Agents on the Move

An IDC White Paper

Analysts: Sandra A. Taylor and Steve Garone

Management Summary

Today, we live in what IDC calls the CyberSmart era — a time when all computing will be characterized by totally complete access to all the computing resources available, at anytime, and from anywhere. Implicating such a computing paradigm is complex and difficult and involves high levels of integration, automation, and intelligence. To meet these challenges, new enabling technologies have appeared on the scene that support the cross-platform metadata and intelligence-based features of CyberSmart implementations. Despite complexity and the newness of the environment, several facts are clear and serve as examples of the trend: No longer will users tolerate arbitrary Web searches that yield thousands of leads, only a small fraction of which are relevant. Similarly, savvy organizations understand that ebusiness is a necessary path toward increasing revenue and profits, lowering costs, and gaining and maintaining customer and partner satisfaction.

One important enabling technology is the software agent — defined as a software component that acts as an autonomous and proactive delegate of either a human or software "master." Its ability to gather information, analyze that information, make decisions, and act on those decisions makes it a critical component in adding intelligence to ebusiness systems. It would be difficult to overstate the software agent's potential role in personalization, negotiation, and other automated activities in an ebusiness context. Mobile agents, moreover, can move across systems and networks on a targeted or as-needed basis, making it possible to extend the flexibility and reach of the agent paradigm.

Despite their apparent advantages, agents as a collective technology face some challenges, including the development and acceptance of industry standards, the establishment of interoperability among agent offerings, and the implementation of robust security mechanisms to meet the demands of the emerging emarketplace and other solutions.

One company addressing these challenges is Tryllian, founded in 1998 to exploit mobile agent technology. The Tryllian product suite is comprehensive and includes a development environment (the Agent Development Kit, or ADK), part of which is a set of extensible agent foundation classes, and an agent runtime environment that provides security, messaging, and transport services to the deployed agents. The support for transporting agents (which gives them their "mobile" characteristics) includes the management of state information, regardless of

IDC
Analyze the Future

5 Speen Street • Framingham, MA 01701 • Phone (508)872-8200 • Fax (508)935-4015

whether the agent "moves" within a specific system or to another system. Testing and additional management capabilities (such as the adjustment of parameters within a production runtime) are also part of the overall environment.

IDC believes that Tryllian can leverage what will be robust interest and market growth relative to mobile agent technology over the next four to five years.

IDC believes that Tryllian can leverage what will be robust interest and market growth relative to mobile agent technology over the next four to five years. Important success factors for the company will be the successful completion and publicizing of case studies, which will both help the company "evangelize" the benefits of mobile agents and will serve to verify the quality of its solution. Additionally, a commitment to increase awareness of the company itself and to refine and enhance its product offering should help Tryllian achieve market success and even leadership.

The eParadigm Imperative

In 1999, IDC articulated its vision of CyberSmart Computing as the defining force in the software industry — then, now, and for the foreseeable future. The essence of CyberSmart Computing is full, ubiquitous access to all computing resources — anytime, anywhere, by virtually anyone. The potential in CyberSmart Computing is enormous, and the computing industry has made significant progress toward fulfilling that potential.

Yet, the vision has not been generally realized. This is due, in part, to the magnitude of the requisite changes in business processes and to still-existing technological issues surrounding the underlying and inherently complex software environments.

In spite of the advanced search engine technology, search results still all too frequently include a glut of duplicate and nonexistent pages and a frustrating number of irrelevant pages.

This complexity surfaces in a variety of forms that still affect the users who access these environments, the corporate business models that rely on these environments, and the IT organizations that develop and manage these environments. Consider, for example, the simple Web search. In spite of the advanced search engine technology, search results still all too frequently include a glut of duplicate and nonexistent pages and a frustrating number of irrelevant pages. Here, we have a functional mainstay of the Internet that, in Web time, has been around forever; yet, we still do not deal effectively with the complexities of large volumes of dynamic information. More recent market developments, such as e-auctions and emarketplaces, have exposed additional limitations in the basic one-to-one, event-response paradigm that forms the computing foundation for the vast majority of today's applications. Although software can be made to solve virtually any problem, a peer-to-peer paradigm would more accurately (and efficiently) reflect the many-to-many relationships of the trading participants.

