

The Design and Implementation of Intelligent Home Service Agent Federation Architecture

蘇培欣、楊豐兆、李德治

E-mail: 9222699@mail.dyu.edu.tw

ABSTRACT

The objective of this thesis is to construct an intelligent home service agent federation, the IH-SAF, using the cooperation distributed problem solving (CDPS) plan and the multi-agent architecture. Various types of service can be shared among federation members, and deployed the specific service from remote site to client site through OSGi framework. Then the service agent, who carries the specific service, executes the service dynamically by moving it to the client site. In the IH-SAF architecture, we design the service agent federation hierarchy with the pattern of agent community, and deploy the services from the federation's service providers through the OSGi framework. We also implement the service auto discovery and auto registry ability using Jini technology to execute the service by the movement of service agent. For the purpose of making the design, deployment, and implementation more flexible and modular, we use the unified modeling language (UML) to build various models for IH-SAF. These models include the use case diagram from the user's view, and the other diagrams from the structure view, the behavior view, the implement view, and the deployment view. Finally, we take the home security service agent example to explain how the service agent federation accomplishes the home security service tasks through the CDPS plan and the federation members' interaction. The development of IH-SAF is based on the need of embedded system. It has the characters of micro system and can start or remove the services dynamically to save the device resource when this system still running. As the result, IH-SAF is suitable for embedding into the small devices as an information appliance service. Then the home services can connect and integrate to the home gateway for interoperating among the other services and construct the ubiquitous management environment.

Keywords : OSGi ; CDPS ; Intelligent Agent ; Intelligent Home Service Agent Federation ; Home Networking

Table of Contents

封面內頁 簽名頁 授權書.....	iii	中文摘要.....	v	英文摘要.....	v
要 錄.....	vii	誌謝.....	ix	目錄.....	x
目錄.....	xiv	表目錄.....	xvi	第一章 緒論.....	1
研究背景.....	1	1.2 研究動機.....	3	1.3 研究目的.....	3
研究問題.....	5	1.5 研究限制與定義.....	6	1.6 論文架構.....	8
第二章 相關文獻研究探討.....	9	2.1 居家網路介紹.....	9	2.1.1 居家網路技術.....	10
術.....	10	2.1.2 國內外相關研究現況.....	16	2.1.3 居家網路目前發展狀況與瓶頸.....	21
類.....	21	2.2 研究核心技術.....	22	2.2.1 Jini.....	23
道 (Open Service Gateway initiative, OSGi).....	25	2.2.2 開放式服務閘道 (Open Service Gateway initiative, OSGi).....	25	2.2.3 智慧型代理者 (Intelligent Agent).....	28
Agent).....	28	2.2.4 代理者社群 (Agent Society).....	31	2.2.5 黑板控制機制.....	37
多重性代理者架構.....	38	2.2.7 智慧型環境.....	41	2.2.8 以元件為基礎之框架的代理者環境 (The component-based framework as an agent environment).....	43
究.....	46	3.1 智慧型代理者模型設計.....	48	3.1.1 使用者觀點.....	49
點 (Behavior Model View).....	55	3.1.3 結構觀點 (Structure Model View).....	58	3.1.4 實作觀點 (Implementation Model View).....	59
點 (Environment Model View).....	61	3.2 一般性服務代理者架構規劃 (Planning the General Service Agent Federation Architecture).....	62	3.2.1 服務代理者內部架構 (Inner the General Service Agent).....	64
Architecture).....	66	3.2.2 服務代理者社群架構 (Service Agent Federation Architecture).....	66	3.2.3 服務代理者協商 (Service Agent Negotiation Protocol).....	72
第四章 居家網路服務代理者社群之實作 - Jini-based IH-SAF.....	75	4.1 以Jini為基礎的服務代理者組成元件.....	75	4.1.1 環境領導代理者 (Environment Leader Agent).....	75
Provider).....	77	4.1.3 服務索取代代理者 (Service Client Agent).....	78	4.2 居家社群環境資源分享架構設計.....	78
型.....	81	5.2 居家保全服務規劃.....	82	5.2.1 時間服務代理者 (Timer service agent).....	85
警報服務代理者 (Alarm service agent).....	86	5.2.3 列印服務代理者 (Printer service agent).....	87	5.2.4 監視服務代理者 (Monitor service agent).....	88
者 (Monitor service agent).....	88	5.2.5 儲存服務代理者 (Storage service agent).....	88	5.2.6 居家保全服務管理代理	

