Using CEP-based Blackboards for Coordinating Mobile RFID Agents [*]

Johannes Westhuis, Ralf Bruns, and Jürgen Dunkel

Hochschule Hannover, University of Applied Sciences and Arts, Hannover
johannes.westhuis@fh-hannover.de

Abstract. This position paper presents an approach on how to coordinate mobile RFID agents using a blackboard architecture based on Complex Event Processing.

1 Problem Statement

In huge warehouses or stockrooms, it is often very difficult to find a certain item, because it has been misplaced and is therefore not at its assumed position. The LegLo project[1] is dealing with this problem. A system architecture has been developed for searching certain RFID (radio frequency identification) tags in stockrooms. The following figure shows on the left hand side the current system architecture: a huge number of RFID tags are spread over the stockroom, which can be searched by a number of mobile RFID readers. In the project a new type of RFID agents has been developed, which use novel RFID antennas for detecting and localizing tags that are in a range of about 2 meters.

If an employee receives a search request for a certain tag the following process is initiated: (1) the reader looks in a database for the assumed position of the tag, (2) then the employee moves to this position, (3) he/she performs a near-distance search with the mobile RFID reader for finding the possibly misplaced tag, (4) finally the tag is brought back to the starting position of the search.

Obviously, this approach has some crucial disadvantages: because the mobile RFID readers are not coordinated and work independently from each other, each reader has to follow long search paths for fulfilling a search request. In the following, we propose a more sophisticated solution approach that is based on a distributed search algorithm and a blackboard coordination mechanism with Complex Event Processing (CEP).
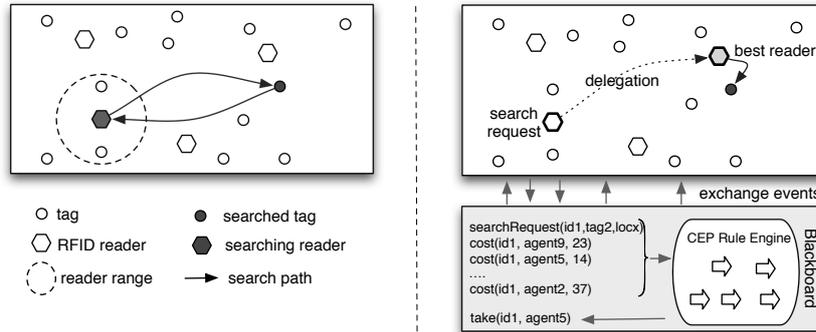
2 Distributed Search

The efficiency of the tag search procedure can be improved by cooperating RFID agents that behave according to the following algorithm:

Delegating search requests: The search request is delegated to the reader that is located nearest to the assumed tag position. This approach could be better adapted to the current situation in the stockroom by using a common evaluation (reward) function. This function calculates the individual cost of an agent for fulfilling an open search task. It could take the estimated distance to the tag into account, but also if an agent could search the requested tag instead of another already accepted search task.

Delegating returns: Similar to delegating search requests, the transport of a detected item can be optimized by a bidding procedure, too.

3 Coordination Mechanisms

The distributed search algorithm requires the following information to be exchanged between the mobile RFID agents: (a) which tags are searched, (b) what are the calculated costs of agents for searching an item or bringing it back. Moreover, some coordination instance must select the best suited agent for a certain task and propagate this decision.

A *blackboard architecture* is chosen as the communication infrastructure for information exchange between the independent RFID agents (illustrated on the right side of the figure). The coordination and agreement of the agent requests are processed on the blackboard using *Complex Event Processing*[2].

Position reports, search requests and cost bids can be modelled as *events*. Two simple events are sent by the mobile RFID agents to the blackboard: (a) searchRequest (requestID, tagID, requestLocation) and (b) cost(requestID, agentID, cost) bids. The key component of the blackbord is a *CEP rule engine* with *event processing rules* that process all incoming events and derive a *complex event* that determines the search delegation in real-time. The ability of CEP to reason about time and continously incoming events allows fast decisions about every search request.

The innovative idea of our approach is the new combination of two concepts: CEP as the coordination and agreement technology in a blackboard architecture.

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[2] D. Luckham: The Power of Events. Addison-Wesley, 2002.