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A Multi-Agent System for Collaborative Editing in Mobile Networks and P2P

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Abstract— **In this article, we propose a multi-agent based mobile agent to design an editor that uses the collaborative approach to operational transformed as a method of optimization for the reconciliation of divergent data in mobile and P2P environments. This system allows the location of staff and communication between them in the mobile and P2P environments, and also works in asynchronous mode in the case of disconnection.**

Keywords. Multi-agent system, mobile agents, transformed operational (OT), reconciliation algorithm, mobile network and P2P.

I. INTRODUCTION (HEADING 1)

Reconciliation of divergent data is one of the critical problems of mobile computing [1], there are many synchronizers and merge tools that address this problem, but no criteria for the correction of a synchronization process exists. In the client / server network, a lot of solutions are proposed for the reconciliations copies synchronously and asynchronously, since the algorithm runs in the server, then all changes are sent to the site server.

The transaction is executed without problems. Among editor collaborative client / server, there are CVS (Concurrent Versions System) which management system are free versions.

However, systems Peer to Peer (P2P) systems are distributed in which the user plays both the role of client and server. They make a completely decentralized approach to sharing objects in these systems the consistency of the copies is not insured at all, in that if a copy is modified, this change is not propagated to others (all copies).

In P2P networks, there are systems that allow only reading as Gnutella [2] and Kazaa [3], and others where updates are partially taken into account in the way that they are propagated to the origins of sites nearby sites such as Freenet [4], in P-Grid [5] updates are performed by an algorithm that provides probabilistic guarantees for consistency of copies.

To develop applications, taking into account the needs and problems related to the contexts of mobile networks and P2P, it is necessary to rely on appropriate software technologies. The main needs to be taken into account, when developing the location of resources, the organization of distributed computing, and the dependability and security. The multi-agent system presents itself as a software tool best suited for this kind of solutions.

II. EDITOR COLLABORATIVE

An editor collaborative is a system that allows multiple users to edit an object simultaneously (which can be text and / or graphic). Such a system is a means to establish collaborations in order to achieve a common task.

Each site has a copy of the shared object that can change at will, and then the changes are propagated to be executed on other copies.

To incorporate the changes effected in the other sites, editors are using synchronous collaborative approach transformed operational (OT) for serializing concurrent transactions.

Operational transformed the (OT) [6] [7] [8] are in the form of algorithms that transforms operations received from other sites to take account of other transactions that have already changed the status of the object, they use the semantic properties of operations to ensure the convergence of copies and create a history for each copy of the object.

Each transaction must go through four phases: (1) The generation on the site, (2) The dissemination to other sites (3) The receipt by the other sites (4) The execution on these other sites.
An algorithm for the integration of converging copies must meet three conditions:

- Causality: the order of operations is the same on all sites
- The intentions of the user transactions are taken into account competing with the transposition before.

- The convergence of copies: if two users change their copies in parallel, the system must ensure that copies will eventually converge so that all changes are taken into account, i.e. that all copies must be identical.

The histories of the various copies are not identical but they are equivalent since the execution order of concurrent operations may be different.

The operational transformation (OT) has the following advantages: (1) supports collaborative work without constraints, no total order on the operations and the sites can share their modifications in any order. (2) Allows the

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processing operations to execute in an arbitrary order, even if the source it does not switch. (3) Provides a state of convergence without loss of updates.

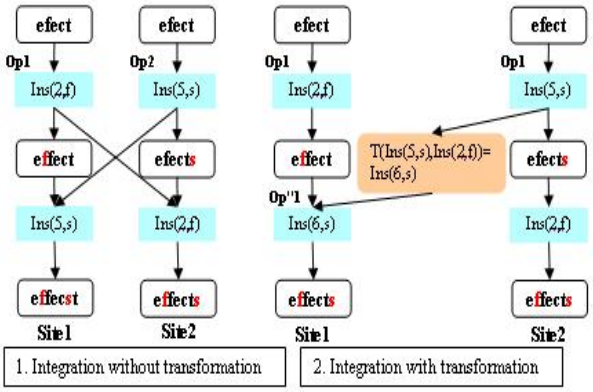

Figure 1. Integration of two concurrent operations [7]

III. MULTI AGENTS SYSTEM

An agent [9] [10] [11] [13] is a software entity, autonomous, capable of acting on itself in its environment, communicate with other agents to exchange information, to improve their behavior and consequently improve the environment.

