



(12) **United States Patent**
Cheyer et al.

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- (54) **SOFTWARE-BASED ARCHITECTURE FOR COMMUNICATION AND COOPERATION AMONG DISTRIBUTED ELECTRONIC AGENTS**
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- (*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
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- (52) **U.S. Cl.** **719/317; 709/202; 717/114**
- (58) **Field of Search** **719/317; 709/202, 709/207, 317; 717/114**

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,638,494	A	*	6/1997	Pinard et al.	709/202
5,802,396	A	*	9/1998	Gray	710/20
5,960,404	A	*	9/1999	Chaar et al.	705/11
6,047,053	A		4/2000	Miner et al.	
6,212,649	B1	*	4/2001	Yalowitz et al.	714/31
6,216,173	B1	*	4/2001	Jones et al.	135/77
6,256,771	B1		7/2001	O'Neil et al.	
6,338,081	B1	*	1/2002	Furusawa et al.	709/202
6,411,684	B1		6/2002	Cohn et al.	
6,484,155	B1	*	11/2002	Kiss et al.	706/46
2001/0039562	A1	*	11/2001	Sato	709/202
2003/0167247	A1	*	9/2003	Masuoka	706/46

OTHER PUBLICATIONS

- Cheyer, Adam. "Mechanisms of Cooperation." Oct. 19, 1998.*
- DeVoe, Deborah. "SRI distributed agents promise flexibility." InfoWorld. Dec. 30, 1996.*

- Sycara, Katia et al. "Distributed Intelligent Agents." IEEE. Dec. 1996.*
- Nwana, Hyacinth et al. "Software Agent Technologies". BT Technology Journal. 1996.*
- Busetta, Paolo et al. "The BDIM Agent Toolkit Design." 1997.*
- Mayfield, James et al. "Desiderata for Agent Communication Languages." Mar. 27-29, 1995.*
- Khedro, Taha et al. Concurrent Engineering through Interoperable Software Agents. Aug. 1994.*
- Moran et al. "Multimodal User Interfaces in the Open Agent Architecture." Proceedings of the International Conference on Intelligent User Interfaces. 6-9/1997.*
- Martin, David et al. "The Open Agent Architecture: A Framework for Building Distributed Software Systems." Oct. 19, 1998.*
- Wilkins, David et al. "Multiagent Planning Architecture." SRI International. Dec. 8, 1997.*
- Moran, Douglas B. and Cheyer, Adam J., "Intelligent Agent-based User Interfaces", Article Intelligence center, SRI International.
- Martin, David L., Cheyer, Adam J. and Moran, Douglas B., "Building Distributed Software Systems with the Open Agent Architecture".

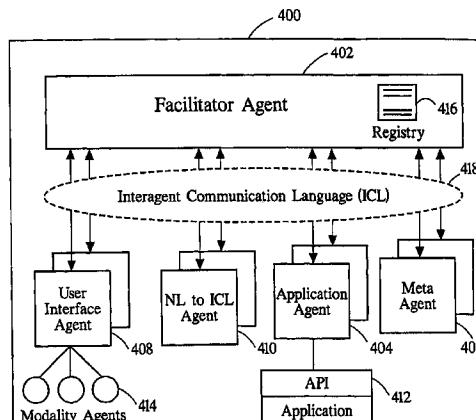
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(57) **ABSTRACT**

A highly flexible, software-based architecture is disclosed for constructing distributed systems. The architecture supports cooperative task completion by flexible and autonomous electronic agents. One or more facilitators are used to broker communication and cooperation among the agents. The architecture provides for the construction of arbitrarily complex goals by users and service-requesting agents. Additional features include agent-based provisioning of multi modal interfaces, including natural language.

89 Claims, 16 Drawing Sheets



OTHER PUBLICATIONS

Cohen, Philip R. and Cheyer, Adam, SRI International, Wang, Michelle, Stanford University, BAEG, Soon Cheol, ETRI, "An Open Agent Architecture".

Julia, Luc E. and Cheyer, Adam J., SRI International "Cooperative Agents and Recognition Systems (CARS) for Drivers and Passengers".