Today, a potent and emerging technology is being applied to the above issues (and others described throughout this report). This technology can mask underlying system complexity from users and help businesses more effectively exploit the opportunities represented by the complex interplay of distributed users and distributed systems. It is agent technology.

In this report, we examine agent technology in general as well as an interesting and potentially high-payback subset: mobile agents. We will also focus on a company at the forefront of this emerging technology: Amsterdam-based Tryllian B.V. By providing agent-specific development facilities, Tryllian enables software developers to create agent-enabled applications for a wide range of environments that include, but are certainly not limited to, emarketplaces, network and system management, detached systems, and personal productivity assistants.

The State of Mobile Agent Technology

IDC defines an agent as a software component acting as an autonomous and proactive delegate of its human (or automated) master.

IDC defines an agent as a software component acting as an autonomous and proactive delegate of its human (or automated) master. It is capable of gathering information about its environment, making decisions based on that information, and then performing delegated tasks derived from those decisions. Agents can be stationary and reside within a confined environment. For example, a personal email assistant that screens inbound email typically lives within the confines of the system. Mobile agents, on the other hand, can migrate to other systems over the network to perform their tasks. A manufacturer's diagnostic agents, for instance, could travel to systems experiencing problems, capture and analyze key metrics, query the manufacturer's diagnostic knowledge base, and either convey a known fix to the system's owner or optionally implement the fix. Although mobile agents represent the most controversial area of agent technology, they also offer tremendous potential. Regardless of whether agents are stationary or mobile, they must frequently collaborate with each other using facilities such as Tryllian's FIPA-based remote messaging services.

A Historical Perspective

Very few articles on agent technology have appeared in trade publications, and, as a result, one could easily get the impression that this technology is in its embryonic stages. Paradoxically, the impression would be both correct and incorrect.

For decades, agent technology has been an essential element of artificial intelligence (AI) projects in advanced research labs and academia.

For decades, agent technology has been an essential element of artificial intelligence (AI) projects in advanced research labs and academia. To a large extent, the proactive and autonomous essence of agent technology was overshadowed by the emphasis on AI, and agent technology remained relegated to the research environment.

The breakthrough, or, more appropriately, break away, came as a result of the increasing pervasiveness of distributed, networked systems.

The breakthrough, or, more appropriately, break away, came as a result of the increasing pervasiveness of distributed, networked systems. As these networks grew in expanse and complexity, it became virtually

impossible to monitor critical system and network resources. What was needed was proactive and autonomous software that could act as a system manager's agent in monitoring these resources.

Agent technology and high-performance small-footprint agents, devoid of AI trappings, fulfilled the need and migrated out of the research lab into the world of commercial software. The concept "took" in the network and system management arena. Today, the much-refined successors to these early agents live in virtually every major network management package now on the market.

The Escalating Demand

Once the technology had proven itself in the system and network management arenas, the proactive and autonomous characteristics of agent technology soon began to appeal to a broader audience. IDC sees today's manifestations of agent technology in a rapidly growing number of environments — online emarketplaces and e-auctions, chat rooms, personal assistants, and knowledge management, to name a few.

The recent advances and convergence on standards have also ultimately furthered the cause of agent technology.

The recent advances and convergence on standards have also ultimately furthered the cause of agent technology. In particular, the maturation of Java with its cross-platform capabilities, network services, and security capabilities has removed many of the communications barriers inherent in heterogeneous systems and provided a uniform and virtually globally accepted environment in which agents can operate.

IDC expects the market for software agents to grow from its $112.3 million level in 2000 to $1.31 billion in 2005.

Another interesting perspective on agent technology is the lack of a "technology bandleader." Unlike Java and Sun Microsystems, there is no major industry vendor carrying the agent technology banner to the marketplace. However, akin to the acceptance model of the Internet, the technology is surviving on its own merits. Thriving is perhaps a better term because IDC research pegs agent technology as one of the fastest growing markets in the software arena. As depicted in Figure 1, IDC expects the market for software agents to grow from its $112.3 million level in 2000 to $1.31 billion in 2005.

