.... collateral....

WHITE PAPER

Product Summary

Abstract

Oracle Mobile Agents? is Oracle’s mobile computing infrastructure for extending the client/server architecture to mobile environments. Oracle Mobile Agents implements a new computing paradigm - client/agent/server - to provide people on the move with efficient and secure access to information.

Why Mobile Agents?

The Mobile Worker

In all professions we come across instances where people could benefit from having the right information available at the right time:

- A Sales person on the road wants to know the latest prices and inventory status,
- A Dispatch service needs to inform delivery personnel of changes in the next drop-off address,
- A Lawyer in the courtroom needs to reference an old brief saved on a computer on the law firm?s premises
- A Police officer needs to verify a suspect?s record at the crime scene,
- A Doctor would like to consult a patient?s medical history, and order a prescription, without leaving the bedside,
- A Money Manager wants the latest stock and bond indexes, even when not in the office
- An executive on the road wants to be informed of itinerary changes,
- A Realtor wants the latest listings for houses on sale,
- A sports fan wants updated scores and statistics for a favorite team.

All of these people need their data while they are on the move. However, the size and scope of activities covered under the term "mobile computing" vary widely. The desired data ranges from a simple text-based stock listing to a graphic mug-shot of a criminal. The destination device ranges from a doctor?s PDA (small screen, limited functionality) to a lawyer?s laptop. The mobile worker might use a Packet Radio modem while on the road and a dial-up option at the airport hotel. Communication cost could be a concern for a high volume dispatch business, but not an issue in a disaster relief area where the ability to communicate could save lives. Mobile users are so diverse in their data, platform, and communication requirements that it is difficult to provide one shrink-wrapped solution that satisfies everyone.

The Mobile Setting

The other roadblock to ubiquitous mobile computing is that mobile networks are slower and less reliable than the usual Local Area Networks. Packet Radio or Cellular networks disconnect or fade in and out of coverage depending on your location and terrain. Even with a reliable connection, bandwidth may be limited. Latency, or the time it takes for data to travel across the network, is orders of magnitude higher. The net effect of these differences is that normal, "connection-oriented" client/server applications do not work well in a mobile environment. The following example clarifies the impact that long latencies can have on traditional client/server computing. A typical client point-of-sale application might exchange fifty criteria (customer name, product ID, etc.) with a server during the course of a single transaction. On a LAN, where the typical latency is 0.002 seconds, fifty round trips only takes 0.1 seconds, a time lapse hardly noticeable to the user. On a wireless network, in contrast, the latency may be 4 seconds. This means the same fifty round trips now take over 3 minutes. Further, traditional Client/Server computing is "connection-oriented", meaning that it assumes that a reliable connection is maintained throughout the length of the transaction and has no built in mechanisms for handling interrupted connections. If the wireless network fades out halfway through these fifty exchanges, the client has no choice but to start again from the beginning. This quickly leads to a frustrating and unproductive session for the mobile worker.

The Mobile Solution

- Oracle Mobile Agents provides two key elements that together form a complete solution for mobile computing:
- An open, highly scaleable, and secure store-and-forward messaging infrastructure that is optimized to solve the problems of mobile computing. It hides the vagaries of the underlying communication networks from the user, providing consistent and reliable performance over all networks.
- A rich Software Developer?s Kit (SDK) that provides a variety of already built sample applications, making it very easy to tailor applications according to the customer?s needs and environment.

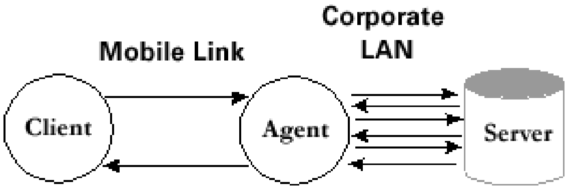
These two elements permit corporations to quickly deploy a client-agent combination that provides access to their legacy data sources from anywhere on the road. In addition, they provide the flexibility to build mobile applications based on new or emerging information services.

The rest of this document describes the architecture and features of Oracle Mobile Agents. System Architecture provides an overview of Mobile Agents and an example of how it enables wireless data access. Product Specifications enumerates the capabilities of Oracle Mobile Agents. Components provides a more in depth description of the software elements.