Moran, Douglas B., Cheyer, Adam J., Julia, Luc E., Martin, David L., SRI International, and Park, Sangkyu, Electronics and Telecommunications Research Institute, "Multimodal User Interfaces in the Open Agent Architecture".

Cheyer, Adam and Lulia, Luc, SRI International "Multimodal Maps: An Agent-based Approach".

Cutkosky, Mark R., Engelmores, Robert S., Fikes, Richard E., Genesereth, Michael R., Gruber, Thomas R., Stanford University, Mark, William, Lockheed Palo Alto Research Labs, Tenenbaum, Jay M., Weber, Jay C., Enterprise Integration Technologies, "An Experiment in Integrating Concurrent Engineering Systems".

Martin, David L., Cheyer, Adam, SRI International, LEE, Gowang-Lo, ETRI, "Development Tools for the Open Agent Architecture", The Practical Application of Intelligent Agents and Multi-Agent Technology (PAAM96), London, Apr. 1996.

Cheyer, Adam, Martin, David and Moran, Douglas, "The Open Agent architecture™", SRI International, AI Center. Dejima, Inc., <http://www.dejima.com/>.

Cohen, Philip R, Cheyer, Adam, Wang, Michelle, Stanford University, BAEG, Soon Cheol ETRI: "An Open Agent Architecture," AAAI Spring Symposium, pp. 1-8, Mar. 1994.

Martin, David; Oohama, Hiroki; Moran, Douglas; Cheyer, Adam; "Information Brokering in an Agent Architecture," Proceeding of the 2nd International Conference on Practical Application of Intelligent Agents & Multi-Agent Technology, London, Apr. 1997.

