

Agent-based Systems: Do They Provide a Competitive Advantage?

Onn Shehory

IBM Haifa Research Labs



Organization Portfolio

- IBM is among the 5 largest companies in the world, yearly income more than 80 Billion USD
- IBM is active in virtually any field of computing – hardware, software, services and research
- ~300,000 employees, ~3000 in research worldwide
- Research division goal: create value to IBM, advance its technologies
- International labs: Tokyo, New Delhi, Haifa, Zurich
- Autonomic computing becomes a prominent field of interest – agents are an enabling technology
- Agent research: at T.J. Watson, Haifa, Tokyo
- Haifa Research Lab (HRL): ~350 staff, the largest outside the US
- Major fields: storage systems, microelectronics, optimization and verification, information retrieval, servers, system management, event management



Outline

- What are agent based systems?
- Where are agents useful?
- Application domain: eCommerce
- Application domain: storage networks
- Is there a competitive advantage?
- Conclusion

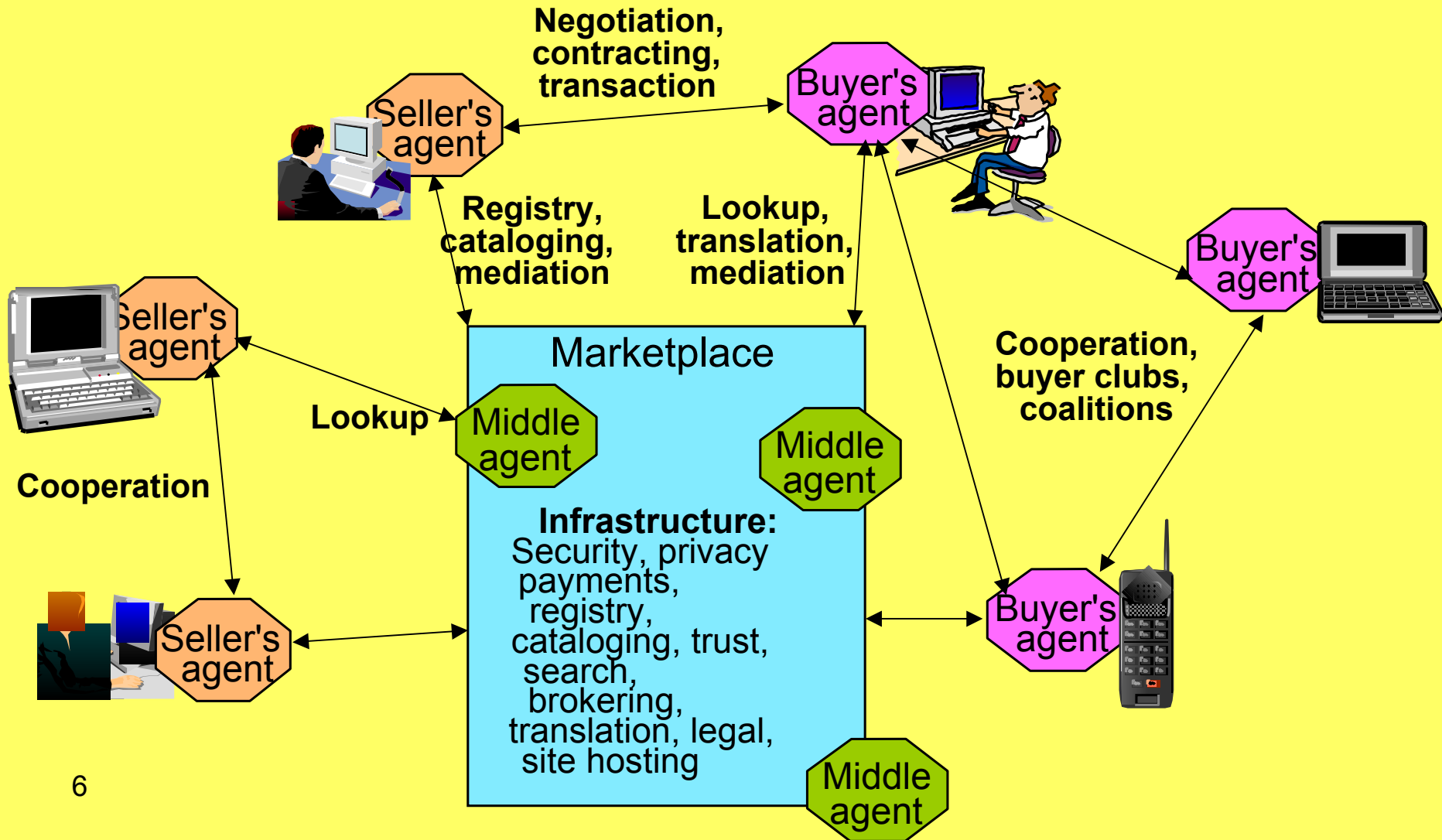
What are agent-based systems?

