Zoteca BackEnd (ZBE)

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1 What is the Zoteca BackEnd (ZBE)?

With all the hype and counter-hype surrounding the Dot-com bubble, it is easy to lose sight of the fact that fundamental shifts *have* occurred in the world of information technology (IT). In the past, a company's IT infrastructure was locked behind the organizational walls and access to the corporate database was restricted. Internet technologies accelerated the trend started by the PC revolution, opening up the database to many different groups and individuals within the enterprise. The Internet boom also accelerated the inter-connection of corporate databases across organizational boundaries.

Building IT infrastructures in large organizations is never simple. But Intranets and Extranets add new layers of complexity to an already exceedingly complex task. First there is the complexity resulting from the heterogeneous nature of IT infrastructures. Multiple operating systems are in use both at the client level and certainly at the server level. Different DBMS software, different network operating software, different communication protocols all add to the complexity. This is true not only between organizations, but even within one organization.

Then there is the inherent complexity of the applications themselves. Internet applications are distributed — they involve multiple computers, both client and server. They are event-driven — some event occurs in one location which effects what must be done in another location. They are asynchronous — the reaction to the event may occur at a later time.

Finally there is the complexity of the network environment. True, the whole idea of the Internet is that all computers are inter-connected. But the strength of that connection varies widely. At some places in the network, especially at the edges, the connection can be very tenuous.

Internet technology is exciting because it apparently simplifies this complexity by doing two things:

1. providing a common protocol — HTTP — for cross-organizational communication;
2. providing a common front-end — the Web browser — to back-end databases.

It is therefore no surprise that recently, a new buzzword has arisen: Web services. Proponents claim that HTTP-based protocols should be used to create cross-organizational distributed applications that allow Intranets and Extranets to seamlessly work in the heterogeneous world of contemporary IT.

However, as someone once said, when all you have is a hammer, everything looks likes nails. Despite all the nice features of the Web, it is often not the appropriate means of communication. Anyone forced to use Web-mail while on the road, knows why an email client is so much superior. And the ever-growing popularity of instant messaging (IM) shows that in many cases email isn't the best way to communicate either. Many corporate applications have sophisticated GUI front-ends, for which a Web browser may be too limited. Similarly, HTTP was created as a publishing protocol. It was never meant to be a protocol for inter-process communication. In fact, it is quite bad at doing that — not least because it is inherently one-way, and communication needs to be two-way.

To reduce the complexity of building asynchronous, event-driven, applications for a distributed network environment, what is needed are:

1. a simple, efficient, yet powerful protocol that supports asynchronous, two-way communication;
2. support for the multiple-protocol service standards that are currently in use for inter-networking, both proprietary and open standard;

3. a multi-platform tool-set that will allow the application to use whatever front-end service is in fact appropriate, and multiple services if need be;
4. practical tools for the implementation of business process and workflow models.

The Zoteca BackEnd (ZBE) framework provides these fundamental requirements and more. It serves as a powerful work environment for rapid development and deployment of network aware applications.

2 Remote Object Protocol

The core of the ZBE is a sophisticated, asynchronous, multiplexed and two-way remote object protocol. Whenever the need arises to develop a new protocol, the ROP can be used to quickly implement it. Because the ROP is used with object-level abstractions, changes can be made easily, and new features added, without having to deal with the design restrictions and application development complexities of a custom protocol. For the very same reason, the ROP can be used to work with any existing protocol and model new ones. The ROP is:

Efficient The ROP uses a fast, simple binary encoding. In comparison, XML-RPC or SOAP messages use at least 5 times as many bytes to transfer the same message. Because it is asynchronous, multiple commands can be sent at once, without having to wait for a reply.

Two-way Unlike many other protocols, the ROP allows two way communication — the server can call published objects on the client. This is very important for event notification. In HTTP-based protocols (Web services), there is no way for the server to notify the client that a new event has occurred, since HTTP only allows responses to client requests. The result is that you need to constantly poll the server for new events. With ZBE's ROP, event notification can be done in a much cleaner and efficient manner, since it is two-way and asynchronous.

RAD The ROP allows developers to publish objects in a very simple fashion, and supports multiple services over the same connection. This allows rapid application development and deployment of new services.