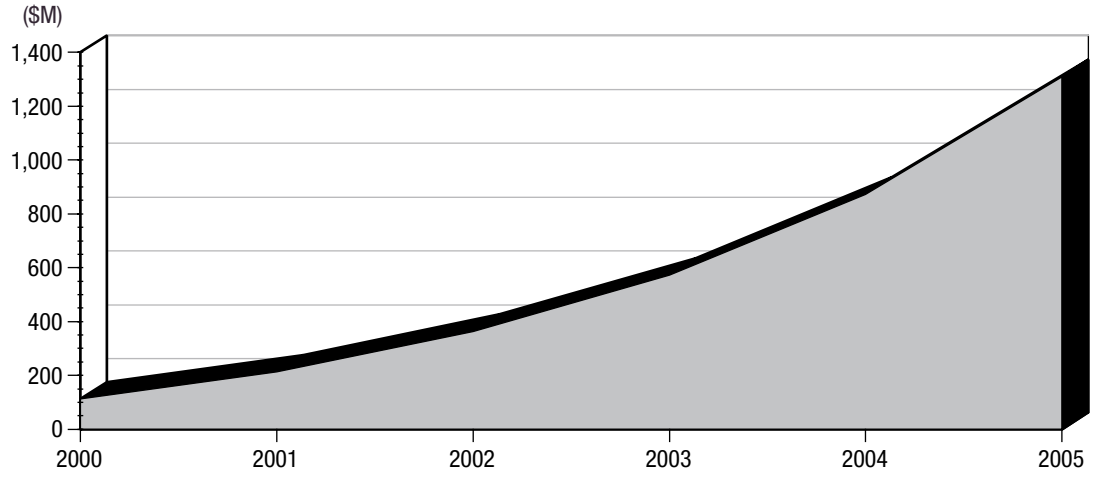
Agents at a Glance

The impetus for this growth lies in the nature and behavior of agents. Although space precludes a detailed discussion, Table 1 shows the constant and variable characteristics that have made agent technology so attractive to the development communities responsible for implementing today's ebusiness initiatives.

Facing the Challenges

Although IDC is clearly in the agent technology camp, we also believe the technology must eventually overcome significant challenges before it becomes generally accepted.

Figure 1
Worldwide Market for Software Agents, 2000–2005 ($M)



Source: IDC, 2001

Table 1
Agents at a Glance

The Constants	
Goal oriented	Agents have a mission that typically involves some degree of quantitative decision making.
Delegated responsibility	Agents act in lieu and on behalf of their human (or automated) master.
Autonomous and proactive behavior	Agents act proactively and independently in performing their specified tasks (i.e., human involvement is not required).
The Variables	
Domain expertise	Agents are domain-specific experts (i.e., a printer diagnostic agent is thoroughly familiar with the techniques for analyzing problems with a given printer, while an emarketplace trading agent understands how and when to bid on a given item.
Mobility	Agents can be stationary and operate within a constrained environment, or they can be mobile and migrate over the network to perform their delegated functions.
Security	The vast majority of agents adhere to some form of security scheme (e.g., digital certificates). The exception is the malicious virus.
Intelligence	The definition of intelligence is one of the more loosely defined terms used in conjunction with agent behavior. Today's agents fall into one of two classes: The most common class of agent operates within the context of user-defined constraints. The second class can alter its behavior based on experience (i.e., the agent has the ability to learn) or, alternatively, provide experienced-based feedback that allows changes to be effected.
Agent-agent collaboration	Agents display a range of socialization. Some agents function unilaterally, without the assistance of other agents. Others work collaboratively, each with its own goals, yet working together toward a larger end.
Agent-environment collaboration	Agents do not operate in a vacuum but within various software environments and domains. As such, agents must be able to communicate with various elements in that domain (assuming, of course, security privileges allow it).

Source: IDC, 2001

As was proven by Java, a fast-track technology can be extremely difficult to manage from a standards perspective.

- **Standards.** The industry has already recognized the need for standards, and the European-based Foundation for Intelligent Physical Agents (FIPA at **www.fipa.org**) was founded in 1996 to form critical agent-oriented standards. Developing agent standards is nontrivial for multiple reasons. As domain-specific entities, agent characteristics will vary dramatically from domain to domain. The high-growth potential is also a factor. As was proven by Java, a fast-track technology can be extremely difficult to manage from a standards perspective.

- **Agent-to-agent interoperability.** Although it may be virtually impossible to standardize every aspect of agent technology, one essential area, and an area where FIPA is extremely active, is the interoperability issue. In a CyberSmart environment comprised of multiple companies and multiple systems, the need for collaboration between different agents from different vendors becomes mandatory. Using the history of messaging systems as an example, it was only when the industry began focusing on a limited subset that the doors opened to a much freer flow of information. FIPA hopes to avoid a repeat of those painful lessons.