- Agents are autonomous computer systems
- Usually reside in a distributed environment
- Interact with users and perform tasks on their behalf
- Interact with other agents, collaborate and delegate tasks
- Interact with non-agent computer systems
- Exhibit reactive and proactive (intelligent?) behaviors
- Agent-based systems are designed and implemented using the agent metaphor

What are agents good for?

- Although some believe so, agents are not a solution for everything
- They are good for systems
 - that have multiple components;
 - that are distributed over a network;
 - that exhibit dynamic changes;
 - that handle large quantities of information from multiple heterogeneous sources;
 - that require autonomous behavior

Application domain: eCommerce



eCommerce agents

- Vision – all parties automate trade via agents:
 - Buyer agents, seller agents, middle agents
 - Embedded on servers, desktops, mobile and handheld computers, mobile phones
 - Implementing sophisticated trade, negotiation and collaboration
 - Behaving rationally to maximize gains
 - Expected benefits: more and better deals, reduced transaction costs
- Reality (in industry):
 - Mainly buyer side agents
 - Working mainly on servers, a few on mobile devices
 - Implementing very simple search and trade activity
- What are the reasons for this slow adoption?

eCommerce agent slow adoption

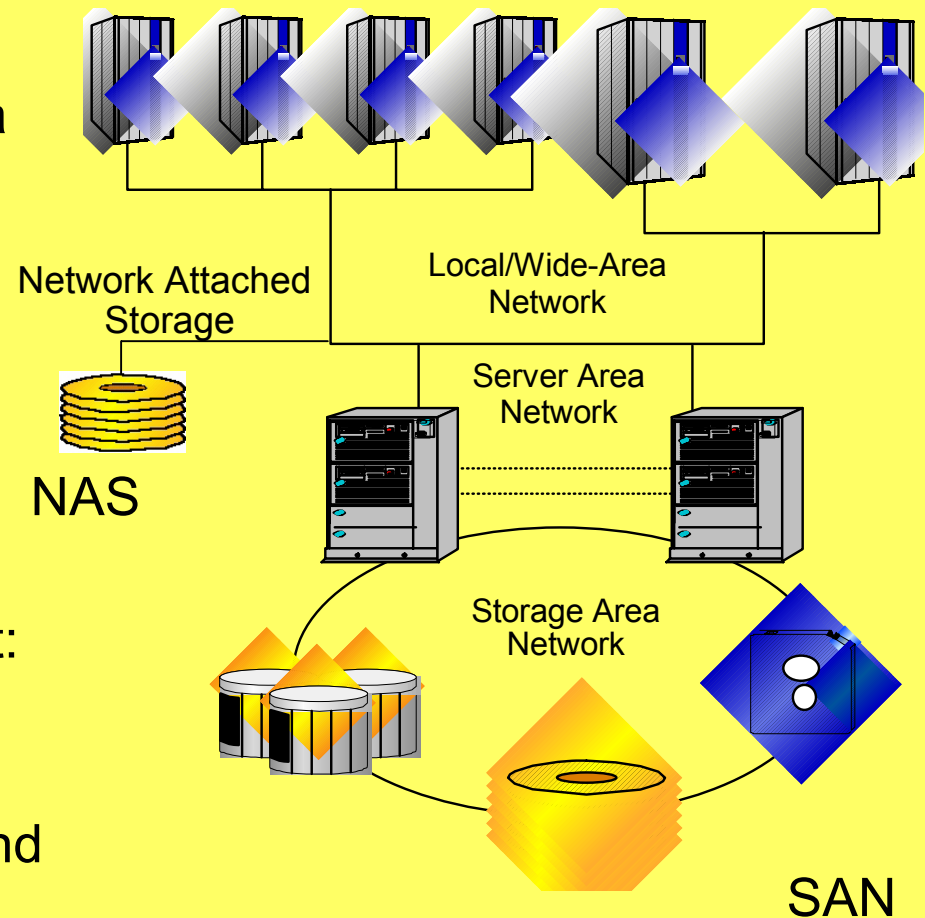
- Are eCommerce agents an inferior technology?
- Unlikely:
 - They promise cost reduction and increased gains
 - They are not too complex to implement or too heavy-weight to run
- So why aren't they adopted?
 - Slowdown in web-based technologies reflects on eCommerce too
 - B2B: still adopting first generation eCommerce – eMarketplace infrastructure. Agents are second generation eCommerce
 - B2C: consumers will not pay for agents, industry too lean in profits, will not give agents away
 - General: agent manufacturer's liability issues – e.g., what happens if an agent performs a bad deal on behalf of a buyer?
 - Cultural/psychological: delegation of tasks to an autonomous software entity – an agent – that makes financial decisions on behalf of the user. Would you let an agent do that for you?

