High Efficiency and Light Mobile Electronic Business System Based on Mobile Agent Middleware

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Abstract Mobile Network technology has been being the research focus during the 1990’s. The middleware technology is imported for the sake of running distributed transaction smoothly. In this paper, a mobile agent based middleware high efficiency mobile electronic business oriented middleware (HEMEBOM) is designed and implemented based on the requirement and background of collaborative electronic business. Its architecture, elements and excellent properties are mainly focused. Then high efficiency mobile electronic business system μMcommerce is built using HEMEBOM.

Key words B2B electronic business; middleware; mobile agent; real-time information push; lightweight mobile commerce

With the development of wireless network, many people want to carry out commerce activity because of its convenience and mobility. It is necessary to build high efficiency and collaborative transaction system due to high delay and burst error in wireless network. Unfortunately, it is difficult for traditional technology to achieve high efficiency in low bandwidth network and new technology is expected.

Large analysis of collaborative commerce system shows that there are some common design elements although the network, operating system(OS) and database system are different. In order to communicate in heterogeneous network environment, middleware technology must be introduced[1]. In order to exchange information securely, efficiently, real-timely and reliably between entities, high performance distributing technology is indispensable. Mobile agent technology meets these requirements.

1 High Performance Mobile Agent

The concept of mobile agent was brought forward by General Magic Corporation in the 1990’s when telescript is distributed[2]. Mobile agent is a program that can move from a host to another autonomously in heterogeneous network environment, and it is mixture of artificial intelligent(AI) technology and distributing computing technology. While the interactions between the traditional remote process computing(RPC) client and server need continuous communication, mobile agent can move to server and communicates with server locally, and the local communication does not need to occupy network resources.

Supposing that client’s request needs N interactions between client and server and Treq is average transferring time of interaction request, Tqueue is the waiting time of interaction request in the server’s queue, Tproc is average processing time of interaction request and Trspn is average transferring time of interaction result. We can get that to complete the service, the time of C/S is

$$T_{cs} = N(T_{req} + T_{queue} + T_{proc} + T_{repn})$$ (1)

the time of mobile agent is

$$T_{agent} = N(T_{queue} + T_{proc}) + T_{req} + T_{repn}$$ (2)

the different time between C/S and mobile agent is

$$T_{CS} - T_{agent} = (N-1)(T_{req} + T_{repn})$$ (3)

From Eq.(3), it is clear that with the increase of interaction between client and server, the advantage of mobile agent is more obvious.

Just because of the above features of mobile agent system, it is very fit for highly reliable and high performance system.

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2 Design and Implement of HEMEBOM

2.1 The Elements of Mobile Agent System in Middleware

Agent entity: an agent entity is a Java object.
Mobile agent proxy: it is the delegation of mobile agent entity. Also, it provides location transparency to mobile agent entity.
Mobile agent context: the context is the workplace of mobile agent.
Agent message: agent message is an object that is used to interact between mobile agents.
Future reply: it can be used as a later result handle when mobile agent communicates asynchronously.
Agent identifier: each mobile agent has one identifier, and the identifier is responsible for identifying mobile agent entity in the whole lifetime.
The entire above elements exist as Java class or interface.

2.2 The Operation of Mobile Agent System in Middleware

The followings are basic operation of mobile agent, and they are the minimum function set of the mobile agent lifetime’s management.
Agent creation: creating agent entity in agent’s context and the new agent is allocated an agent identifier. After initialization, the new mobile agent can run.
Agent dispatching: It is responsible for moving out mobile agent from current context into the destination context and the mobile agent entity will restart in the new context.
Agent disposal: It will dispose the running mobile agent and move mobile agent out of current context.

2.3 The Flow of Real-Time Push Algorithm

The core of middleware is real-time push module. It also has some modules such as status module, user administration module, system maintenance module and system help module. Here, we only give out the algorithm of core module (as shown in Fig.1.).