Reputable vendors recognize the potential exposure associated with privacy and security issues and are doing everything within their power and means to provide a safe and secure agent-enabled environment.

- **Privacy and security.** With the increasing use of agents in ebusiness scenarios comes the potential for these agents to gain access to extremely sensitive data. Because agents do no more or less than is programmed into their behavior, one of the real questions becomes the ethics and scruples of the company that creates the agents and uses the information obtained by the agents. Another question lies in the transfer of information over the Internet and its vulnerability. Reputable vendors recognize the potential exposure associated with privacy and security issues and are doing everything within their power and means to provide a safe and secure agent-enabled environment.

Tryllian: Agents on the Move

Founded in March 1998, the Tryllian vision is to be a leading innovator in mobile agent technology and open the technology to forward-looking companies that can see this technology's potential. To that end, the company marries a forward-looking technology vision with an aggressive practicality demanded by today's corporate Internet initiatives — a philosophy reflected throughout the company's products.

Corporate Introduction

- **Financials.** The company is privately held and venture-capital-funded. Tryllian received its first round of venture capital funding from NPM Capital and Twinning Seedfund B.V. in 1999.

Management additions have also included sales and marketing managers who will take the Tryllian message to the U.S. and European markets.

- **Management team.** As might be expected, the core management team is small and technology-heavy, although some changes are occurring. Management additions include sales and marketing

managers who will take the Tryllian message to the U.S. and European markets.

- **Product strategy.** Tryllian provides an integrated Java-based development, deployment, and management framework that its customers can use to create secure, robust, agent-enabled applications. Essentially, Tryllian provides the underlying agent-enabled platform and related services, while the Tryllian customer (typically in conjunction with Tryllian support services) adds the domain-specific intelligence.

  Tryllian initially offered pure agent-oriented services; however, as the company continues to move into different environments with its various customers, it is also adding commonly used horizontal and vertical functionality to a growing library of services.

  In addition to selling its ADK to developers, which will develop and host their own applications, Tryllian will also develop and host applications for companies wishing to use agent technology but that do not wish to develop and/or host their own systems.

To help penetrate both the European and U.S. markets, Tryllian maintains a presence in both geographies.

- **Sales strategy.** To help penetrate both the European and U.S. markets, Tryllian maintains a presence in both geographies. The company's corporate headquarters is in Amsterdam, and its U.S. headquarters is in San Jose, California. The sales and marketing efforts currently target two primary audiences in both Europe and the United States. One group is the large and/or influential corporation. Here the company is rightfully seeking to build credibility within the end-user IT community. Concurrently, to build volume, Tryllian's channel strategy targets software independents, system integrators, and so on. The good news for both of these communities is that the company is obviously committed to ensuring the success of these initial technology initiatives.

The Tryllian Product Suite

In a highly graphic environment, a Gossip user first specifies an area of interest and then sends an agent out to retrieve topical information from generic user-specified sources.

Although the company's flagship products are its ADK and its Agent Runtime Environment (ARE), we would be remiss not to mention Tryllian's free, downloadable Gossip — a Tryllian-built intelligent Web surfer and a superb visual and functional demonstration of proactive and autonomous mobile agent behavior. In a highly graphic environment, a Gossip user first specifies an area of interest and then sends an agent out to retrieve topical information from generic user-specified sources (i.e., search engines, databases, other agents) — with instructions to terminate the search after a specified period of time. For those who are new to agent technology, Gossip is a "must see." Equally important to development organizations that want to look under the covers and see how it is done, Tryllian provides the source for Gossip — both for educational purposes and optionally for additional customization if appropriate to its customers' needs.

The Tryllian Environment

The Tryllian environment comprises two main functions (see Table 2): an agent development environment that employs Tryllian's agent constructors and foundation classes and an agent runtime environment that then manages the "live" agents and provides the essential system services needed by those agents (security services, messaging services, transport services).