者(Home Security Service Management Agent).....	89	5.3行為觀點 - 循序、互動模型
.....91	5.4實作觀點 - 元件模型.....	93
5.5環境觀點 - 部署模型.....	95	第六章 系統特性.....
97	6.1 IH-SAF的物件導向系統結構.....	97
6.2 IH-SAF的代理者系統特性.....	99	6.2.1代理者的行為能力.....
100	6.2.2代理者的溝通能力.....	101
6.2.3代理者的認知能力 - 智慧能力.....	102	6.2.4代理者的其他特性.....
102	第七章 結論與未來研究方向.....	104
7.1居家服務代理者社群架構的貢獻.....	104	7.2未來研究方向.....
105	7.2.1與網路服務整合.....	107
7.3未來預期成果.....	109	參考文獻.....
111	圖目錄 圖1-1 網際網路服務的觸角向外伸展.....	1
圖1-2 網際網路的新型態 - 居家網路的發展.....	2	圖2-1 浮現中的標準與網路七層協定之對照.....
10	圖2-2 Jini服務發覺協定架構.....	24
圖2-3 Generic Agent Architecture.....	31	圖2-4 OOCDPSS (Object-Oriented Cooperative Distributed Problem Solving Shell)架構.....
33	圖2-5 群組的基本活動圖.....	36
圖2-6 Basic Blackboard System.....	37	圖2-7 The MIX Architecture - Agent Model.....
39	圖2-8. The MIX Architecture - Network Model.....	40
圖2-9 智慧型空間中架構.....	41	圖3-1 人類接受訊息方式示意圖.....
47	圖3-2 居家服務代理者社群架構的各個觀點模型.....	49
圖3-3 一般性代理者使用案例模型.....	51	圖3-4 延伸一般性代理者使用案例模型.....
55	圖3-5 一般性代理者動態模型 - 互動圖.....	56
圖3-6 一般代理者生命週期.....	57	圖3-7 一般性代理者靜態模型 - 類別圖.....
59	圖3-8 居家網路組成概念圖.....	60
圖3-9 數位居家生活環境之環境觀點 - 部署圖.....	61	圖3-10 以動態元件為基礎的代理者系統.....
63	圖3-11 服務代理者一般性架構圖.....	65
圖3-12 一般性架構居家社群組織示意圖.....	67	圖3-13 服務社群階層架構.....
70	圖3-14 契約網路協定示意圖.....	73
圖4-1 環境領導代理者架構.....	76	圖4-2 服務提供代理者架構圖.....
77	圖4-3 用戶端代理者架構圖.....	78
圖4-4 環境領導者之代理者模組與網路模組.....	79	圖5-1 居家保全服務使用案例圖.....
82	圖5-2 居家裝置服務代理者之三層式架構.....	84
圖5-3 居家保全服務行為觀點的互動圖.....	92	圖5-4 居家入口網站的實作觀點.....
93	圖5-5 資訊家電之實作觀點.....	95
圖5-6 居家保全服務部署圖.....	96	圖6-1 IH-SAF系統架構.....
98	圖6-2 居家保全服務架構.....	99
圖7-1 研究架構圖.....	106	表目錄
表2-1 Wired Physical Media within Homes, their Data Rates, and Related Consortia.....	12	表2-2 Device Interface and Their Data Rate.....
13	表2-3 無線網路技術與該資料傳輸速度.....	14
表2-4 國內外相關研究狀況與文獻.....	20	表2-5 居家網路技術與國內外研究狀況彙總.....
21	表2-6 居家服務開道相關工具統整.....	28
表3-1 代理者接受的刺激來源.....	50	表5-1 時間服務代理者(Timer service agent).....
85	表5-2 警報服務代理者(Alarm service agent).....	86
表5-3 列印服務代理者(Printer service agent).....	87	表5-4 監視服務代理者(Monitor service agent).....
88	表5-5 儲存服務代理者(Storage service agent).....	89
表5-6 居家保全服務管理代理者(Home Security Service Management Agent).....	90	表6-1 代理者系統的各項特性與IH-SAF架構的實作程度.....
100		

