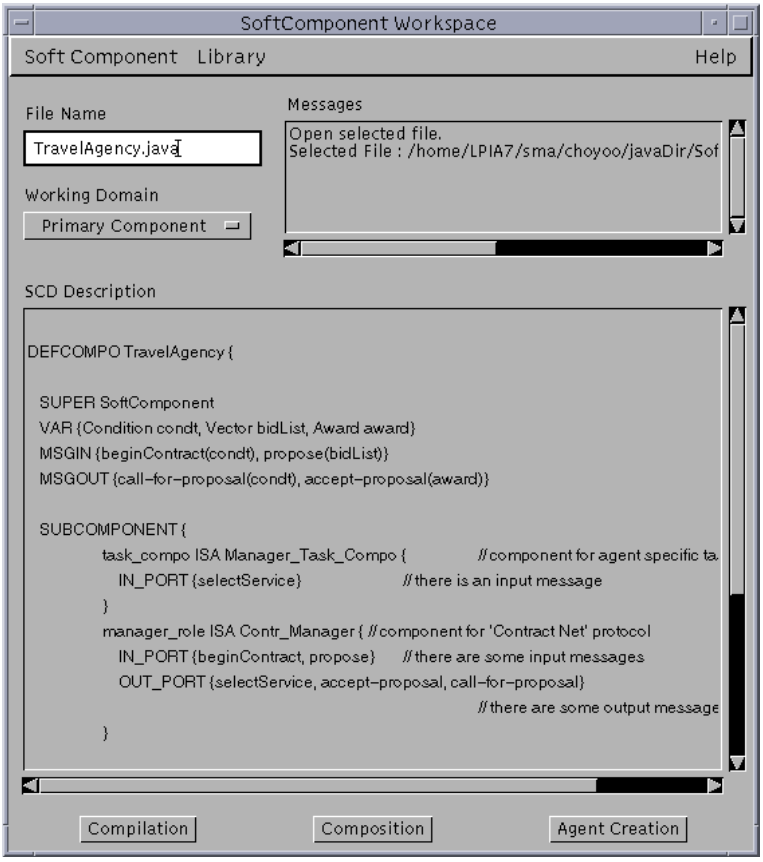

Figure 9. SoftComponent editing and compiling environment

Finally the generated components code in Java is encapsulated into a mobile agent structure so as to be integrated into a mobile agent platform as an executable agent. The agents collaborative aspects can be visualized by messages sent and received. The figure 10 shows the example of JNA screen which visualizes the different messages of the agent in conversation through the Contract Net protocol.