Table 2
Tryllian Agents at a Glance

The Constants	
Goal oriented	
Delegated responsibility	Full compliance
Autonomous and proactive behavior	
The Variables	
Domain expertise	Domain expertise is typically added by customer in conjunction with Tryllian support personnel or procured from Tryllian.
	Tryllian also continues to add to its domain-specific software library.
Mobility	Optimized for mobile behavior, although stationary agents can be implemented.
Security	Agent-specific controls, as well as support for digital certificates
Intelligence	Agent intelligence typically added by customer in conjunction with Tryllian support personnel or procured from Tryllian.
	Tryllian also continues to add to its domain-specific intelligence.
Agent-agent collaboration	Optimized for local and remote agent collaboration, although unilaterally functioning agents can be implemented.
Agent-environment collaboration	Optimized for execution in a Java environment, either Unix or NT.

Source: IDC, 2001

Development essentially involves expanding these foundation classes with customer-specific Java application code.

Development

In its Agent Foundation Classes, Tryllian provides a full selection of agent templates. Development essentially involves expanding these foundation classes with customer-specific Java application code. Currently this process is coding-intensive; however, Tryllian is investigating various graphical constructors and plans to introduce these capabilities at a later date. More important, while the graphic facilities are not yet there, the functionality is, and IT development organizations have access to a broad gamut of agent-based capabilities, including the following:

- **Mobility.** This is a keystone characteristic of Tryllian agents. If the agent is moving to a different location on the same system (e.g., into a different discussion group or trading session), only the agent's data and state information need be moved. If the migration is to a remote location, the agent's code must also be transported. Tryllian provides the services that realize these different migration scenarios.

Although true mobility may be desirable in certain situations, messaging between stationary agents may be more appropriate in other situations.

- **Messaging.** Although true mobility may be desirable in certain situations, messaging between stationary agents may be more appropriate in other situations. For example, a diagnostic agent that has determined the problem with a printer has no need to migrate back to the corporate knowledge base to retrieve the fix. A simple message to a collaborating agent with access to that database should suffice. For such collaboration, Tryllian provides a rich set of FIPA-based messaging services utilizing XML-formatted plain text messages. The combination of XML and plain text messages not only provides for Tryllian-to-Tryllian agent collaboration but also offers the flexibility needed for easy integration with other agent systems.

A second level of security can be applied when remote agents need to communicate with one another. Here, Tryllian supports the creation and validation of digital certificates.

- **Security.** Tryllian addresses the security issue on a variety of levels. One level deals with the actions an agent is allowed to perform (e.g., whether it can or cannot communicate with other remote agents, whether it can or cannot access various system resources, such as the host's database). This level of security is developer-defined when the agent is created. A second level of security can be applied when remote agents need to communicate with one another. Here, Tryllian supports the creation and validation of digital certificates.

Testing

Although the Java platform debugging API (JPDA) can be used in the testing phase, a higher level of testing is available through Tryllian's "inspectors."

Although the Java platform debugging API (JPDA) can be used in the testing phase, a higher level of testing is available through Tryllian's "inspectors." These inspectors provide a higher-level view of the agent environment and the operations and properties associated with the agents in the environment. Developers can also utilize inspectors to send messages directly to an agent and evaluate the agent's behavior in response to that message, to create (or remove) agents, to alter agent and environmental properties, and to trace the developer-selected actions performed by an agent.

Management

Because the commercial application of agent technology is so new, Tryllian is working with its customers to determine what facilities should be available in a management tool.

Where Tryllian's testing facilities are designed for the preproduction phase, management facilities provide insight into and the ability to adjust certain parameters in the production system. Targeted primarily for use as a system administration tool, this facility provides facilities such as sets and inspects system properties and notifies the administrator of agents that violate their security privileges. Because the commercial application of agent technology is so new, Tryllian is working with its customers to determine what facilities should be available in a management tool.

Opportunities and Challenges

IDC believes Tryllian sits on the brink of an explosion in market demand.

IDC believes Tryllian sits on the brink of an explosion in market demand. The challenge will be for this small company to gain visibility within the market. Agent technology is surprisingly unique in that the industry publications have not yet picked up and focused on the technology. Such disinterest essentially removes one of the classic vehicles used to reach prospects.

Given the relative newness of agent technology in non-network-management environments, Tryllian must play the role of evangelist, as well as technology provider. Add the current efforts involved in strengthening the company's sales and marketing organization, and the Tryllian plate is quite full.