System Architecture

Client/agent/server

Client/agent/server is a three-tiered, connectionless architecture that has been developed primarily for mobile environments. Communication between client and server is mediated by agents, which can reside on the same machine as the server. When a client wishes to initiate a transaction, it sends a message to an agent. The agent performs the desired transaction on behalf of the client, and sends the results back to the client.



As stated, the basic means of communication between the system components is the exchange of messages. Messages carry structured data between clients and agents via the Message Gateway. Note that there is no direct connection between client and server. Once the agent receives the request, the client is not required to remain connected. The agent will execute the task, even if the client drops the mobile link. When the client reconnects it will be given the results. This "message-oriented" scheme increases overall transaction performance by minimizing traffic over the slow mobile communication link. The result is the fastest possible service to the mobile client regardless of the complexity of the task.

Clients can be extremely light-weight, since they have to do very little processing. This is especially helpful when the client applications are running on PDAs, SmartPhones and other small devices with limited capabilities.

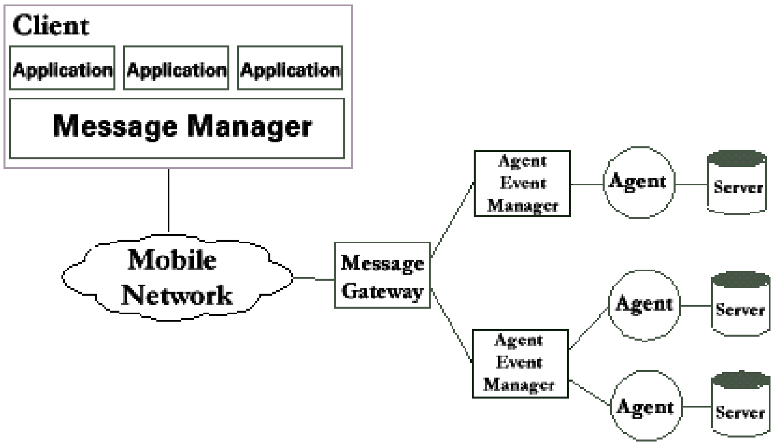
Oracle Mobile Agents

Oracle Mobile Agents is "mobile middleware" - a combination of software installed and used throughout the network. Briefly, Oracle Mobile Agents comprises the following pieces:

- Applications - What the user interacts with. They send requests to the appropriate agents and then display the responses.

- Message Manager - Manages communications for all applications and hides network complexities.
- Message Gateway - Routes messages and manages the message queues for registered clients and agents. Also responsible for enforcing system-wide authentication and security policies, user-profile management and general system management.
- Agent Event Manager -Manages the communications between the agents on a particular machine and the Message Gateway. Analogous to the Message Manager on the client.
- Agents -Process client requests by interfacing with the servers and returning the results to the client.
- Server -Any data repository: corporate information, mail servers, web servers, etc.

Each component plays an important role in the system. The relationship among them is illustrated below.



Example: Using Mobile Agents

Let?s say a stockbroker running Oracle Mobile Agents and the appropriate client wishes to view the current value of a hot internet stock while in his car. He starts the Message Manager and establishes a mobile link, and then runs a portfolio application. After entering the stock symbol, he clicks "get quote", triggering the following chain of events:

- Request for stock quote is issued by the portfolio application.
- Message Manager receives request, performs data encyrption , and sends the message to the Message Gateway.
- Message Gateway looks at the message, determines what service it is addressed to, and forwards it to a portfolio agent via the agent event manager.
- Portfolio agent queries a financial information service database, receives the quotes, bundles the information into a reply, and sends it back to Message Gateway.

- Message Gateway sends reply back to Message Manager.
- Message Manager delivers reply to portfolio application.
- Application displays the current value of the hot internet stock - not so hot anymore .

Product Specifications

Oracle Mobile Agents provides functionality that is fundamentally different from that found in today's client/server systems. Here is a list of the features of Version 2.0, plus some of the benefits that arise from the client/agent/server architecture.