Application domain: Storage networks management

NAS - Network Attached Storage:
storage device attached directly to a TCP/IP based network, accessed using specialized file access/file sharing protocols

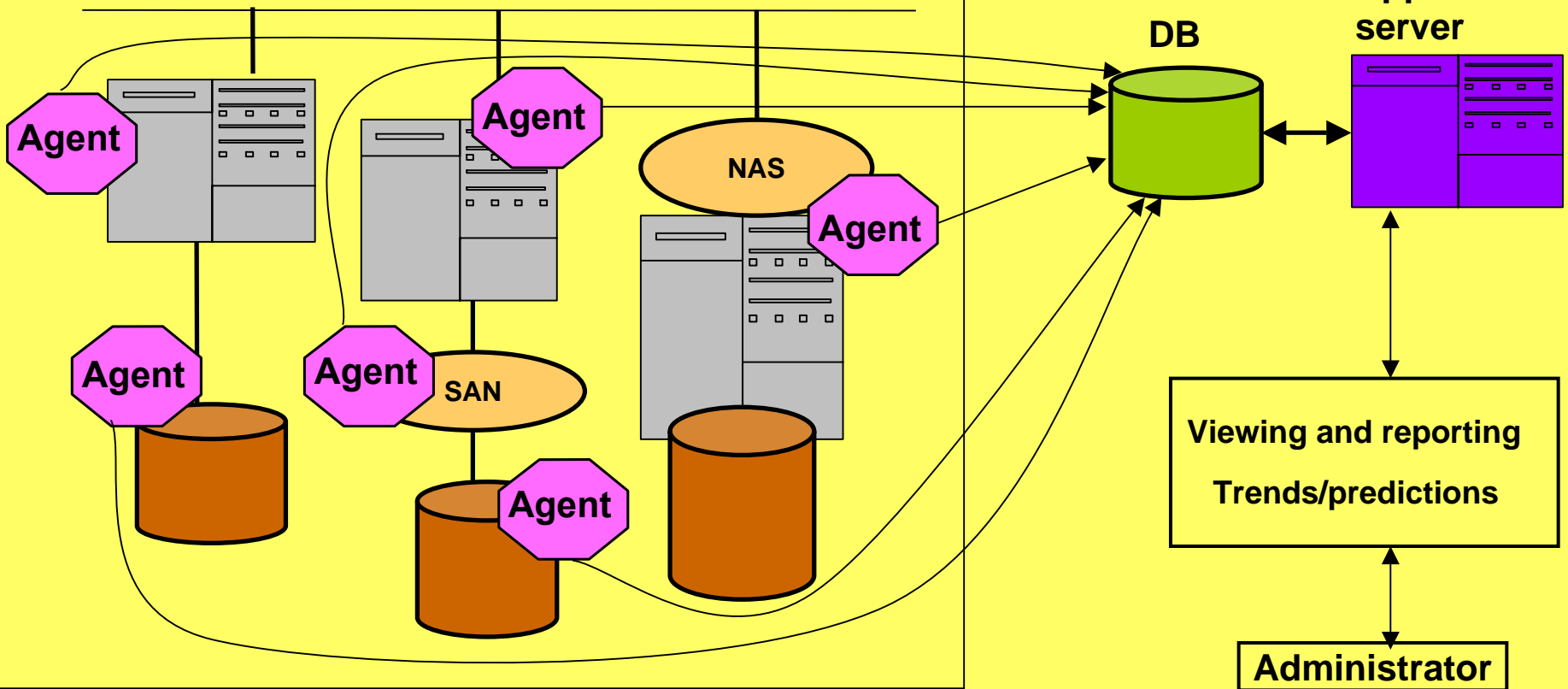
SAN – Storage Area Network:
high-speed network, connects servers and storage systems