REFERENCES

- Hanfy Meleis, "Toward the information network," Computer, Vol. 29, Issue: 10, pp. 59 -67, Oct., 1996.
- Open Service Gateway initiative, "OSGi Service Gateway Specification Release 1.0," May, 2000, "Release 2.0," Oct., 2001, <http://www.osgi.org>.
- Kirk Chen and Li Gong: Programming Open Service Gateways with Java Embedded Server Technology, Sun Microsystems, 2001.
- Bang-Cheng Chen, OSGi Based Embedded LINUX Network Service Gateway Implementation and Design, Master Thesis of National Chiao Tung University, 2001.
- B. Horowitz, N. Magnusson, and N. Klack, "Telia's service delivery solution for the home," IEEE Communications Magazine, Vol. 40 Issue: 4, pp. 120 -125, Apr. 2002.
- Dimltar Valtchev and Ivailo Frankov "Service gateway architecture for a smart home," IEEE Communications Magazine, Vol. 40, Issue: 4, pp. 126 -132, Apr. 2002.
- Dave Marples and Peter Kriens, "The Open Services Gateway Initiative: an introductory overview", IEEE Communications Magazine, Vol. 39, Issue: 12, pp. 110 -114, Dec. 2001.
- Dobrev, P.; Famolari, D.; Kurzke, C.; Miller, B.A., "Device and service discovery in home networks with OSGi," IEEE Communications Magazine, Vol. 40, Issue: 8, pp. 86 -92, Aug. 2002.
- Michael Condry, Ulrich Gall, and Pierre Delisle, "Open Service Gateway architecture overview," in Industrial Electronics Society, 1999. IECON '99 Proceedings. The 25th Annual Conference of the IEEE, Vol. 2, pp. 735 -742, 1999.
- Smith, L., Roe, C. and Knudsen, K.S., "A Jini™ lookup service for resource-constrained devices," Networked Appliances, 2002 and Proceedings. 2002 IEEE 4th International Workshop, pp. 135 -144, 2002.
- Joong-Han Kim, Sung-Su Yae and Ramakrishna R.S., "Context-aware application framework based on open service gateway," Info-tech and Info-net, 2001. Proceedings. ICII 2001 - Beijing. 2001 International Conferences, Vol. 3, pp. 209 -213, 2001.
- Chemishkian, S., "Building smart services for smart home," Networked Appliances, 2002. Proceedings. 2002 IEEE 4th International Workshop, pp. 215 -224.
- John R. Barr, Ph.D., President, OSGi, "Open Service Gateway initiative:Enabling Services for the Networked Home", <http://www.havi.org/news/8300/barr.pdf>.
- Open Service Gateway initiative, "Open Service Gateway initiative Specification Overview," Jan., 2000, http://www.osgi.org/resources/spec_download2.asp.
- OSGi White Paper: "The Connected Home Powered by Java Embedded Server