Secure The ROP is designed to make secure development easy, using a capabilities-based model (see below), and integrated support for authentication and encryption.

Multi-Language Implementations in Java and Python are currently available. Support for additional programming languages can be added as well.

3 Protocols and Services Support

3.1 Standards Protocol Support

Out of the box, ZBE supports a large number of service protocols: HTTP, FTP, SMTP, LDAP, DNS, SOCKSv4, IRC, telnet, POP3, AOL's instant messaging and more. This allows developers to use these protocols immediately, without having to spend time re-implementing them. In addition, ZBE can talk to multiple, industry standard DBMS. It also can be used to communicate with CORBA, JBE and .NET (COM+) servers and to control and integrate with standard Windows applications (Word, Excel, etc.).

3.2 Simultaneous Multiple Protocol Support

Unlike other frameworks, which are designed to address a specific domain — email, Web sites, Web services — ZBE is designed to support both multiple frameworks and multiple protocols at the same time. Thus, ZBE can be used to implement web sites or services, email servers, instant messaging servers. Moreover, these services can all run in the same process.

Why is this important? In today's networked world, applications rarely need to talk only one protocol, or support just one service. Virtually any server application will probably want a web interface for monitoring and configuration, while simultaneously providing a more sophisticated GUI front-end for most users. Email notification, SNMP monitoring — all involve additional protocol support.

3.3 Fast Protocol Development

In order to facilitate fast protocol development, ZBE provides abstractions and support classes for many common tasks of protocol implementors. These include:

- Building blocks for common types of protocols, e.g. line-based protocols such as HTTP or SMTP
- Separation between protocol and transport, allowing transport replacement (e.g. replacing TCP with SSL)
- Standard transport support — TCP, UDP and SSL

Additionally, any system that provides a C or Java API can be connected to the ZBE.

4 Tool-Set Features

4.1 Multi-Platform Support

ZBE runs on top of a number of platforms: Unix (in various flavors, including Linux), Windows (in various flavors) and Java. .NET support will be available in the future. Unlike a Java-only solution, ZBE can easily take advantage of platform specific features. For example, when running on Windows, COM support is available, while when running on Java all Java libraries can be used to extend an application. On Unix, ZBE can daemonize, use Unix IPC, etc.

4.2 Authentication and Access Control

ZBE includes powerful abstractions for identities and capabilities, that are used throughout the framework, including the web system, the remote object protocol and the email and instant messaging servers. The system differentiates between identities ("who you are") and capabilities ("what you can do"). Each service matches up between identities and their granted capabilities, allowing access to the same resources via different protocols and authentication mechanisms. The user databases are pluggable (memory-based, LDAP, RDBMS and so on) and different authentication mechanisms are supported, as necessary for each protocol. This capabilities-based model of authentication provides a powerful, simple and practical tool for implementing business process and workflow models.

4.3 Configuration and Deployment

ZBE supports a sophisticated system for storing complex presets and configurations. Once a specific system setup has been implemented, it can be encapsulated in a configuration preset, allowing quick deployment in the future. Servers can be configured via a web based system, allowing customization of running servers, or generated using command line tools.

4.4 Logging

ZBE includes a logging subsystem, supporting automatic log rotation and remote log viewing.

4.5 Metrics

Metrics about the server, including CPU and memory usage, protocol specific statistics, etc., can be collected to a centralized server and browsed via a web interface.

4.6 Open Standards

The ZBE is based on non-proprietary, open standards. An open source version is available.

5 Example Applications

The ZBE has been used to develop many different services and systems, including:

- Event notification services;
- Online help desk;
- Highly coupled distributed servers;
- Centralized metrics collection for servers (CPU, memory usage, server specific stats);
- Multi-player games.

What follows are details on two such applications.

5.1 Email Server

Consider an integrated email server. A ZBE-based system provides the following features:

- SMTP, POP3 and IMAP support.
- Mailing list support, including NNTP support, both for newsgroup subscription and publishing.
- Web based interfaces for email access and mailing list subscription.

- Management interfaces, both web based and GUI (the GUI would connect to the server using the ROP).
- Authentication of users and administrators via the different protocols, and pluggable back-ends for users (e.g. LDAP or Unix users).

