

Electric Elves Agent Technology for Supporting Human Organizations

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Detailed Reference

- *Electric Elves - Agent Technology for Supporting Human Organizations*
- By H. Chalupsky, Y. Gil, C. Knoblick, K. Lerman, J. Oh, D. Pynadath, T. Russ and M. Tambe
- In AI Magazine, V 32, No. 2, pp. 11-24.

Outline

- Introduction
- The Electric Elves Project
- Underlying Agent Technologies
- Electric Elves Architecture
- Discussion
- Summary

Introduction

Mixed - 15 agent team:

- Agent proxies for 9 researchers (called "Friday"s)
 - Interface via PDA with GPS, WAP phones
- Agent proxy for a project assistant
- Information agents, schedulers, matchers...

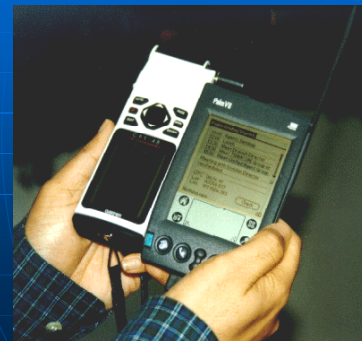
Agent proxies run 24/7

- **First deployment in a real organization**
- Coordinate meetings (reschedule if delays, cancel)
- Decide on presenters at research meetings (via auctions)
- Track people (www.isi.edu/teamcore/info.html)
- Order meals

Research Challenges

- Adjustable autonomy [Teamcore]
- Data source verification and re-induction [Ariadne]
- Hybrid logic and topic-based matching [Loom]
- Matchmaking for complex agents [Expect]

Handheld Devices Used



Results for Auctioning Research Presentation Slot

Meeting Date	Number of bids	Highest Bid	Autonomous Decision?
July 6	7	Scerri <1,1>	No
July 20	9	Scerri <1,1>	Yes
July 27	7	Kulkarni <0,1>	Yes
Aug. 03	8	Nair <1,1>	Yes
Aug. 31	4	Tambe <1,1>	Yes
Sept. 19	6	Visitor <-, ->	No
Oct. 31	7	Tambe <1,1>	Yes
Nov. 21	7	Nair <1,1>	Yes

Underlying Technologies

- Interaction with human user – Friday
- Flexible assignment of tasks – MDP decision theoretic policy selection
- Adjustable autonomy
- Reliable access to information – wrappers (ARIADNE)
- Knowledge from unstructured sources – matchmaking (PowerLoom)
- Coordination of component agents – TEAMCORE, STEAM

STEAM Teamwork Model

Teamcore proxies general teamwork model "STEAM"

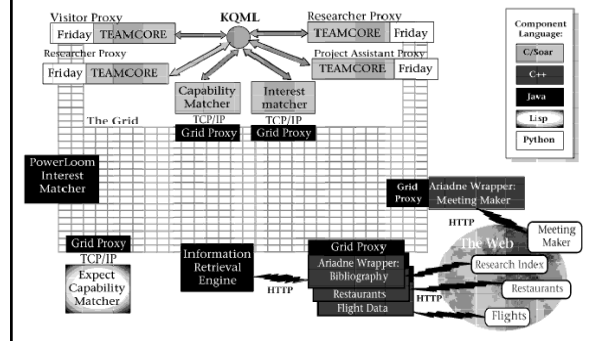
- Domain independent rules of teamwork
 - Explicitly outline team member's responsibility in teamwork
- Used in helicopter combat simulations, RoboCup, ...
- Proxies can team up heterogeneous agents

Teamcore: Basis of team-oriented programming (TOP)

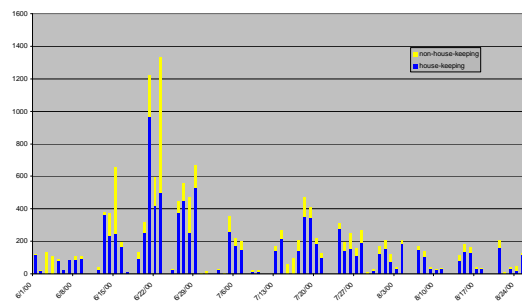
- Three parts: *Team plan hierarchy, organization hierarchy, agents*
- Assign subteams to plans, agents to roles in subteams
- Teamcore proxies automatically execute required coordination

Reduce development cost in building team-based applications

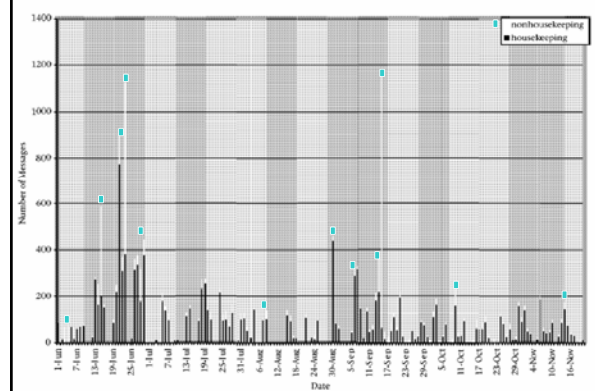
Electric Elves System Architecture



Daily Coordination Messages in the First 3 Months



Messages in 7 Months



Results

- *Dynamic team formation (e.g., via auctions)*
- *Human organization norms: authorities, permissions etc*
- *Scale up complexity, number, and heterogeneity*
- *Rapid incorporation of new agents*
- *Robustness and adaptability of agents*
- *Widespread substitutability of agents*

Conclusion

- Real-world application critical: Provided real data & challenges
- Adjustable autonomy: Fundamental challenge in employing multi-agent systems in real human organizations
- Wireless devices: New agent opportunities & research challenges
- Adaptability: Critical to dealing with a changing environment

Questions

