previously existing domain-level (DL). Accordingly, the P2P MAS constitutes the domain-level whilst the meta-level consists of a set of agents we call assistants organised to aid peers. Each assistant provides a subset of peers (cluster) with the following functionalities:

Information. It consists on providing agents with necessary and useful information to participate: the description of current norms and the identifiers of...
those other peers interested in the same data. An assistant supplies this information to new peers joining its cluster and to all peers in its cluster whenever this information is updated. Norm descriptions are sent by means of “norm <norm_id> <definition>” messages, whereas information about peers are sent with “interested <peer> [,<peer>]” messages.

**Justification.** It justifies the effects of agent actions due to social conventions: involves providing explanations about why some messages have been filtered out due to the application of a norm. We assume Internet Service Providers (ISP) are equipped with an infrastructure mechanism that filters out messages that violate norms. This approach is not unrealistic since, nowadays, there exist ISP initiatives to improve P2P distribution systems. Specifically, assistants supply justifications to their peers by sending a “justification ’<orig_message>’, action ’filtered out’ reason ’norm <norm_id>’” message.

**Advices.** It consists in suggesting plans to contact other peers. Based on network communication times, assistants recommend the subset of agents to be contacted by a newcomer peer. Each assistant generates these plans based on partial information it receives from its clusters. This information consists of communication times and data possession. At meta-level, assistants communicate among them to share a summary of this information. Consequently, each assistant has detailed information about its cluster and an overview about the rest of the domain-level. Assistants use this information to estimate which are the shortest paths among data sources and destinations. Accordingly, they recommend peers to contact those other peers that are in these shortest paths, by sending “contact <peer> [,<peer>]” messages.

**Adaptation.** In updates system’s organisation to improve its design purpose achievement. Our meta-level adapts the domain-level organisation by changing its bandwidth norm (norBW_DL). It changes the bandwidth limit (maxBW) at certain time intervals. As this limit increases, the time to share data decreases since more network is used to transmit it. However, a large increase of network usage can saturate it and, as a result, increase time instead of reducing it. Assistant agents observe its cluster network usage and suggest to vary this limit in order to increase the usage without achieving network saturation (see [3] for further details). Then, assistants need to agree on the next value of maxBW. In current implementation, each assistant computes the average of all suggested maxBW and communicates it to its peers.

### 3 Implementation and Results

We have implemented a prototype [3] of our P2P proposal in Repast Symphony [4]. Our actual P2P scenario is composed of 12 peers grouped in 3 different clusters, each one having its own assistant. Figure 1 depicts the underlying network topology composed by peers (p), assistants (a), routers (r) and links among elements (lines with an associated bandwidth).

We tested three MAS approaches: Brute-force-no-ML, a MAS without ML in which all peers contact all the others to request the datum; 2-LAMA-AgAss, our proposed architecture providing agent assistance through information, justifica-