Using ZBE, developing such a system is far easier than with any other existing system. Many of the necessary protocols are already supported, and new ones can be easily added. The same back-ends can be used for authentication for the different protocols, and the same interfaces for both the web and GUI based administration tools. Use of the ROP allows remote-access control of any aspect of the server, without having to design a new protocol from scratch. Additionally, building load-balancing and fall-over servers can be easily done with the ROP.

5.2 Zoteca's Data Sharing Server

Zoteca's has developed a set of infrastructure platforms based on a unique technology, which allows for simultaneously efficient and safe data sharing. [Further details on these platforms can be found in our other white papers and on our website.] We wanted data sharing to take place without the need for active push or pull operations. Hence two-way, asynchronous event-notification is a critical part of the back-end of these platforms. Because of security concerns, we also wanted to allow sharing to take place without have to open up the corporate firewall. A two-way efficient protocol was critical. We wanted to support heterogeneous IT infrastructures. The ZBE provided the perfect development framework, and Zoteca's platforms use many of it's advanced features. Specifically they use an efficient custom protocol for data exchange, while event notification is done using the ROP. The single process, multi-protocol aspect is also exploited. For example, statistics for the server can be viewed using a web based interface.

6 Conclusion

As noted above, Zoteca originally used the ZBE to develop our own sophisticated, event-driven, distributed network applications. We soon understood that we were working with the most advanced system available for the creation of such applications. The ZBE significantly reduces the time needed to develop event-driven network applications as well as to maintain and extend them, and so provides huge cost savings. Equally important, by reducing complexity while increasing protocol choices, ZBE allows for rapid development of network applications that are productivity enhancing, resource efficient and organizational friendly.

Zoteca is now offering the following software and services:

- a fully supported, licensed version of the ZBE;
- training in using the ZBE for in-house development;
- consulting services for building ZBE-based applications;
- consulting services for extending the ZBE, e.g. additional protocol support.

Founders

Aron Trauring — CEO. Aron has worked nearly 25 years in technical development and management and international sales and marketing for high-tech companies in the US and abroad, including a stint as Director of European Sales at AMDOCS. Seven years ago he co-founded an interactive agency, MAXIMA Multimedia (http://www.maximam.com). He also co-founded an Internet B2B ASP two years ago.

Itamar Shtull-Trauring — Chief Technology Architect. Itamar has worked professionally in software technology development for nearly seven years. He studied computer science and mathematics at Tel Aviv University and is the author of several patents. He most recently served as the chief programmer at an Internet startup.

Board of Advisors

Dr. Mahadev Satyanarayanan Professor Satyanarayanan is the Carnegie Group Professor of Computer Science at Carnegie Mellon University. An experimental computer scientist, he has pioneered research in the field of mobile information access. An outcome of this work is the Coda File System, which provides application-transparent support for disconnected and weakly-connected operation. Key ideas from Coda have been incorporated by Microsoft into a forthcoming release of the Windows NT file system. More recently, Satyanarayanan and his research group have been working on application-aware adaptation, a more general approach to mobile information access. This concept is being explored in the context of a new platform, Odyssey.

Dr. David Chaum — Founder and a member of the Board of Directors of DigiCash Inc., a company that has pioneered electronic cash innovations. In the area of cryptography, Dr. Chaum has published over 45 original technical articles, received over 17 US patents, and founded the scientific organization, the International Association for Cryptographic Research (IACR). Concurrently he created and chaired the Smart Card 2000 conferences and several European Union funded industry consortia, including CAFE, which focused on electronic-wallets and the smart cards they hold. He built up a cryptography research group at the Center for Mathematics and Computer Science (CWI) in Amsterdam and during this time also founded DigiCash.

Dr. Mel Horwitch — Professor of the Management and Chair of the Department of Management at Polytechnic University and founding Director of the Institute for Technology and Enterprise. He is also Visiting Professor at London Business School. Previously he was Professor and Founding Dean of Management at Theseus Institute in Sophia Antipolis, France, serving on the Theseus Board of Directors and Theseus Scientific Advisory Board. He has written extensively on innovation and technology strategy, particularly with reference to such knowledge-intensive sectors as services, information technology, and telecommunications.

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