Security

The most important enhancement to Oracle Mobile Agents in Version 2.0 is the inclusion of more advanced user authentication and data security to provide a secure mobile computing environment. Security policies are administered and enforced centrally at the Message Gateway. All clients and agents must subscribe to them. A message going from client to agent is verified at each hop - between client and Message Gateway and then again between Message Gateway and agent.

Authentication

Two types of authentication policies are now offered - basic and strong.

Basic authentication is carried over from Version 1.0. With basic authentication, each user is assigned a password. The client sends this password with each registration request to the Message Gateway, which verifies it before allowing the client to register itself. The same procedure is used for agents. Basic authentication is one-way. The Message Gateway is assumed to be secure and does not have to authenticate itself to the client.

New for Version 2.0 is strong authentication. With strong authentication, all components are required to prove their identity when talking to each other. This is accomplished using RSA Public Key Cryptography. Each endpoint in the system (including the Message Gateway) has its own public/private key pair which it uses to establish its identity to all other endpoints.

For added security, the gateway administrator can set an authentication lifetime so that users are required to periodically re-authenticate themselves.

Data Encryption

Oracle Mobile Agents 2.0 uses several methods to ensure message integrity. A unique session key is created every time a client or agent registers with the Message Gateway. This session key is then used to encrypt all messages using industry or government standard data encryption algorithms (DES-40, DES-56, RC4-40, RC4-256). To detect if messages have been tampered with, a digital fingerprint is generated for each message and sent along with the rest of the data. The receiver generates its own fingerprint of the incoming data and compares it to the attached signature. If the fingerprints do not match, the integrity of the message is considered to have been compromised and the message is discarded. Finally, the Message Gateway discards any duplicate messages or messages with incorrect sequence numbers, protecting against "message replay" attacks.

Compression

Compression of data during transmission increases system throughput This is particularly beneficial over wireless links.

Network Independence

With Oracle Mobile Agents, the user can choose the most appropriate communications available between the client and the Message Gateway and between the Message Gateway and the Agent Event Manager. A typical mobile user is not a "single transmission medium" user, but will require a combination of technologies to ensure connectivity in any situation. For example, a sales representative may regularly use:

- packet radio technology -in the car, at customer sites, at the airport
- phone line connections - when radio is unavailable or out-of-coverage, when speed is important, when a phone line is convenient (hotel room, home)
- LAN connections - in the office

Oracle Mobile Agents 2.0 runs over DataTAC networks (DataTAC 4000 and 5000), Mobitex, CDPD, PPP (for dialup) and TCP/IP (for LAN?s).

Multiple Gateway Support

Mobile devices can communicate simultaneously with multiple Message Gateways, on completely separate systems. For example:

- An online travel service application can receive updates and information from a travel agency, while simultaneously, corporate applications receive data from servers at the main office.
- Within the same corporation, developers and testers can use development and production systems simultaneously. Most other products and systems allow connection to only one system at a time.

Active Agents

Traditional client/server applications are dependent on the client connecting to a server and then proactively requesting information. With Oracle Mobile

Agents, an agent can initiate messages. This means an agent can be programmed to seek information and then deliver a "data alert" to the client, without the client specifically asking for it. Data alerts allow the user to find out about changes as they occur, without having to actively search for them.

Unsolicited data alerts are an extremely powerful tool. With data alerts:

- A field service engineer can receive a data dispatch for a service outage requiring immediate attention.
- A user can be notified of a customer escalation for a key account.
- A doctor can be forwarded the medical history of a patient coming into the emergency room.

Data alerts tightly couple data and users so that information is always readily available.

Asynchronous Operations

Oracle Mobile Agents is an event-driven, store and forward system. This allows all applications to be written asynchronously. Users can dispatch a number of jobs (i.e., message transactions) and receive responses as they are completed. The user never has to wait while a transaction is processed. (Read the description of the Mobile Web Browser in the SDK section for a good example.)

Suspended/Disconnected Operations

Users can continue to work despite marginal network coverage or even with no coverage at all, such as on an airplane. While disconnected, all user requests are queued for later transmission. When communications are reinstated, queued messages are forwarded to their destination.