* cited by examiner

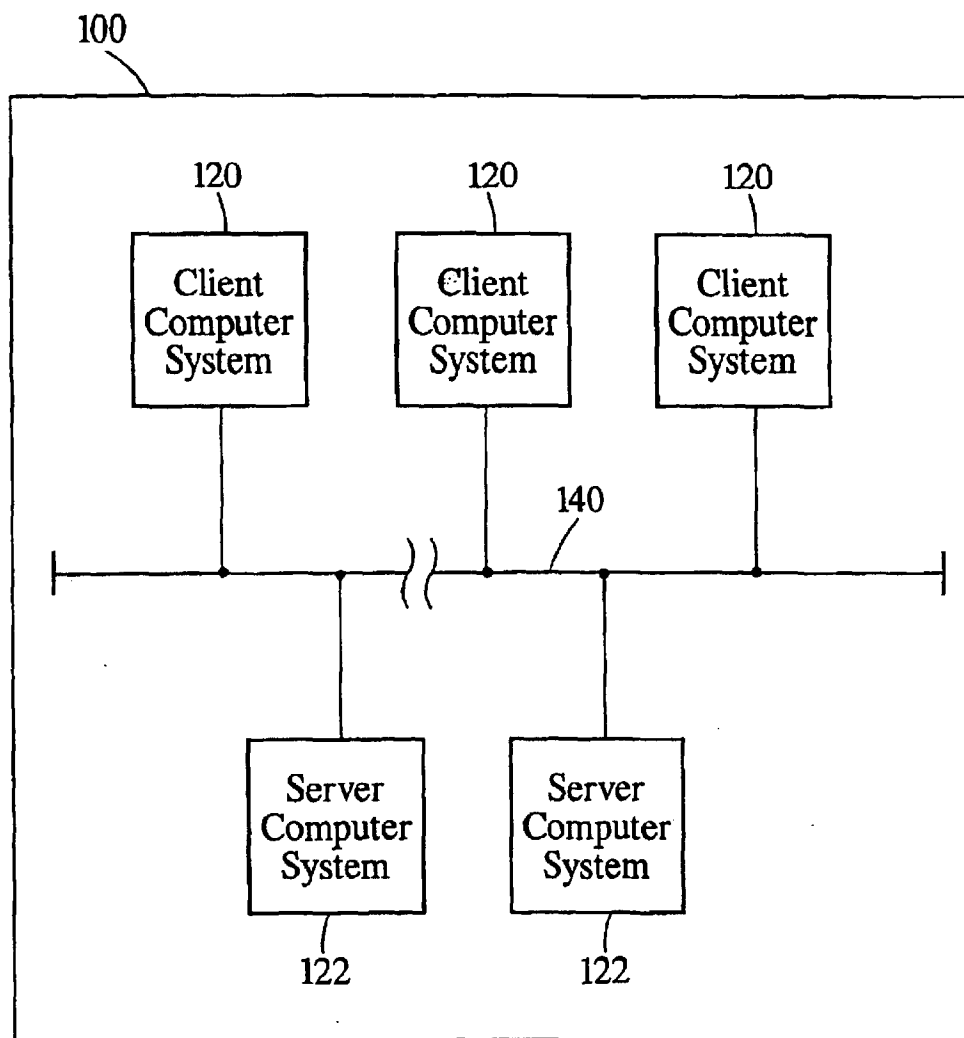


Fig. 1
(Prior Art)

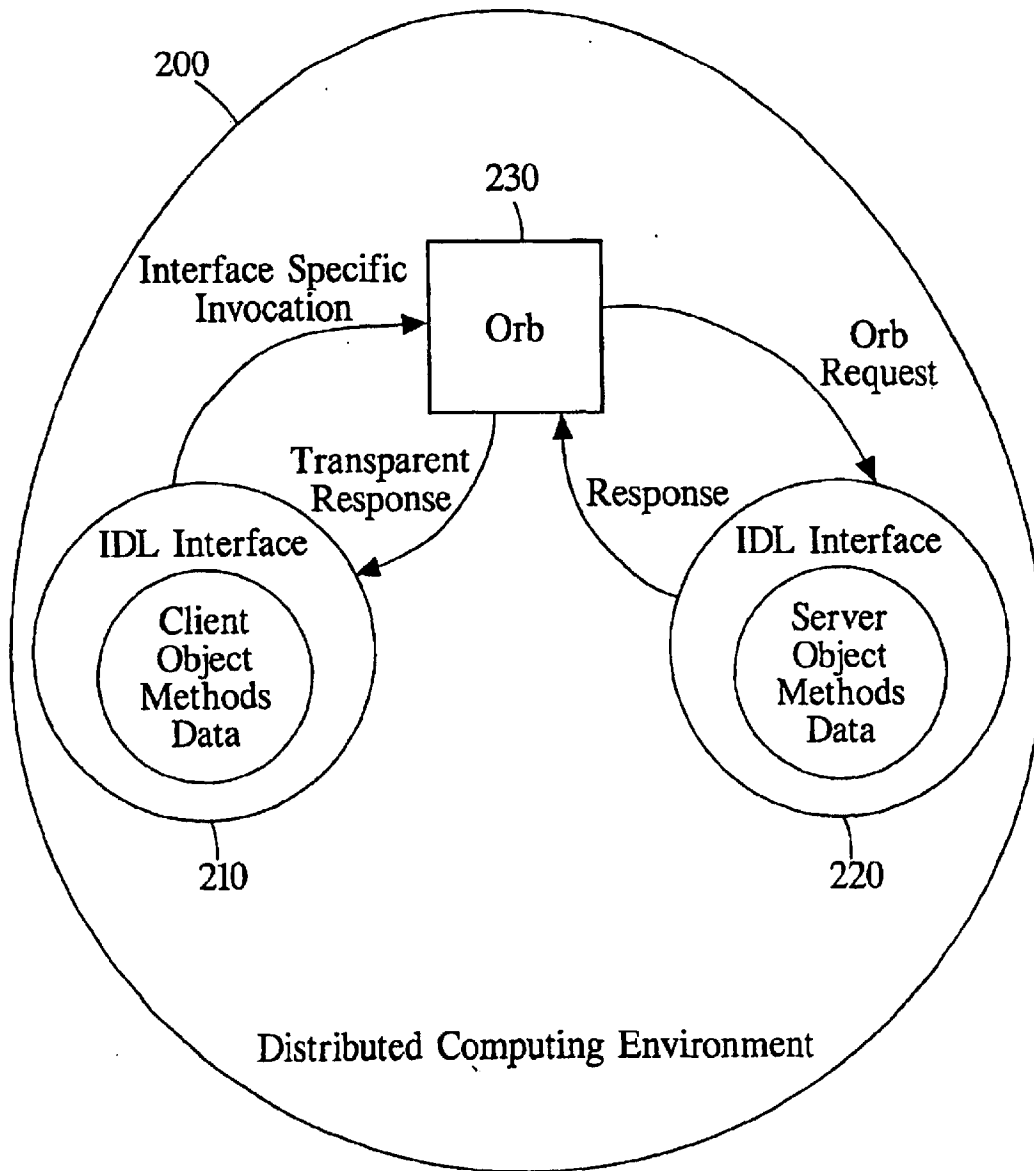


Fig. 2
(Prior Art)

