

**Applying Broadcasting/Multicasting/Secured Communication to agentMom in
Multi-Agent Systems**

Software Requirements Specification

Version 1.1

This document conforms to IEEE Std 830-1998 Software Requirements Specification.
This document is submitted in partial fulfillment of the requirements for the degree MSE.

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1 Introduction

This section provides an overview of this project.

1.1 Purpose

The purpose of this document is to describe functionality and behavior of the new agentMom framework. This document is intended to be viewed only by project advisor and committee members.

1.2 Scope

This document covers the software requirements for the project “Applying Broadcasting/Multicasting/Secured Communication to agentMom in Multi-Agent Systems”.

1.3 Definitions, Acronym & Abbreviations

agentMom 1.2 refers to current implementation of agentMom

New agentMom refers to this project, including agentMom with capability of broadcasting, multicasting and secured communication

Unicast refers to one-to-one communication in such a way that a packet originates from a single Internet host, and it is destined to a unique location of another Internet host.

Multicast refers to one-to-many communication in such a way that a packet originates from a single Internet host, and it is destined to multiple receivers within the same multicast address.

Broadcast refers to one-to-many communication in such a way that a packet originates from a single Internet host, and it is destined to all receivers within the same local network.

Organization refers to a set of agents.

Reorganization refers to a situation where the previous organization structure is not efficient to succeed the mission.

Group refers to a set of agents who agree to use the same multicast address to subscribe group message.

Time-To-Live (TTL) refers to the number of hops that multicast message is allowed to remain in the network before it is discarded by the router.

1.4 References

- AgentMom User’s Manual, Air Force Institute of Technology, July 2000
- Multiagent Systems Engineering. *The International Journal of Software Engineering and Knowledge Engineering*
- IEEE Standard for Software Requirement Specification, IEEE 830-1998
- Project Overview version 1.0, Kansas State University, March 2003, (http://www.cis.ksu.edu/~cme6556/project_overview_1.0.pdf)

1.5 Overview

The remainder of this document provides a greater detail functionality and requirement of the software. Section 2 describes product perspective, overall functionality, intended users, constraints and assumption of this software. Section 3 provides general Use Cases and specific requirement of this software.

2 Overall Description

This section provides an overview of the project functionality and factors that affect this project and its requirements.

2.1 Product Perspective

This project will be a framework that provides reusability of agent's communication. It is implemented in Java and provides the basic building blocks for building agents, conversations between agents, and the message that are passed in the conversations.

- 2.1.1 Software Interface – java version 1.4.0 is required to use the software.
- 2.1.2 Communication Interface – TCP/IP is used in order to send unicast message. Multicast protocol is used in order to send multicast message. UDP is used in order to send broadcast message.

2.2 Product Functions

- 2.2.1 Enable agents to broadcast a message to all the agents within the same local network.
- 2.2.2 Enable agents to multicast a message to all the agents within the same multicast address.
- 2.2.3 Enable agents to unicast a message to other agents within organization.
- 2.2.4 Allow agents to choose among unicast, multicast and broadcast communication.
- 2.2.5 Allow agents to join and leave multicast group.
- 2.2.6 Provide message encryption and decryption techniques for secured communication.
- 2.2.7 Allow agents to choose to encrypt or not to encrypt message.

2.3 User Characteristics

Users who want to implement multi-agent systems based on this framework are expected to have general knowledge of Java programming, object-oriented programming and Multi-Agent Systems Engineering Methodology.

2.4 Constraints

- 2.4.1 Reliable message delivery – multicast/broadcast packets are delivered with best effort. Thus, a packet may be delivered to all specified agents or none.
- 2.4.2 Security – we provide some basic mechanisms for security such as message encryption. However, there is no guarantee that the others cannot decrypt the encrypted messages.
- 2.4.3 Multicast Protocol – in order to send multicast message, network environment such as router, network card and operating systems must support multicast protocol.
- 2.4.4 Broadcast Message – in many network, only system administrator is allowed to send broadcast message.

2.5 Assumptions and Dependencies

- 2.5.1 We assume that each agent knows the address of destinating agents in order to send unicast message.
- 2.5.2 We assume that each agent has enough knowledge to decide the best way to communicate with the other agents.
- 2.5.3 In the case of using secured multicast communication, we assume that there is an agent whom each agent can request for the same encryption and decryption key. This agent should maintain a list of agents who are allowed to get the keys.
- 2.5.4 We assume that each agent knows the multicast address in order to send multicast message.

3 Specific Requirements

This section provides all of the project requirements in detail.