This is particularly important when using packet radio networks or phone lines. If a user temporarily goes outside the radio tower?s coverage area, and then comes back in, messages automatically begin to flow. Similarly, if the connection is lost during a dialup session, the application can reconnect and pick up where it left off. Oracle Mobile Agents guarantees delivery of messages

Auto-Configuration

Many distributed system products suffer from confusing and redundant installation and configuration processes. Users have to enter information in multiple locations and it is hard to maintain consistency. With Oracle Mobile Agents, all configuration information for the system is stored at the Message Gateway. To the end-user, installation and configuration is as simple as clicking on an installer. When an agent, user, or application requires system details, they can refer to the Message Gateway. This eliminates most of the user errors many products encounter when configuration data is entered in many places.

Additionally, it shields the mobile worker from low-level details of the system.

Easy System Management

Oracle Mobile Agents can be easily integrated into existing management infrastructures. An SNMP agent can be used to manage and monitor the Message Gateway and Agent Event Manager components of a system. Dynamically configurable logging provides an audit of system activities.

Additionally, a remote administration tool for user, service, and message administration can be used from a LAN, dial-up, or wireless connection.

Open Interfaces

Oracle Mobile Agents uses an open architecture. There are no proprietary protocols or hardware requirements. This not only eases development but also means that as new protocols and platforms become available, Oracle Mobile Agents can be easily adapted to take advantage of them. This flexibility makes Oracle Mobile Agents an attractive platform for both customers and third party vendors to develop integrated mobile solutions.

Structured Object Transfer

Most other messaging systems support the transfer of binary messages between points in a system. In a heterogeneous environment, this leaves the application programmer with the task of converting data structures and objects between different operating systems or hardware architectures. Oracle Mobile Agents uses the native type systems of its clients to pass structured data directly from the objects and structures of the native programming environment. For example, in Microsoft Windows, a Visual Basic application can put and take data directly from screen fields into Oracle Mobile Agents messages. Underneath that programming model, Oracle Mobile Agents uses OLE 2.0 to determine the datatype of the field and convert it appropriately for use around the network.

SDK for Windows

Oracle Mobile Agents ships with an SDK that includes client and agent source code and executables for a variety of mobile applications. These applications can be used as is, or as a starting point to develop customized solutions. They include:

- an expense reporting front-end for the Oracle Payables. This application permits anyone to submit an expense report while they are on the road.
- a file transfer utility for moving files over the network, not only between client and server machines but client to client as well.
- a mobile fax application that uses the file transfer utility to transfer a file from a users laptop to a back-end fax server.

a mobile web browser that permits users to browse the corporate Intranet. Multiple requests to retrieve web pages can be submitted to a web agent at the same time. The web agent talks to a web server and retrieves the requested pages. Once the request is complete, it sends the entire page in a single message. This prevents the client from blocking on any request and having to worry about optimizing the HTTP traffic.

With the Windows NT version, you can develop agents and Windows 3.11, 95, and NT clients from a single machine, even over wireless networks, by attaching two modems and communicating modem-to-modem. The entire setup for this configuration takes less than one hour. The SDK also includes a debugging tool to let developers see inside structured messages and an object oriented API for the Message Manager.

DOS Libraries

A set of DOS libraries is now available for OEMs. These facilitate the development of Oracle Mobile Agents applications for handheld devices, some of which are beginning to use DOS as an operating system.

Components

Applications

Customers use applications to access their data sources. Requests are initiated by the client application by creating a message, identifying the message contents, and issuing a send command to pass it onto the Message Manager. A message can be addressed to a service (such as an agent that interfaces with a Web server) or to another user.

On PDAs, applications tend to be tightly coupled with the Message Manager for optimum use of limited memory and computing resources. On a Windows platform, Oracle Mobile Agents? SDK provides a variety of options. Developers can use either a simple OLE 2.0 object or a Windows DLL to access the Message Manager. Any Windows tool that can act as an OLE 2.0 client or can call a Windows DLL can be used to write Oracle Mobile Agents applications. This includes tools such as:

- Oracle Developer 2000
- Oracle Power Objects
- Microsoft Visual Basic
- Microsoft’s C/Visual C++
- Microsoft Excel
- Powersoft PowerBuilder
- Gupta SQL Windows
- Borland C/C++