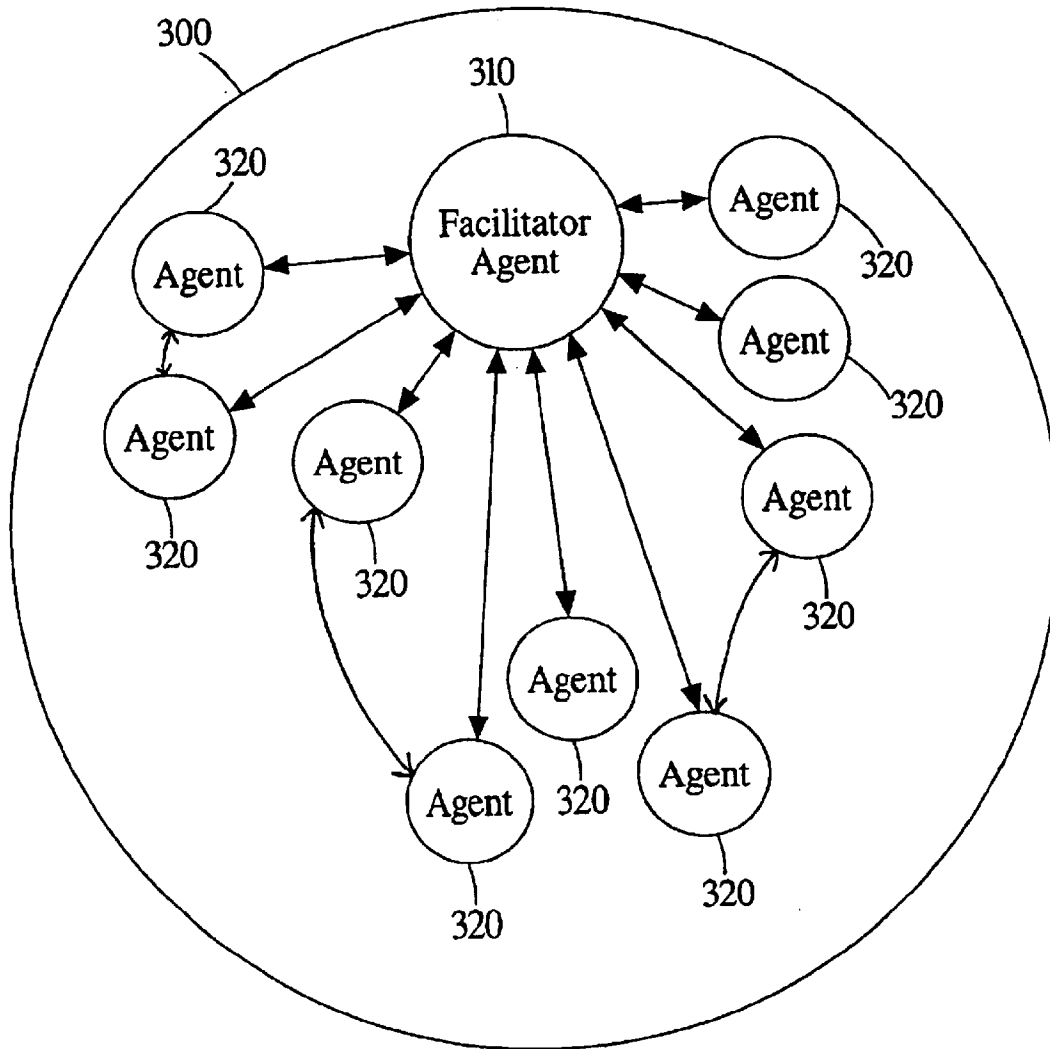


Fig. 3

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