Planning Requirements for Hierarchical Coalitions in Disaster Domains

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Abstract: Coalitions are organisations whose members combine abilities and knowledge to carry out mutual purposes. Rather than to be composed by a team of equals, coalitions generally require a hierarchical structure of command and control where agents take different kinds of planning decisions at each level. This work analyses the use of a constraint-based ontology as a way of supporting the coalition activities, highlighting the requirements related to collaboration and user control. The practical use of this approach is exemplified via demo applications in disaster relief scenarios.

How to Support Coalitions?

Customised agents can be deployed to support specific activities carried out by different members of a coalition.

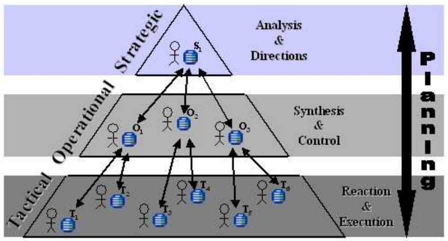

Fig.1 *Abstract idea of a three-level hierarchical coalition, where each join user is assisted by an agent*

The set of agents can form a hierarchical coalition support system (Fig.1), which needs to consider the requirements of collaborative planning and user control on agents. This last requirement is specially important where decisions can create situations of risk for human lives, as during disaster relief operations.

Agent-Human Teamwork

The implementation of teamwork concepts enables that agents in fact play as members of a collaborative group. Important lessons of teamwork theories are:

- Agents have to establish commitments on the performance of activities, reporting their status (failure, completion and progress);
- Agents also have to support the activities of others participant agents;

However early research on teamwork was mainly focused on agent-agent interaction. A agent-human teamwork will bring additional threads:

- Agent inaction while waiting for human response can lead to potential miscoordination with others coalition members;
- Local decisions taken by a member can seem appropriate to her/him, however unacceptable to the team;
- Agents will deal with knowledge that needs to be properly delivered to human users.

<I-N-C-A> Ontology

We are using <I-N-C-A> to design a hierarchical coalition support system based on the ideas of agent-human teamworks.

<I-N-C-A> (Issues-Nodes-Constraints-annotations) is a general-purpose ontology that can be used to represent a plan as a set of constraints on the space of all possible options in the application domain. Each plan is considered to be made up of a set of issues and nodes. **Issues** represent potential requirements that need to be considered at sometime. **Nodes** represent activities in the planning process that may have parts called sub-nodes making up a hierarchical description of plans. Nodes are related by a set of detailed **constraints** of several kinds such as temporal, sequential, priority and so on. **Annotations** add complementary human-centric and rational information to plans and their components.

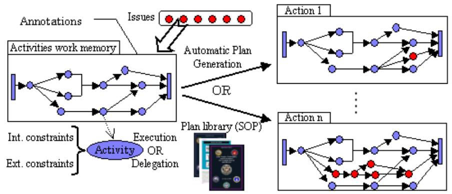

Fig.2 *Planning process overview*

An issue-oriented planning (Fig.2) creates actions in a dual cycle: respecting the current constraints and propagating the new constraints. Important notes on this process are:

- Each delegation involves a commitment to perform the activity;
- <I-N-C-A> defines messages to information sharing and reports;
- Int. constraints are set by users and restrict the agent operation;
- Ext. constraints cannot be changed by users and:
  - Restrict the user options, avoiding interferences between activities
  - Enables an initial understanding about others activities
  - Support a better information sharing

Application and Scenarios

The ideas summarised in this work are being implemented via I-X Process Panels (Fig. 3).

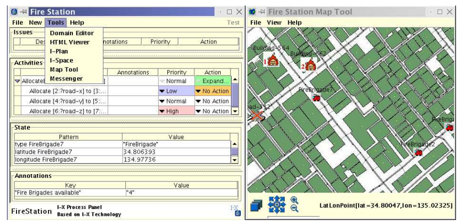

Fig.3 *I-X Process Panel and associated tools*

We are setting the I-P^2 to support coalitions in three different test domains:

- Urban domain: the system is being integrated with a simulator that generates earthquake events in a Japanese region;
- Military search and rescue domain: based on soldiers' search and rescue missions in hostile environments (Fig. 3);
- Indoor domains: supports the action of firemen into large buildings.