A multi-agent system [11] [14] is a system which has an autonomous agents acting in parallel to meet a goal or a function of satisfaction and also has agents communicating in their environment. It can solve complex problems by dividing to its latest problems, which can also be divided again to get to simple problems easy to solve.

Our system uses a hybrid multi agent system, which consists of static and mobile agents. A mobile agent [12] is an autonomous entity capable of communicating, with partial knowledge of its environment, and an ability to execute its own, it acts on behalf of a third part (another agent, user) that is not necessarily connected to it, reacts and interacts with other agents. It can move from one site to another running to access data or resources, it moves with its code and its own data, but also with its stage of implementation.

IV. CONTRIBUTIONS

We propose an architecture of a multi-agent system based on adaptive mobile agents deployed in peer to peer networks, the agent is able to reconfigure dynamically so as to adapt to changes in its execution.

Maintaining the consistency of documents edited in a peer to peer network is another problem, because there is no specified server to send all modified versions of a document to perform reconciliation algorithm, each network node is both a client and server at the same time, the most frequent disconnection of the nodes are another issue.

To resolve this problem, we propose that each node would have an autonomous agent able to implement adaptable algorithms reconciliation of data on the one hand, and ensures communication and cooperation between the various networks in the other hand. Each agent has a list of neighbors to maintain the dynamic changes of network.

Therefore, our solution is based on the following:

• The creation of a collaborative editor dedicated to mobile devices (PDA, cell phone).

• The design of a multi-agent architecture based on an adaptable mobile agent to overcome the problems of implementing algorithms reconciliations in peer to peer networks, and to reduce the network load.

• The implementation of a mobile agent model adaptable to ensure support for the execution of applications in embedded environments.

Figure 2. General architecture of the working environment

We will use a heterogeneous network composed of connected P2P network with a wireless mobile network, this architecture allows to show how multi-agent systems make networks physically heterogeneous networks logically consistent.

In collaborative editors that run in client / server algorithms reconciliations are performed on the user site. It acts as a middleware to synchronize for each user who wants to integrate the operations of other users.

In our solution, each user is assisted by an autonomous agent able to perform the reconciliation algorithm [6] and can detect their neighbors (other agents) and integrating local and remote operations provided by a mobile agent that visits regularly sites with user transactions in other sites, the data exchange is done inside the node, therefore, the network load will decrease.

This solution creates a uniform execution environment for collaborative editors on eliminating the concept of single server for processing reconciliation copies.

V. ORGANIZATION AGENT

Our system is based on the AGR (Agent Group Role) [18], [19] which aims at providing the minimum concepts to describe organizations, an agent member is inscribed in a set of groups to which it may play roles, describes the role, an agent plays in a group, this role is an abstract representation of a function, service or identification of an agent within a group. One officer is designated as an active communicating entity

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which plays roles in groups. Groups are sets of atomic aggregation of agents; each agent is part of one or more groups.

The reconciliation algorithm [6] used by the agents is based on replication and processing operations, allows simultaneous access to data and automatic restoration of data consistency. A causal minimum between operations is implemented through a relationship of a dependence based upon the semantics of object collaboration. This algorithm allows a variable number of sites during the working sessions, and enables deployment in a peer-to-peer.

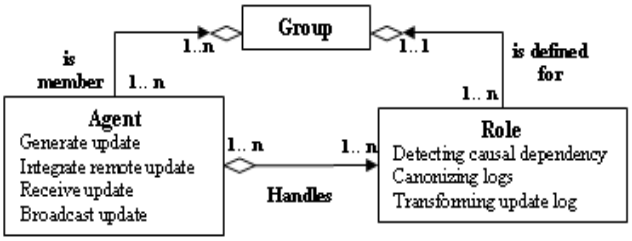

Figure 3. Conception of our system by the AGR model.

An agent can generate local updates, and integrate remote updates applied by other groups. Each agent has the ability to receive and distribute the operations.

The roles within the system offer officers such as the detection of causal dependency, the canonization of local operations in the log files, and processing of updates log between staff groups.

A. Functioning principles

Mobile devices are widely used today, their forces are the availability, portability, easy connection anytime and anywhere, for these benefits application side, this is blocked on a memory address low, and a very small ability to calculate. To overcome this problem, we have adopted mobile agent technology; it allows attending a treatment that goes in the mobile device.