SRM - Storage Resource Management:
A system that monitors storage resources (disks, disk arrays, switches, etc.), analyzes the data and reports to administrator



SRM system

Agents collecting information about devices on the managed storage network



SRM agents

- Vision – an agent attached to storage network components:
 - Monitors activity, reports on it and analyzes it
 - Recognizes problems and automatically manages the components to resolve problems
 - Interacts with other component-attached agents for system-wide coherence
- Reality –
 - Virtually any SRM system includes agents! (EMC, HP, Tivoli,...)
 - However, these only monitor and report
 - Analysis and communication with administrators is done via a separate subsystem
 - Automatic problem resolution as well as interaction with others are not performed
- What are the reasons for this wide adoption?

SRM agents wide adoption

- Are SRM agents a superior technology?
- Not yet, there are some obstacles:
 - They are not too simple to implement
 - They should be tailored to component-specific data models
 - They must be very light-weight to run on devices and very efficient to minimize performance overhead
- But SRM agents are used because SRM systems are an appropriate application domain:
 - Multiple heterogeneous components, distributed over a network, dynamically create large amounts of data
- In the near future, most of the obstacles will be removed:
 - SNIA (Storage Networking Industry Association) will finalized CIM and WBEM standards for storage management, hence interoperability will be supported
 - Template agents for handling CIM data gradually become available
- Autonomic problem resolution and interaction not supported

Comparing domains

eCommerce

- Distributed, networked
- Agents attached to users
- Moderate amount of data, dynamically changes
- Open system
- Activity: information gathering, analysis, trade
- Agent may be “fat”
- User centric
- No standard, no tools

SRM

- Distributed, networked
- Agents attached to devices
- Large amount of data, changes rapidly
- Close system
- Activity: data collection and possibly analysis
- Agent must be “thin”
- System centric
- Standard and templates under way

Is there a competitive advantage?

- Not all application domains are appropriate for agents
- Distributed, networked application domains with large amounts of heterogeneous data are more suitable [in line with Navi Radjou, Forrester]
- However, as we have seen, suitable application domains do not promise success:
 - eCommerce agents are slowly adopted
 - SRM agents are widely used
- There are some software development barriers

Software engineering aspects

- Software engineering (SE) methodologies, e.g., UML (Unified Modeling Language)
 - Provide means for analyzing, designing, implementing and testing
 - Reduce development time, increase reliability and maintainability
- Agent technology provides some SE methodologies
- **Question:** do agent-oriented methodologies provide necessary SE properties not available otherwise? If so, to what extent?
- **Answer:** yes – better support for the combination of autonomy , distribution, collaboration and knowledge management
- **Answer:** very limited extent
 - There is no industry-grade agent-oriented methodology
 - Existing agent-oriented methodologies have limited tools, if any
- But, Agent oriented methodologies are improving, covering more aspects, will become industrially applicable

Future application domains

- Network/asset management:
 - Monitoring
 - Problem detection, analysis and prediction
 - Autonomous problem resolution
 - Open networks?
- Physically distributed, loosely coupled systems:
 - Transportation: coordination among cars?
 - Robotic environments: mining, manufacturing
 - Autonomous spacecraft and aircraft
 - Traffic control
 - Mission control
- Support for human teams
 - Mixed human/machine teams (military, emergency)

Conclusion

- Agents can provide a competitive advantage, if:
 - Used for a suitable application domain
 - Distributed heterogeneous networked environments
 - Designed and implemented using software engineering concepts and tools
 - Agent-oriented methodologies get closer to industry
 - Do not face psychological and legal obstacles
 - Alternatively, you may need excellent marketing ...

Thank You!