

# Layered Message Semantics using Social Commitments

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## ABSTRACT

Although mental states have its own place in the definition of message semantics, social commitments have emerged as a complementing element to circumvent the limitations of using mental state definitions in open multiagent systems. Based on current social commitment approaches, and inspired by theories of language use, we propose a commitment-based model where messages are defined according to their use as coordinating devices for advancing conversations and the state of social commitments that bring about the actions advancing the joint activities in which agents participate.

## Categories and Subject Descriptors

I.2.11 [Artificial Intelligence]: [Multiagent systems]; I.2.11 [Artificial Intelligence]: [Coherence and coordination]

## General Terms

Design, Languages, Standardization

## Keywords

Agent communication languages, protocols, commitments.

## 1. INTRODUCTION

Most of the practical advances in agent communication languages has been led by FIPA-ACL [2], which defines the meaning and sequencing of messages using mental states and conversation protocols. Although successful for many years to advance the state of the art, this approach has faltered to support conversations in open multiagent systems, where the mental states of agents cannot be verified to abide to the messages they utter [8], and where protocols should bear a correlation between the definition of messages and their use in conversations [7]. A recent trend proposes that the meaning and connectedness of messages could be defined using social commitments [3] [5] [6] [10]. Based on this notion, we propose that the meaning of messages could be

expressed according to a) the relationships between their instance components, b) their use in conversations aiming to advance the state of commitments, and c) the actions these commitments entail within the context of a joint activity.

## 1.1 Social Commitments

*Social commitments* [9] have been proposed as a way to raise expectations about agent performances. They are defined as engagements in which an agent (the debtor) is responsible relative to another agent (the creditor) for satisfying a condition. A commitment could be either *accepted* or *rejected* according to whether or not agents are engaged in it. If accepted, a commitment is either *active*, *violated* or *fulfilled*; if rejected, it is either *inactive* or *cancelled*. There are four commitment transitions: *adoption*, where an inactive commitment becomes accepted; *violation* and *fulfillment*, where an active commitment becomes violated or fulfilled, respectively; and, *discharge*, where an accepted commitment becomes cancelled. Utterances are events marking the occurrence of communicative actions attempting to make a commitment become adopted or discharged, or accepting or rejecting an attempt to make such as change. To be consistent with the public nature of commitments, we address communications making commitments accepted or rejected, and are not concerned with the other transitions, which deal with the commitments' conditions of satisfaction.

## 2. COMMITMENT-BASED MODEL

Studies of language use define two complementary types of meaning[1]: *speaker's meaning*, where messages are used for the communication of intent, and *signal meaning*, where messages are used as coordinating devices advancing the state of joint activities. Based on the latter, we conceptualize messages as coordinating devices that advance conversations that establish social commitments that bring about the actions that advance joint activities; where the state of conversations, commitments and activities is part of the common ground of agents. As shown in Figure 1, the meaning of messages is incrementally defined in four levels: a *compositional level*, where meaning is based on the relationship between instances in a message; a *conversational level*, where meaning is based on their occurrence as part of a conversation attempting to advance the state of commitments; a *commitment state level*, where meaning is based according to the state of the commitments these messages attempt to advance; and a *joint activity level*, where meaning is based according to the use of these messages to advance activities. A detailed description of this model can be found in [4].

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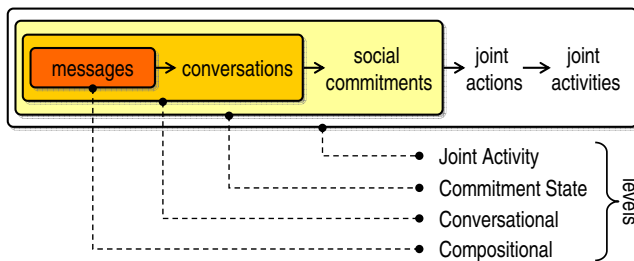


Figure 1: Message semantics levels.

## 2.1 Compositional Level

Messages have certain meaning independently of their use as utterances and according to their instance components. Agents advance certain commitment states through conversational agreement, by proposing and replying (accept, reject, or counter) to commitment operations [3]. In this view, a message is a *proposal* if it has a propose token, or a *reply* if it has a reply token. Messages with refined meaning can be derived from these; e.g., a *rejection* is a reply with a reject token, an *offer* is a proposal where the speaker is the debtor, and a *request* is a proposal where the hearer is the debtor.

## 2.2 Conversational Level

This level builds upon the compositional level, and indicates the meaning of messages once they are uttered. Definitions take into account the time when shared utterances between speaker and addressee were issued, and the sequencing of these utterances towards agreement. Thus, an agent is *proposing* to another agent if the uttered proposal is shared, and if this proposal can be replied. Also, an agent is *replying* to another agent if the uttered reply is shared, and if it could answer to an existing shared proposal that has not been replied yet. These definitions can be used to derive new messages, such as *accepting*, *rejecting*, *offering*, *requesting*.

## 2.3 Commitment State Level

This level builds upon the compositional and conversational levels, and refines the meaning of messages to take into account the commitment states these messages attempt to advance when uttered. For example, an utterance proposing to discharge an accepted commitment is one defined as proposing to delete a currently adopted commitment. This definition could be refined as an *offer withdrawal* if the referred commitment is active, and its discharge is being proposed by the same agent that offered its adoption.

## 2.4 Joint Activity Level

The joint activity level builds upon the compositional, conversational and commitment state levels, and refers to the meaning given to messages when they refer to actions in joint activities. To exemplify an activity with actions, and the commitment messages aiming to bring about these actions, we refer to a contract net joint activity [3] that specifies a manager and bidder roles interacting to bring about three sequential and interdependent actions: producing a bid, evaluating a bid, and performing a contract. Actions are defined as independent activities with independent roles (each of which are defined exclusively in terms of the commitment messages agents in these roles can utter), and then merged into a contract net activity, where roles and actions

are correlated, e.g., the bid from the bidding is the bid that is evaluated. In this activity, a *call for proposals* message in the manager's role is one in which  $\mu$  (the manager) requests to  $\beta$  (the bidder) to adopt an inactive commitment where  $\mu$  is the creditor and  $\beta$  is the debtor and actor of a bid-producing action. Likewise, a *request for evaluation* is a message in the bidder's role in which  $\beta$  proposes  $\mu$  both to discharge the active bid-producing commitment, and to adopt a commitment where  $\beta$  is the creditor and  $\mu$  is the debtor of a bid-evaluating action, while informing a bid that could satisfy the former and be a precondition of the latter.

## 3. CONCLUSIONS

Although subtle, the difference between *speaker's meaning* and *signal meaning* is striking: whereas speaker's meaning appeals to the reasons behind the advancement of an activity, signal meaning puts forth a public token advancing it.

Traditionally, most semantics models emphasized speaker's meaning, which is unrivaled for communicating intent: agents can readily know the intention of messages by just observing their definitions rather than inferring it from the context of interaction. Yet, definitions are given independently of any context, and their use in open systems demands sincerity.

Signal meaning, on the other hand, has been kept as a low profile component of meaning and is not addressed by traditional efforts. We set out to explore this type of meaning, and developed a model where commitment messages act as coordinating devices advancing conversations, the state of commitments and the activities whose actions they entail.

## 4. ACKNOWLEDGEMENTS

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