3.1 Use cases

Use Case 1: Notify join/leave multicast group

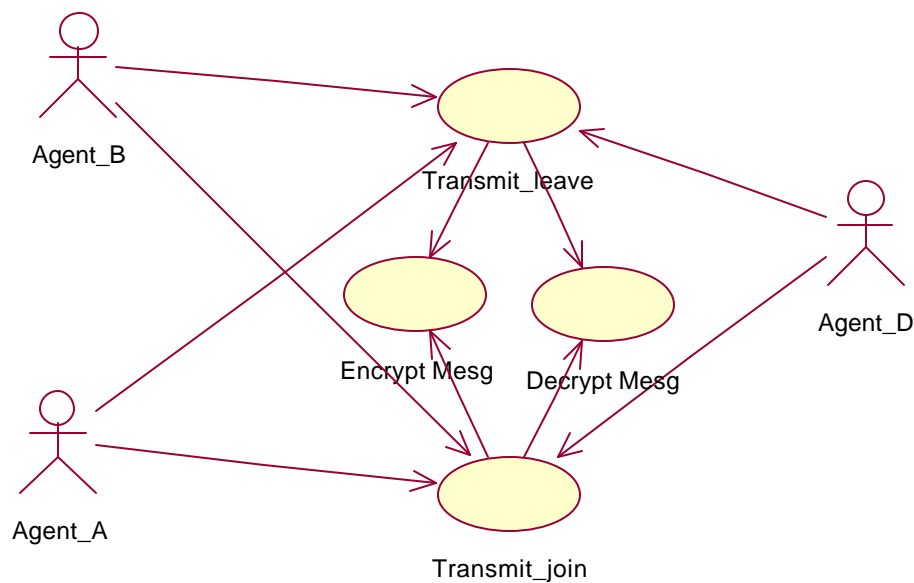


Figure 1. leave/join

1. Message is encrypted or Message is not encrypted.
2. An agent sends notify to join/leave multicast group.
3. Message is decrypted only if Message is encrypted.

For example, Agent_B and Agent_D belong to the same group, and then Agent_B wants to leave the group and Agent_A wants to join the group. In this situation, when reorganization occurs, Agent_A who is previously not part of the group may send notify message to join the group, and Agent_B who is previously part of the group, may send notify message to leave the group. For instance, Agent_B suffers a failure in one of its

capabilities and does not want to receive any further message from the group. Agent_A who may have capability to substitute Agent_B is needed to be part of the group. This involves sending notify of join and leave the group.

Use Case 2: Send/Receive Unicast

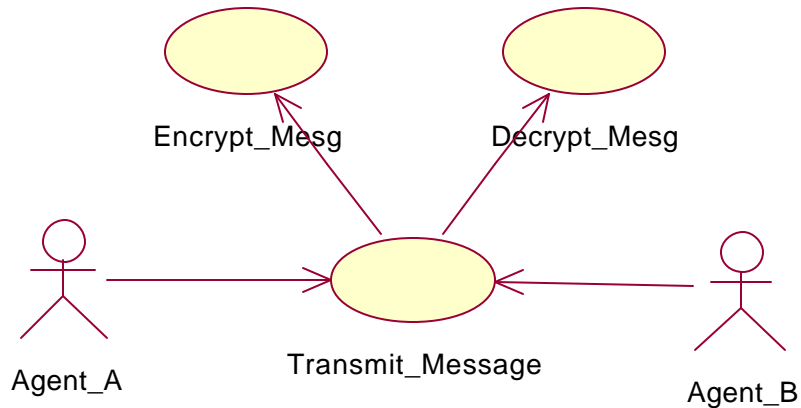


Figure 2. unicast

1. Message is encrypted or Message is not encrypted.
2. An agent sends unicast message to another agent.
3. Another agent receives message.
4. Message is decrypted only if Message is encrypted.

In this situation, Agent_A wants to communicate with Agent_B. This direct communication can happen between any two agents within organization.

Use Case 3: Send/Receive Multicast

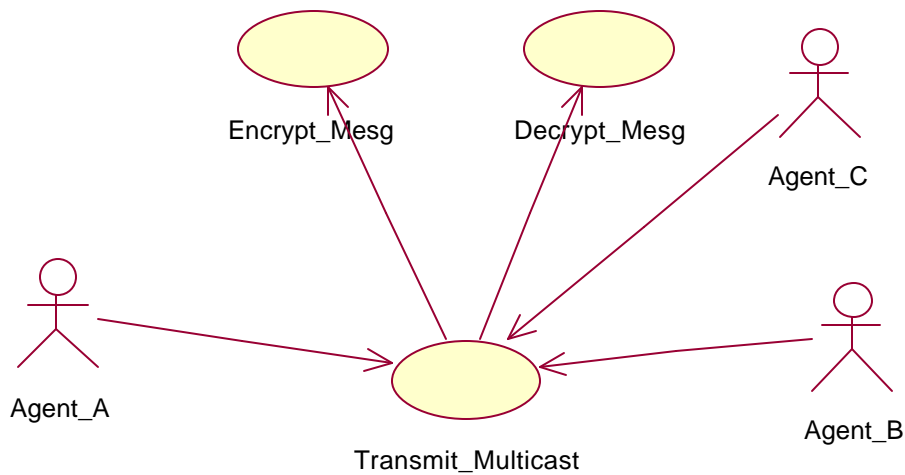


Figure 3. multicast

1. Message is encrypted or Message is not encrypted.
2. An agent sends multicast message to the group (multicast address).
3. Other agents in the group receive message.
4. Message is decrypted only if Message is encrypted