In our case, we use a mobile agent to assist editing an XML document, for we can not perform reconciliations algorithms in mobile devices because of the above reasons, the agent sends a copy of document to the mobile device and recovers it after its modification by the user, and then it executes the algorithm in a host machine.

The operations of local modifications of the document are made at the customer site and recorded in log files, but the operations are performed remotely by a mobile agent who periodically visits the sites of the users who use the same document, and implement distant operations based on their experience certificates of other sites visited, for example, the mobile agent moves from site1 to site2 with the operations of local transformations site1 encapsulate in its execution, then executes the algorithm on two transformations applied in the site1 and site2, the result will be used by the mobile agent to the next site 3 for example.

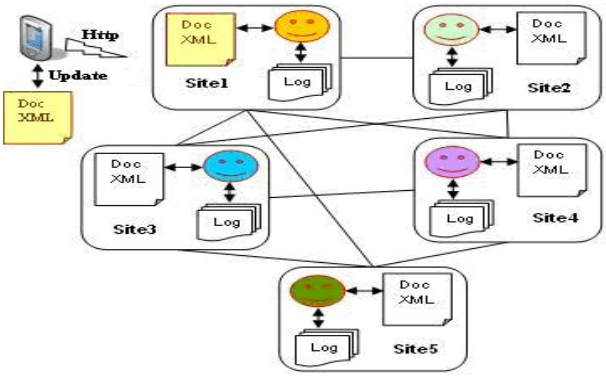

Figure 4. Architecture of P2P-based agents

The last site visited by the mobile agent will have the final change, the mobile agent is re-reversing path is provided at each site the final version of the document on using the results of the transformations of all visited sites.

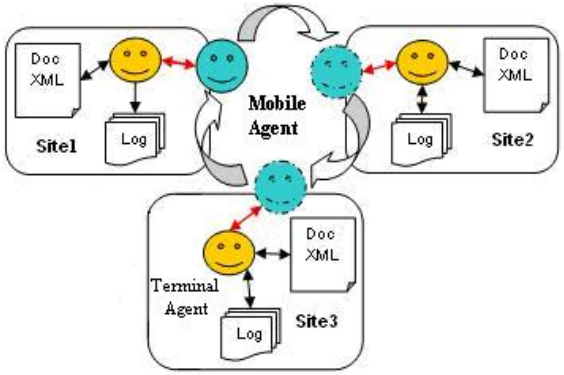

Figure 5. Functional architecture of a multi-agent system based on mobile agent

VI. RELATED WORKS

Wiki [20] [21] is a centralized system for managing website content that makes web pages and also freely editable by all visitors allowed, but existing semantic wikis are centralized systems, they go wrong at , do not tolerate failures and do not work out. These problems are solved by the wikis on peer-to-peer.

Wooki [23] is a wiki built in a unstructured peer-to-peer, propagation of updates between peers is done through an epidemic of probability distribution, and accumulation of the fusion updates to date, under the control of WOOT (Without Operational Transformation) [24] algorithm to maintain consistency.

SWooki (Wiki semantic P2P network and optimistic replication) [22] It is a system composed of a distributed network of servers semantic wikis autonomous in this network, each node hosts a copy of wiki pages and a base of knowledge, servers play the same role and provide the same services.

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DistriWiki [25] provides a peer-to-peer wiki architecture, with nodes that communicate each node represents a set of wiki pages stored on a user's computer.

Bayou [26] is a data management system for collaborative applications in a mobile environment. A copy of the shared object is on each server applications interact with this copy through a programming interface Bayou API, which allows the user to perform the operations of reading and writing the copy.

IceCube [27] is a generic reconciliation system that is running a mix of concurrent updates.

VII. CONCLUSION

Our objective is to propose a generic design model for collaborative editor in mobile and P2P environments, based on the use of agent technology to control the complexity of the development, deployment and maintenance of distributed applications suitable for heterogeneous networks. Model also allows the editing of documents on mobile devices (PDA, Cellular phone,..).

It also hopes to find some agreement between the agent technology and algorithms reconciliations to overcome the shortcomings of P2P environments, and to assist the treatment of documents in mobile devices.

Currently we are working on implementing this model, we chose a multi-agent platform and a distributed algorithm for reconciliation of data in P2P networks [6].

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