That said, Tryllian not only has the technology but also is being used successfully in commercial installations. Although agents will be a new concept for many IT organizations, their extensive use in network management, plus an almost intuitive appropriateness as a solution to certain issues, legitimizes the technology.

Summary and Conclusion

With the advent and global acceptance of the Internet and the precepts comprising IDC's CyberSmart Computing, the opportunities for the judicious application of agent technology have skyrocketed.

In the annals of computing history, agent technology has previously (and rightfully) been tagged as a technology solution looking for a problem to solve. With the advent and global acceptance of the Internet and the precepts comprising IDC's CyberSmart Computing, the opportunities for the judicious application of agent technology have skyrocketed. Yes, there are barriers to overcome. However, as Tryllian and its customers prove that mobile agents provide secure, robust commercial value, the barriers will ultimately fall. For market and technology-aggressive companies that see and understand this value, the competitive opportunities are enormous, and such companies would do well to look at Tryllian's agent technology.

NORTH AMERICA

Corporate Headquarters
5 Speen Street
Framingham, MA 01701
508-872-8200

IDC Canada
36 Toronto Street, Suite 950
Toronto, Ontario
Canada M5C2C5
416-369-0033

IDC Irvine
18831 Von Karman Ave, Ste 200
Irvine, CA 92612
949-250-1960

IDC Mountain View
2131 Landings Drive
Mountain View, CA 94043
650-691-0500

IDC New Jersey
120 Wood Ave South, Suite 509
Iselin, NJ 08830
732-632-9222

IDC New York
2 Park Avenue
Suite 1505
New York, NY 10016
212-726-0900

IDC Texas
100 Congress Ave, Suite 2000
Austin, TX 78701
512-469-6333

IDC Washington
8304 Professional Hill Drive
Fairfax, VA 22031
703-280-5161

ASIA/PACIFIC

IDC Asia/Pacific (Hong Kong)
12/Floor, St. John's Building, 33 Garden Road
Central, Hong Kong
852-2530-3831

IDC Asia/Pacific (Singapore)
71 Bencoolen Street, #02-01
Singapore 189643
65-226-0330

IDC Australia
Level 4, 76 Berry Street
North Sydney
NSW 2060, Australia
61-2-9922-5300

IDC China
Room 611, Beijing Times Square,
88 West Chang'an Avenue, Beijing,
P.R. China, 100031
86-10-8391-3456

IDC (India) Limited
Cyber House
B-35, Sector 32 - Institutional
Gurgaon - 122002
Haryana, India
91-124-6381673 to 80

IDC Japan
10F The Itoyama Tower
3-7-18, Mita Minato-ku
Tokyo 108-0073, Japan
81-3-5440-3400

IDC Korea Ltd
Suite 704, Korea Trade Center
159-1, Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-729
82-2-55-14380

IDC Malaysia
Suite 13-03, Level 13, Wisma KiaPeng
No. 3, Jalan Kia Peng
50450 Kuala Lumpur, Malaysia
6-03-2163 3715

IDC New Zealand
Level 7, 246 Queen Street
Auckland, New Zealand
64-9-309-8252

IDC Philippines
7F, SEDCCO 1Bldg
Rada Street Corner
Legaspi Street
Legaspi Village
Makati City, Philippines
632-894-4808

IDC Taiwan Ltd.
10F, 31
Jen-Ai Rd, Sec 4,
Taipei 106, Taiwan, R.O.C.
886-2-2731-7288

IDC Thailand
27 Soi Charoen Nakorn 14
Charoen Nakorn Road, Klongtonsai
Klongsan Bangkok 10600, Thailand
66-2-439-4591-2

IDC Vietnam
37 Ton Duc Thang Street
Unit 1606
District-1 Hochiminh City Vietnam
84-8-910-1235

LATIN AMERICA

IDC Miami
Latin America Headquarters
8200 NW 41 Street
Suite 300
Miami, FL 33126
305-267-2616

IDC Argentina
Trends Consulting
Rivadavia 413, 4th Floor, Suite 6
C1002AAC, Buenos Aires, Argentina
54-11-4343-8899

IDC Brasil
Alameda Ribeirão Preto, 130 cj 41
01331-000 São Paulo
SP Brazil
55-11-253-7869

International Data Corp. Chile
Luis Thayer Ojeda 166 Piso 12
Providencia, Santiago 9, Chile
56-2-231-0111