In this situation, Agent_A wants to send a message to everyone within the group, assuming that Agent_A, Agent_B and Agent_C subscribe to the same multicast address. This involves the multicast communication since other agents who do not belong to the group cannot receive this message. For instance, an agent may want to inform everyone in the group when the assigned tasks are completed. This is more effective than in unicast communication since only one copy is sent. Also, using bidding/market-based protocols fit well with this kind of communication. An agent may request a bid from other agents for doing some tasks.

Use Case 4: Send/Receive Broadcast

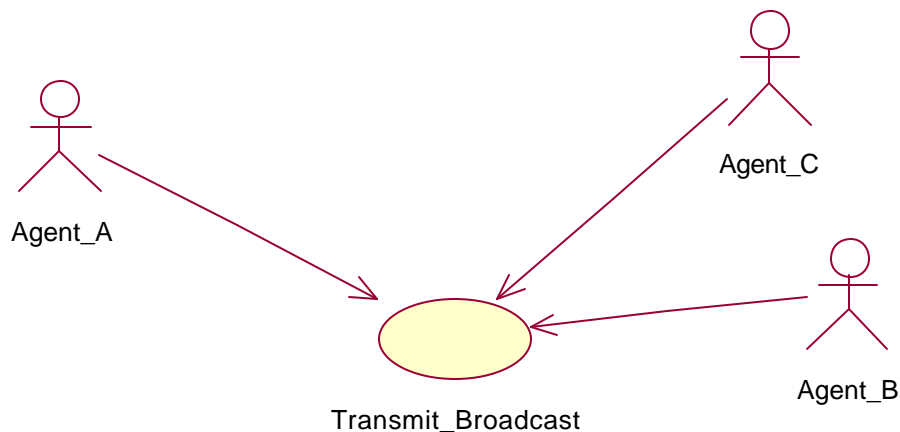


Figure 4. broadcast

1. An agent sends message to everyone in the same local network
2. Other agent in the same local network receive message

In this situation, Agent_A wants to send a message to everyone within the same local network that agent A belongs to. This involves the broadcast communication since any agent in the same local network as Agent_A can receive this message. For instance, when a new agent who does not previously exist in that local network wants to announce the existence to other agents.

3.2 Specific Requirement

3.2.1 Unicast Communication

- 3.2.1.1 *agentMom shall support the ability to send unicast message.
- 3.2.1.2 *agentMom shall support the ability to receive unicast message.
- 3.2.1.3 Unicast message shall only be received by the specified address.

3.2.1.4 Unicast message shall arrive at the specified address and in order.

3.2.2 Multicast Communication

3.2.2.1 *agentMom shall support the ability to send multicast message.

3.2.2.2 *agentMom shall support the ability to receive multicast message.

3.2.2.3 *agentMom shall support the ability to send request to join multicast group.

3.2.2.4 *agentMom shall support the ability to send request to leave multicast group.

3.2.2.5 agentMom shall not allow receiving multicast message from a group before joining that multicast group.

3.2.2.6 agentMom shall not allow receiving multicast message from a group after leaving that multicast group.

3.2.2.7 agentMom shall support the ability to set time-to-live for multicast message.

3.2.2.8 agentMom shall support the ability to set multicast address and port for sending and receiving multicast message.

3.2.2.9 agentMom shall support the ability to receive multicast message from multiple groups.

3.2.3 Broadcast Communication

3.2.3.1 *agentMom shall support the ability to sent broadcast message.

3.2.3.2 *agentMom shall support the ability to receive broadcast message.

3.3.3.3 *Broadcast message shall be sent to all possible hosts under the same local network.

3.2.4 Security

3.2.4.1 *agentMom shall support the ability to encrypt unicast message.

3.2.4.2 *agentMom shall support the ability to decrypt unicast message.

3.2.4.3 agentMom shall allow an agent to decide whether or not to encrypt a message.

3.2.4.4 agentMom shall automatically decrypt encrypted message.

3.2.4.5 agentMom shall support the ability to encrypt multicast message.

3.2.4.6 agentMom shall support the ability to decrypt multicast message.

3.2.5 Architecture

3.2.5.1 *agentMom with shall support the use of the architecture that agent directly controls the conversations.

3.2.5.2 *agentMom shall support the use of the architecture that agent's components control the conversations.

3.2.6 Compatibility

3.2.6.1 The new built agentMom shall be compatible with the agentMom 1.2

Note: The “ * ” indicates Driving Requirements that need to be demonstrated by the end of phase II.