FIPA Brokering Interaction Protocol Specification

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1 FIPA Brokering Interaction Protocol

The FIPA Brokering Interaction Protocol (IP) is designed to support brokerage interactions in mediated systems and in multi-agent systems, for example, [Finin97].

Generally speaking, a broker is an agent that offers a set of communication facilitation services to other agents using some knowledge about the requirements and capabilities of those agents. A typical example of brokering is one in which an agent can request a broker to find one or more agents who can answer a query. The broker then determines a set of appropriate agents to which to forward the query, sends the query to those agents and relays their answers back to the original requestor. The use of brokerage agents can significantly simplify the task of interaction with agents in a multi-agent system. Additionally, brokering agents also enable a system to be adaptable and robust in dynamic situations, supporting scalability and security control at the brokering agent.

The representation of this IP is given in Figure 1 which is based on an extension of UML 1.x. [Odell2001]. This protocol is identified by the token fipa-brokering as the value of the protocol parameter of the ACL message.

Figure 1: FIPA Brokering Interaction Protocol
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1.1 Explanation of the Interaction Protocol Flow
The FIPA Brokering Interaction Protocol (IP) is a macro IP since the proxy communicative act (see [FIPA00037]) for
brokerage embeds a communicative act as its argument and so the IP for the embedded communicative act is also
embedded in this IP. This embedded IP guides some parts of the remainder of the interaction, thus parts of this protocol
are written very generically.

The Initiator of the brokering interaction begins the interaction with a proxy message which contains the following:
a referential expression denoting the target agents to which the broker should forward the communicative act, the
communicative act to forward and a set of proxy conditions such as the maximum number of agents to which the
message should be forwarded. The Broker processes the request and makes a decision whether to agree to or refuse
the request and communicates either an agree or a refuse communicative act accordingly. Communication of a
refuse terminates the interaction.

Once the Broker has agreed to be a proxy, it then locates agents per the description from the proxy message. If no
such agents can be found, the Broker returns a failure-no-match and the interaction terminates. Otherwise, the
Broker may modify the list of matching agents based on the proxy-condition parameter. It then begins m
interactions with the resulting list of n agents with each interaction in its own separate sub-protocol. At this point, the
Broker should record some of the ACL parameters (see [FIPA00061]), for example, conversation-id, reply-
with and sender, of the received proxy message to return in the r replies to the Initiator.

Note that the nature of the sub-protocol and the nature of the replies are driven by the interaction protocols specified in
the communicative act from the proxy message. As the sub-protocol progresses, the Broker forwards the responses
that it receives from the sub-protocol to the Initiator. These messages are defined as the reply-message-sub-
protocol communications, and may be either successful replies as defined by the sub-protocol or failure. If the
initial proxy was an inform, there may in fact be no replies from the sub-protocol (and in fact means that the
interaction is identical to a recruited inform). When the sub-protocol completes, the Broker forwards the final reply-
message from the sub-protocol and the brokering IP terminates. However, there can be other failures that are not
explicitly returned from the sub-protocol, for example, the agent that is executing the sub-protocol has failed. If the
Broker detects such problems, it returns a failure-brokering, which terminates the IP.

A second issue to address occurs because multiple agents may match and therefore multiple sub-protocols (m of them)
may be initiated by the Broker within the brokering IP. In this case, the Broker may collect the n received responses and
combine them into a single reply-message-sub-protocol, or may forward the reply-message-sub-protocol
messages from the separate sub-protocols individually (1 p n). This is complicated by situations such as one agent
responding with a failure while a second agent returns a reply-message, or the situation where results are
inconsistent. The Broker must determine whether to resolve such situations internally or forward the responses to the
Initiator. In doing this, the Broker must also be careful to avoid disruptive acts such as directly forwarding a failure
from a sub-protocol, which would have the inadvertent effect of ending the brokering IP.

Any interaction using this interaction protocol is identified by a globally unique, non-null conversation-id parameter,
assigned by the Initiator. The agents involved in the interaction must tag all of its ACL messages with this conversation
identifier. This enables each agent to manage its communication strategies and activities, for example, it allows an
agent to identify individual conversations and to reason across historical records of conversations.

In the case of 1:N interaction protocols or sub-protocols the Initiator is free to decide if the same conversation-id
parameter should be used or a new one should be issued. Additionally, the messages may specify other interaction-
related information such as a timeout in the reply-by parameter that denotes the latest time by which the sending
agent would like to have received the next message in the protocol flow.

1.2 Exceptions to Interaction Protocol Flow
At any point in the IP, the receiver of a communication can inform the sender that it did not understand what was
communicated. This is accomplished by returning a not-understood message. As such, Figure 1 does not depict a
not-understood communication as it can occur at any point in the IP. The communication of a not-understood
within an interaction protocol may terminate the entire IP and termination of the interaction may imply that any
commitments made during the interaction are null and void. However, since this IP broadcasts to more than oneParticipant, multiple responses are also possible. Each response, then, must be evaluated separately – and some ofthese responses might be not-understood. However, terminating the entire IP in this case might not be appropriate,as other Participants may be continuing with their sub-protocols.

At any point in the IP, the initiator of the IP may cancel the interaction protocol by initiating the meta-protocol shown in

*Figure 2*. The conversation-id parameter of the cancel interaction is identical to the conversation-id parameter
of the interaction that the Initiator intends to cancel. The semantics of cancel should roughly be interpreted as meaning
that the initiator is no longer interested in continuing the interaction and that it should be terminated in a manner
acceptable to both the Initiator and the Participant. The Participant either informs the Initiator that the interaction is done
using an inform-done or indicates the failure of the cancellation using a failure.

![FIPA-Cancel-Meta-Protocol](image)

*Figure 2: FIPA Cancel Meta-Protocol*

This IP is a pattern for a simple interaction type. Elaboration on this pattern will almost certainly be necessary in order to
specify all cases that might occur in an actual agent interaction. Real world issues such as the effects of cancelling
actions, asynchrony, abnormal or unexpected IP termination, nested IPs, and the like, are explicitly not addressed here.
2 References


3  Informative Annex A — ChangeLog

3.1 2002/11/01 - version G by TC X2S

Page 1, line 42: Reworked and expanded the section description of the IP
Page 2, Figure 1: The not-understood communication was removed
Page 2, Figure 1: Used a more generic set of communicative acts which the Broker is going to forward the responses it received from the sub-protocol and if the Broker notices some failure, such as no response at all from the sub-protocol after a given time period, then the Broker may send the Initiator a failure of its own
Page 2, Figure 1: Multiple sub-protocols indicated by inserting m, n and p respectively on three arcs; m sub-protocols can be started, resulting in n responses that the Broker can consolidate into p responses to the Initiator
Page 2, Figure 1: To conform to UML 2, the protocol name was placed in a boundary, x is removed from the diamonds (xor is now the default) and the template box was removed
Page 2, line 70: Added a new section on Explanation of Protocol Flow
Page 2, line 70: Reworked and expanded the section on Exceptions of Protocol Flow to incorporate a meta-protocol for cancel
Page 2, line 70: Added a paragraph explaining the not-understood communication and its relationship with the IP

3.2 2002/12/03 - version H by FIPA Architecture Board

Entire document: Promoted to Standard status