Magenta Logistics i-Scheduler

Jonathan Himoff
CEO of Magenta Technology
33 Glasshouse Street, London W1B 5DG
Telephone number: +44 207 725 4960

jon.himoff@magenta-technology.com

ABSTRACT
The following demonstration will provide an overview of the key functionality and capabilities of Magenta's Logistics i-Scheduler – a multi-agent software tool for real time scheduling.

Categories and Subject Descriptors
H.4.2 [**Information Systems Applications**]: Types of Systems - *decisions support, logistics.*

General Terms
Management, Measurement, Design, Economics, Performance.

Keywords
Agents, multi-agent system, Ontology, decision making support, Logistics, Supply Chain Management.

1. INTRODUCTION
Based on the multi-agent and semantic web technologies, Logistics i-Scheduler is a software intelligent scheduler capable of matching resources to demands in complex environments characterized by high level of volatility, difficult trade-offs, business interoperability, collaboration across teams/companies and frequent occurrence of unpredictable disruptive events.

2. TARGET AUDIENCE
The demonstration session of Logistics i-Scheduler is intended for:
- Companies involved into multi-agent software development who plan to commercialize their products and technology;
- System integrators;
- Companies that work in conditions of high uncertainty and that would like to get some tool to manage the natural complexity of their business environment.

3. DEMONSTRATED FEATURES

3.1 Prioritization
All orders selected for scheduling are prioritized by Company Agent. Logistics i-Scheduler can begin planning with orders which first entered the system or with most constrained ones, or prioritize according to orders agent preferences:

- Larger orders first
- Most distant points first
- Known cross-docks first
- Primary moves first

3.2 Incremental Planning
Logistics i-Scheduler reacts to the occurrence of events such as the arrival of a new order, a change/cancellation of an order, availability of a new resource, a delay, or a failure, in real time, by attempting to re-schedule previous allocations to accommodate the new event. This means that the scheduling is event-driven and therefore incremental.

3.3 "Ripple Effect"
The idea of the method is not to reschedule the whole plan from scratch when some events occur but to throw changes into the plan during the system functioning. It is obvious that in some cases each new event might not require changes of plans at all and result only in minimal changes in schedules that can be made in seconds. It was suggested to consider this process as a ripple process when changes spread from the source of disturbance and this allows recreating and observing the "ripple effect".

3.4 Constraint Stressing
Each element of the network has its own hard constraints and soft preferences. During schedule generation there are situations when availability window constraint stressing (namely, extending the allowed operation time window) allows significant improvement of the schedule. At the same time it might solve the problem of consolidation, backhaul and idle time. If time window constraint is defined as a soft one it can be stressed.

3.5 Manual Re-Work of The Schedule
Logistics i-Scheduler provides a facility for users to change a computer generated schedule. It incorporates effective tools for manual modifications of schedules and for the evaluation of decisions made by operators.

3.6 Visualization

The schedule generated by the system can be viewed in different formats: Gantt chart that shows resources' activities along timeline; Map that gives geographical representation of the network including locations and directions of trucks' movements; Time table that contains printable version of the schedule.

3.7 Agent Log

Agents' work is organized as "virtual market" where demand agents buy services from resources and resource sell their services to demands. Agents are able to react to events, make decisions, negotiate with other agents, close deals and cancel them depending on how they can achieve their goals. These negotiations are carried out in accordance with rules of real market simulated in the developed system. All agents' activities and negotiations are written down into Agent log. This allows the user to track the whole process of decision making and understand the logic behind agents' decisions.

4. INFRASTRUCTURE REQUIREMENTS

For the system demonstration a table, chair, access to the Internet and electric power supply are required.

5. STRENGTH AND WEAKNESSES

5.1 Strengths

- Event driven planning/replanning
- Balance across multiple characteristics of the network in parallel choosing the best direction from domain knowledge:
    - Vehicle/trip/fleet constraints
    - Vehicle/trip/fleet KPIs
- Ability to stress constraints and balance the level of stressing against KPIs
- User can define flexible KPIs in ontology: cost, profit, risks
- Incrementally plan new orders into the schedule
- Each new event can both fit into open slots or cause small changes to already created schedule to improve KPIs (ripple effect)
- Small event can cause large changes if necessary (positive catastrophes)
- Operators' decision logic is captured in ontology to increase efficiency of scheduling
- Mixing own and third party resources
- Customizing resources and customer preferences

5.2 Weaknesses

- No secondary logistics support

- No groups of agents
- No commit time
- Only order agents are proactive

6. RELATED PROJECTS

6.1 Confectionary Producer

Magenta Logistics i-Scheduler based on the multi-agent technology with software agents assigned to business resources of the network and arriving demands (transportation instructions), used the agents' capability to negotiate, analyze the situation and resolve conflicts to solve problems of this specific transportation network with all special requirements of its own, long-gained experience of planning and execution.

6.2 Car Rental Company

Logistics i-Scheduler was customized to provide the Client with the possibility to plan cars across multiple zones and compare between many rental locations and single rental location scenarios.

6.3 Cement Distributor

Magenta Technology has developed a multi-agent scheduling tool for a large distributor of cement. The enhanced functionality of Logistics i-Scheduler provided the ability to validate trucks availability, check the inventory and validate the product availability in relevant terminals before accepting new orders; offer allocation options with alternative time windows, if necessary.

7. DRAWBACKS TO BE IMPROVED

7.1 Proactivity of Agents

In the current version of the system only agents of orders are pro-active and can trigger schedule revision if they are not satisfied and see opportunities to improve the schedule. In the future it is planned to make all agent of all objects of the network proactive.

7.2 Group of Agents

In the future it is planned to implement the concept of group. Currently each agent negotiates with all other agents. In order to reduce time of negotiations one agent can represent a group of similar objects.

7.3 Commit Time

Since Logistics i-Scheduler allocates resources continuously following Forecast-Plan-Commit-Execute cycle, when the process approaches commit time it becomes more and more difficult to break matches because of the lack of time for consequent re-scheduling; special methods are employed to solve this problem. Currently agents search for all options regardless any time limits. When commit time is defined, agents will flexibly find the balance between risk of unfeasible schedule and value of made decision.