IDC Colombia
Carrera 40 # 103-78
Bogota, Colombia
571-533-2326

IDC Mexico
Select - IDC
Av. Nuevo Leon No. 54 Desp. 501
Col. Hipodromo, Condesa
C.P. 06100 Mexico, D.F.
52-5-256-1426

IDC Venezuela
Calle Guaicapuro
Edif. Torre Seguros Alianza
Piso 6, Ofc. 6-D, El Rosal
Caracas 1060, Venezuela
58-2-951-3270

EUROPE, MIDDLE EAST, AND AFRICA

IDC Austria
c/o Loisel, Spiel, Zach Consulting
Mayerhofgasse 6
A-1040 Vienna, Austria
43-1-50-50-900

IDC Benelux (Belgium)
29 Avenue Louis Gribaumont
B-1150 Brussels, Belgium
32-2-779-46-04

IDC Benelux (The Netherlands)
A. Fokkerweg 1
1059 CM Amsterdam
The Netherlands
31-20-669-2721

IDC Central Europe (ECE)
Male Namesti 13
Praha 1 110 00, Czech Republic
420-2-2142-3140

IDC Central Europe (Germany)
Nibelungenplatz 3, 11th Floor
60318 Frankfurt, Germany
49-69-90502-0

IDC Central Europe (Switzerland)
Niederlassung Züerich
WTC, Leutschenbachstrasse 95
CH - 8050 Züerich
Switzerland
41-1-307-1000

IDC Egypt
39 Iraq Street
Mohandesseen, Cairo, Egypt
20-2-336-7355

IDC France
Immeuble La Fayette
2, Place des Vosges, Cedex 65
92051 Paris la Defense 5, France
33-14-904-8000

IDC Hungary
Nador utca 23, 5th Floor
H-1051 Budapest, Hungary
36-1-473-2370

IDC Israel
4 Gershon Street
Tel Aviv 67017, Israel
972-3-5611660

IDC Italy
Viale Monza, 14
20127 Milano, Italy
390-2-284-571

IDC Nigeria
House 2, 'C' Close, 403 Road, 4th Avenue
New Extension, Festac Town
Lagos, Nigeria
234-1-883585

IDC Nordic (Denmark)
Jagtvej 169B
DK-2100 Copenhagen, Denmark
45-39-162222

IDC Nordic (Finland)
Jarrumiehenkatu 2
FIN-00520
Helsinki, Finland
358-9-8770-466

IDC Nordic (Sweden)
Box 1096 Kistagången 21
S-164 25 Kista, Sweden
46-8-751-0415

IDC Poland/ProMarket
Wrobla 43
02-736 Warsaw, Poland
48-22-754-0518

IDC Portugal
Av. Antonio Serpa, 36 Piso 9
1050-027 Lisbon
Portugal
351-21-796-5487

IDC Russia
c/o PX Post, RDS 186
Ulitsa Zorge 10
Moscow 125525
Russian Federation
7-501-929-9959

IDC South Africa
c/o BMI-TechKnowledge
3rd Floor, 356 Rivonia Blvd.
PO Box 4603, Rivonia, 2128
South Africa
27-11-803-6412

IDC Spain
Ochandiano, 6
Centro Empresarial El Plantio
28023 Madrid
34-91-7080007

IDC Turkey
Tevfik Erdonmez Sok. 2/1 Gul Apt.
Kat 9D; 46 Esentepe
Istanbul, Turkey
90-212-275-0995

IDC U.K.
British Standards House
389 Chiswick High Road
London W4 4AE
United Kingdom
44-20-8987-7100

IDC is the foremost global market intelligence and advisory firm helping clients gain insight into technology and ebusiness trends to develop sound business strategies. Using a combination of rigorous primary research, in-depth analysis, and client interaction, IDC forecasts worldwide markets and trends to deliver dependable service and client advice. More than 700 analysts in 43 countries provide global research with local content. IDC's customers comprise the world's leading IT suppliers, IT organizations, ebusiness companies and the financial community. Additional information can be found at www.idc.com.

IDC is a division of IDG, the world's leading IT media, research and exposition company.

Sponsored by Tryllian
01-348SOFTWA2915
April 2001

IDC
5 Speen Street • Framingham, MA 01701
(508) 872-8200 • Fax (508) 935-4015 •
www.idc.com