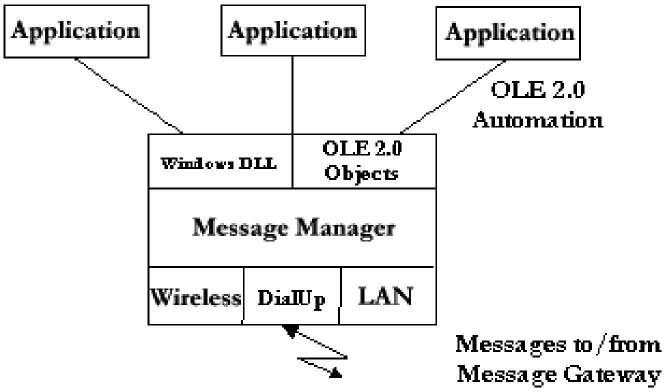
Message Manager

The Message Manager component receives messages from all client applications and delivers them over the currently available communications link to the Message Gateway. It resides with the client applications on the mobile device. In addition to delivering messages, it also provides status information about the message queues and the quality of the connection to the mobile network.

The Message Manager provides identical service over all available networks. Application programmers are thus able to focus on application development rather than the underlying networking software.

The Client Environment

Applications and the Message Manager together make up the client environment. Here?s what that environment looks like on a Windows client:



Message Gateway

The Message Gateway routes messages throughout the system. It has four primary roles:

- store messages intended for clients or agents that are out of coverage, turned off, or otherwise unavailable
- forward messages to mobile users and agents once they become available
- facilitate administration and maintenance of user profiles
- enforce system-wide security policies

The Message Gateway and the Message Manager work together to guarantee that the data sent over the radio or phone line is sent quickly, securely, and with the integrity of the contents guaranteed.

Agent Event Manager

The Agent Event Manager tells the Message Gateway what agents are available on a machine. It also contains a utility for administering and maintaining the various agents that reside on its machine. In this sense its role is similar to that of the Message Manager. There is an Agent Event Manager on each machine that runs Agents.

Agents

Agents are the key data access components in the Oracle Mobile Agents system, since they are responsible for processing requests from the client. Agents offer services such as email or web access. Each agent would typically consist of a number of "custom transaction handlers" - one for each type of transaction that the client applications can initiate.

An Agent looks at the incoming message?s id to determine which handler to pass it on to. The handler in turn interprets the specific message, performs some action based on the contents, and returns a response.

Agents are written using application environments native to the target platforms. On UNIX servers, this will most commonly be the C programming language, while for Windows, any of the tools mentioned in the application section could also be used to write an agent.

Servers/Data Sources

Servers are the sources of data requested by the user. While agents will often execute against database servers, such as Oracle7, they can also use flat files, file servers, electronic mail, or on-line information services as their data sources. The system is as open on the server-side as it is on the client-side.

Agents access servers using the best available native interface to that server. For example, Oracle7 is accessed using the Oracle PRO*C or OCI interface on UNIX, while on Windows these same interfaces as well as Oracle Glue or ODBC are available.

A non-intuitive, yet powerful implication of the Mobile Agent architecture is that the server can be mobile as well. For example, an architect has the master blueprints of a new office complex on a laptop. Equip the laptop with a wireless modem, place an Agent Event Manager and the appropriate Agent on the machine, and suddenly the blueprints are available to everyone on the construction site as well as engineers in the office. (Provided they are running Oracle Mobile Agents clients, of course.)

Summary

Oracle Mobile Agents provides the tools and infrastructure to fully enable the mobile age. Version 1.0 unveiled a new computing model (client/agent/server) that uncoupled the client from the server, allowing the mobile worker access to corporate data anytime, anywhere. Version 2.0 builds upon the foundation set down in the first release by adding features that increase the productivity of the mobile user. User authentication and data encryption provide corporations with the security they need to fully entrust mobile workers with corporate data. DOS libraries facilitate the migration of Oracle Mobile Agents to hand-held devices, which are beginning to use DOS-based operating systems. Finally, expanded network support means greater flexibility in choosing service and increased coverage. These new features further enhance Oracle Mobile Agents position as the software of choice for bringing data out of the office and into the field.