Software," <http://www.osgi.org>. 16. OSGi.org, <http://www.osgi.org>. 17. aveLink OSGi solution, <http://www.osgi.org>. 18. Gerard O'Driscoll, "A Helicopter View of The Home Networking Industry", Home Networking Industry Forum, Feb., 2001., http://www.xilinx.com/esp/home_networking/pdf_files/hnif_presentations/keynote_gerard.pdf. 19. David Jordan, "Java in the Home: OSGi Residential Gateway", Java Report, Sep., 2000, <http://www.javareport.com>. 20. Timo Honkanen, "OSGi-Open Service Gateway initiative", http://www.automationit.hut.fi/julkaisut/documents/seminars/sem_s01/honkanen.pdf. 21. K. Hofrichter, "The residential gateway as service platform," Consumer Electronics, 2001. ICCE. International Conference, pp. 304 -305, 2001. 22. Sun Microsystem, "Experiences from Development of Home Health Care Applications based on Emerging Java Technology," <http://www.ami.imt.liu.se/>. 23. Emil M. Petriu, Nicholas D. Georganas, and Dorina C. Petriu, et. al., "Sensor-based information appliances," IEEE, Instrumentation & Measurement Magazine, Vol. 3 Issue: 4, pp. 31 -35, Dec. 2000. 24. Greg Vrana, "Pervasive computing: a computer in every pot," http://www.osgi.org/news/member_news. 25. 交通大學嵌入式系統實驗室, <http://xlab.cn.nctu.edu.tw>. 26. Rob Armstrong, Dennis Gannon, Al Geist, et al., "Toward a Common Component Architecture for High-Performance Scientific Computing," <http://www.llnl.gov/CASC/components/docs/1999-hpdc.pdf>. 27. Craig Larman, Applying UML and Patterns-An Introduction to Object-Oriented Analysis and Design and the Unified Process, USA, Prentice Hall PTR, Jul. 2001. 28. Sinan Si Alhir, UML in a Nutshell, USA, O'Reilly, Oct. 1998. 29. Gerhard Weiss, Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, Cambridge, Massachusetts, The MIT Press, 2001. 30. Jacques Ferber, Multi-Agent Systems: An Introduction to Distributed Artificial Intelligence, Great Britain, Addison-Wesley, 1999. 31. Michael Wooldridge, An Introduction to MultiAgent Systems, West Sussex PO19 1UD, England, John Wiley & Sons Ltd, 2002. 32. Michael Knapik and Jay Johnson, Development Intelligent Agents for DISTRIBUTED SYSTEMS, New York, McGraw-Hill, 1998. 33. P.A.; Huhns, M.N.; Vidal, J.M.; Buhler, "Inside an agent," Internet Computing, IEEE, Vol. 5 Issue 1, pp. 82 -86, Jan./Feb. 2001. 34. Carlos A. Iglesias, Jose C. Gonzalez, and Juan R. Velasco, "MIX:A General Purpose Multiagent Architecture," in Intelligent Agents II - Agent Theories, Architectures, and Languages, M. Wooldridge, J. P. Muller, M. Tambe, Ed. Springer, IJCAI'95 Workshop (ATAL), 1995, pp. 251-266. 35. Feng-Chao Yang and Yu-Kuen Ho, "Cooperative Distributed Problem-Solving Management Framework for Office Automation Systems," Concurrent Engineering: Research and Applications, Vol. 5, No. 1, Mar. 1997. 36. Feng-Chao Yang and Yu-Kuen Ho, "An Object-oriented Cooperative Distributed Problem Solving Shell with Groupware Management Ability," Software- Practice and Experience, Vol. 27(11), pp. 1307-1334, Nov. 1997. 37. Michael N. Huhns, "Agent societies. Magnitude and duration", IEEE Internet Computing, Vol. 6, Issue: 1, pp. 79 -81, Jan.-Feb. 2002. 38. Roland Johnson and Dr. Albert C. Esterline, "Strategies in Multi-Agent Systems," A.C. Southeastcon 2000. Proceedings of the IEEE, 2000, pp. 91 -94. 39. Suguri, H., "A standardization effort for agent technologies: The Foundation for Intelligent Physical Agents and its activities," in Proceedings of the 32nd Annual Hawaii International Conference, 1999, System Sciences, 1999. HICSS-32, pp. 10-40. Yu-Kun Ho and Feng-Chao Yang, "A Group Organizational Structure for Run-Time Management of An Object-Oriented System," in Proceeding of the Sixth Workshop on Object-Oriented Techniques and Applications, Sep. 7, 1995, Taichung, Taiwan, R.O.C. pp. 15-22. 41. Gwo-Rang Lan, A Cooperative Control Architecture in Distributed Blackboard System, Master Thesis of National Cheng Kung University, 1995. 42. Object Management Group, "Agent Technology Green Paper", http://www.objs.com/agent/agents_green_paper_v100.doc. 43. R. G. Smith, "Frameworks for Cooperation in Distributed Problem Solving," IEEE Trans. on System, MAN, and Cybernetics, 29(12), pp. 61-70, Jan. 1981. 44. Gregory D. Abowd and James P. G., "Final Report on the Inter-Agency Workshop on Research Issues for Smart Environments", IEEE Personal Communications, Oct. 2000, pp. 36-40. 45. Mark Stang and Stephen Whinston, "Enterprise Computing with Jini Technology," IT Professional, Vol. 3, Issue: 1, Jan.-Feb. 2001, pp. 33 -38. 46. W. Keith Edwards and Tom Rodden, Jini Example by Example, USA, Prentice Hall PTR, Jun. 2001. 47. Jini.org, <http://www.jini.org>. 48. 資訊安全通訊 第七卷第三期, 2001, <http://www.ccisa.org.tw>. 49. Almut Herzog and Nahid Shahmehri, "Towards secure e-services: Risk Analysis of a Home Automation Service," <http://www.ida.liu.se/~almhe>. 50. Asus e-Magazine, http://www.asusemag.com.tw/trad_ch/tech/tech9-55.htm