In the implementation, in order to get platform independence, security, object oriented property and multi threads, pure Java technology is used. Java database connectivity(JDBC) database technology is used to achieve the transparency and high efficiency of data source. Java based mobile agent technology is used to implement the mobility and management of agent, and knowledge query and manipulation language (KQML) similar language and message mechanism are used to communicate between different mobile agents[3-4].

3 Lightweight Mobile Commerce System \(\mu\)Mcommerce

Lightweight mobile commerce system \(\mu\)Mcommerce is based on the above middleware
HEMEBOM. As shown in Fig.2, it includes goods providing subsystem, goods requiring subsystem, mobile agent middleware subsystem and system administration subsystem[5~6].

1) Goods providing subsystem

Mobile user uses good providing subsystem to register goods information. Sun J2ME technology is used to implement it and brouncy castle lightweight security product lcrypto is used for high security.

2) Goods requiring subsystem

Goods requiring subsystem and corresponding mobile agent subsystem are responsible for receiving and running the dispatched mobile agent program and collecting goods information real-timely. Legend 5100 (Strong ARM) and Pjava are used to implement it and Pjava java.io.File class is used for saving data in time.

3) Mobile agent middleware subsystem

Mobile agent middleware subsystem is responsible for the context and management of mobile agent, and it is the neural network of whole system. It is the logic communication channel, through it, server use real-time push algorithm to push data to PocketPC. Also, it has message mechanism, and data will not lose even if PocketPC shutdown. When PocketPC restarts, PocketPC will receive the data saved in message queue.

In goods providing subsystem, mobile agent middleware has three contexts: Grasshopper mobile agent context, SMI mobile agent context and JADE intelligent agent context, and two addons: mobile agent interoperability addon and mobile agent/intelligent agent addon, so it can move mobile agent created by SMI to Grasshopper context and send FIPA compatible message to JADE, then JADE write data into database.

4) System administration subsystem

System administration subsystem is responsible for the parameter configuration, and it can use Pc for original configuration, then use mobile phone or PocketPC for further configuration. Lightweight intelligent agent platform LEAP is used to implement it, and all configuration request and reply information is passed using FIPA performative.

4 Experiment and Summary

To test the system completely, we carry out the following tests:

Function test: test all the function, the result shows that it accords with the design goal and the system security is well.

Increment test: in order to test the scalability of system, records are added from 20 ~ 80 dynamically with the information querying time shown in Tab.1. The result shows that mobile agent has better performance than RPC. With the network bandwidth decreasing, the performance of mobile agent does not change obviously but the performance of RPC changes evidently. With the increment of records, mobile agent has the ability of scalability, but the time of querying information in RPC increases by exponent.
Mobile agent is different from RPC, and its unique property brings tremendous renovation to distributed mobile computing. Now, most of researchers study mobile agent from AI, so it is hard to make it applicable, we study mobile agent from distributed computing and hope that through the discuss of highly available real-time, lightweight mobile commerce middleware and system, researchers can pay attention to the utilization of mobile agent.

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References

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ZHANG Yunyong (张云勇) was born in 1976. He is now a postdoctor of postdoctoral programme in China unicom. His research interests include: NGN and softswitch, NGI and middleware. He has published about forty papers and two academic books.

LIU Jinde (刘锦德) was born in 1930 and graduates from Shanghai jiaotong university in 1952. He has made outstanding contributions to development of electronic industry especially microprocessor, unix system, engineering workstation, open system and middleware. He is now a Professor at UESTC and Member of Computer Academy. Also he is a Director of Computer Industry Association in Sichuan province. His research interests include: open system and middleware.

<table>
<thead>
<tr>
<th>Table 1 Performance test results</th>
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<tbody>
<tr>
<td><strong>Technology platform</strong></td>
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<tr>
<td>Access mode (Dial number)</td>
</tr>
<tr>
<td>Max bandwidth /Kbps</td>
</tr>
<tr>
<td>Bytes of record</td>
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<tr>
<td>Average time (20 records)</td>
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<tr>
<td>Average time (40 records)</td>
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<tr>
<td>Average time (80 records)</td>
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Tab.1  Performance test results