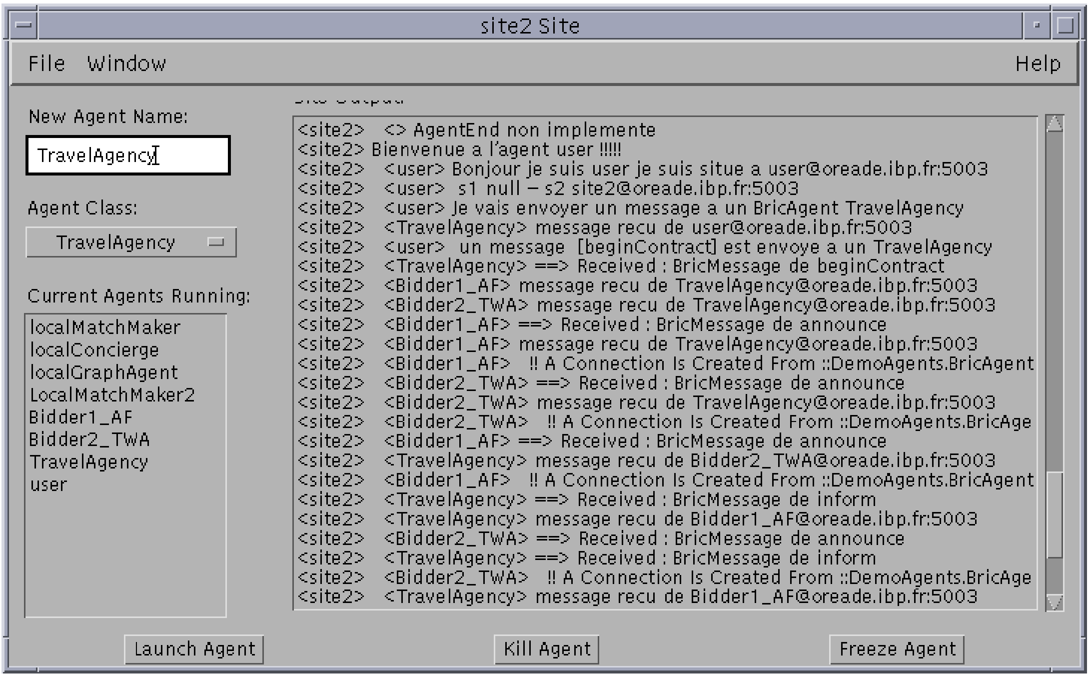

Figure 10. JNA screen example of a site information

5.2 Integration with a mobile agent platform

One of the best benefits of our approach is that the agent modeling and code generation system is weakly dependent upon a given (Java-based) mobile agent platform. This is possible by the compilation of SCD into Java source code. There are some other agent platforms which compile their specification language in order to generate agents, namely SodaBot [Coen 94], LALO [Gauvin et al. 97]. In these cases, the compiled or interpreted information has been directly transformed into a specific agent platform. Thus it is difficult to adapt such systems to another type of environment. But in our case, the compiler generates Java source code which can be integrated into some Java-based agent platform. This has made easy the integration of our componential modeling and code generating system with two different mobile agent platforms.

The first version has been implemented into the JNA (JavaNet Agent) platform [Merlat et al. 97]. JavaNetAgents (JNA) is a mobile agent platform, developed in Java through the collaboration of ONERA (Office National d Etudes et de Recherches A rospatiales) and the laboratory LIP6. Like most of such platforms, its architecture is based on places (sites) and agents [Telescript 95]. Local and distant agents (i.e. agents hosted on the same or distant places) can communicate through agent messages. Security features prevents malicious agents from making unauthorized access to local resources (files, sockets, threads, etc.). The physical agent structure of JNA is close to that of Aglet.

The second version has been integrated with the Voyager mobile agent platform (Object Space, [Voyager 97]). Being based upon our experience with previous mobile agent platform, we have easily achieved the integration with Voyager. Compared to JNA or other mobile agent platforms, Voyager has some interesting features especially for our modeling method.

1. In JNA, it is difficult to trace the mobile agent s current address. Thus the message sending is always invoked from a mobile agent to a stable agent. But the Voyager platform contains a distributed naming service that allows to connect to a mobile agent based on some alias. So sending a message to a mobile agent is transparently achieved as if between residing agents.
2. In JNA there are graphical user interfaces provided by the platform, for observing and managing the current states of the agents on that site. This may give some facilities to whom wants to develop mobile agents directly into the platform. In case of Voyager, such an user-friendly interfaces are weakly provided. The developing environment is rather simple but provides more elaborated technical bases, as distributed naming facility or communication using agent method call with agent name , etc., which are more preferable for us. That is why we have chosen Voyager as the second platform of experimentation.

Although the JNA and the Voyager have distinctive features in terms of agent types (agent as a thread, and an object, respectively) and communication way (by a class of Message and by agent s method call, respectively), we have succeeded in integrating agent modeling and implementation system into these two different platforms.

6. CONCLUSION

Our aim is to provide a *software agent developing environment* for the designer who wants to implement collaborative intelligent mobile agents. We attempted at integrating classical *collaborative intelligent agent* paradigms into *mobile agent* technology. We also addressed the modeling facility by choosing *reusable components and composition* techniques.

The componential agent design is achieved by describing each component using our component description language (SCD). For the purpose of specifying agent mobility the designer can indicate when mobility is triggered within the component description. Afterwards, the model description is translated into Java source code. The generated code is automatically integrated into a mobile agent platform to execute the modeled behavior of the mobile agent. The componential approach for collaborative agent is especially appropriate to design generic conversation protocols and their reuse.

We have already modeled, validated and executed the simple scenario of Travel Agency as described in section 4. We are currently exploring variations and extensions of this initial scenario (for example, using variants of Contract net protocol, adding agents, etc.) in order to further test the reusability of our componential architecture.

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