Crystal Enterprise 10

▶ *Technical Overview*

BUSINESS OBJECTS®

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Audience: IT managers, project managers, developers

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Executive Summary

The need for business intelligence (BI) has never been greater, as the gap between the amount of information available and our ability to analyze and understand it is widening.

Crystal Enterprise™ can provide any organization with the power it needs to understand its corporate information, in one integrated solution for reporting and delivery. For any data source or application, our technology provides an open, customization solution for providing secure access to interactive reports.

This white paper provides a technical overview of the Crystal Enterprise product suite including Crystal Reports® and Crystal Analysis®.

Introduction: Reporting Across the Enterprise

The ready availability of information—whether it's in the form of a short email alert, a nugget of data embedded in an Office document, or a highly-formatted report—drives successful business. Reporting from Business Objects can ensure the consistent flow of information throughout your organization.

Reporting from Business Objects can provide every organization with a powerful, integrated solution for understanding corporate information. For any data source or application, our technology provides an open, customizable solution for providing secure access to interactive reports.

As the core reporting technology in the Business Objects product line, Crystal Enterprise and Crystal Reports benefit from more than ten years of experience in the development and deployment of scalable, reliable enterprise reporting systems. Designed exclusively for the web and mission-critical applications, Crystal Enterprise offers a cost-effective solution for integrating reporting into intranets, extranets, and enterprise portals.

Harnessing the power and pedigree of Crystal Reports, a world-standard for high-performance report design, our enterprise reporting technology is a proven and effective solution for scaling reporting to hundreds of thousands of people.

The Power of a Common Platform

Unlike other central reporting architectures, Crystal Enterprise is designed to integrate seamlessly with your existing data, web, and application investments without imposing a new set of standards and processes. To help you succeed with your information-driven business initiatives, we offer:

- A rich user experience that can be integrated with existing workflows and applications
- A powerful report authoring environment for transforming any data into an interactive report
- Flexible developer interfaces to enable rapid integration with existing web applications
- A scalable infrastructure capable of supporting multiple applications and heavy user loads

The result is a common platform that can enrich any application and support virtually any reporting need.

Rich End User Experience

Crystal Enterprise helps end users quickly find and explore critical business information.

Extending a report beyond the bounds of a printed document or static web page, our technology allows users to easily drill-down into reports, navigate through a group of related reports, and embed live data in Microsoft Office documents.

► **Interactive DHTML Viewing**

DHTML provides rich functionality for viewing and interacting with web content. Unlike plug-in based technologies, DHTML requires no software downloads and no special configuration to enable viewing, making it ideal for deployments through a firewall without compromising security.
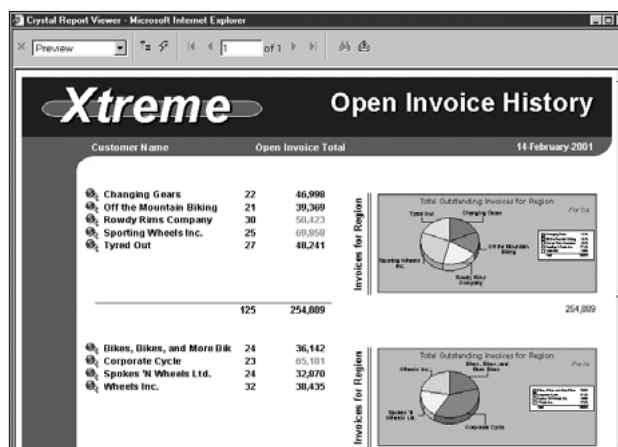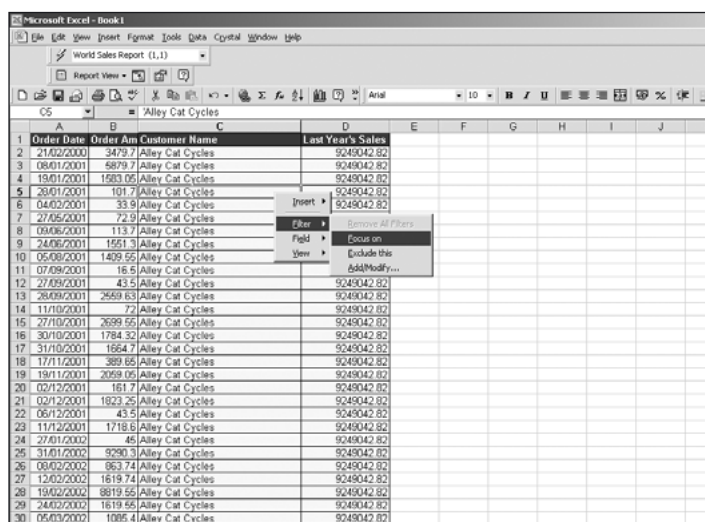

Figure 1: The Crystal Reports web viewer allows users to view, navigate, print and export reports. You can also embed the viewer into web applications and tailor the look and feel to match your application requirements.

Our embeddable zero-client report viewer provides full interactivity and drill-down in a zero-client environment. This includes presentation of rich formatting (high definition graphs, charts and maps) and the ability to drill-down, print (Small ActiveX download required), search and export report results. Advanced viewer capabilities include sorting, filtering, and adding/removing report columns. You can configure viewer capabilities at the application and group/user level.

The viewer for analytic content also uses pure DHTML to support analysis of OLAP data. High-quality worksheet views, charts, drag and drop functionality, and full slicer/dicer capabilities are available in this rich interface.

► Microsoft Office Integration

Unlike most other enterprise reporting systems, Crystal Enterprise embraces Microsoft Office as an interactive reporting client. You can embed live report data into Excel worksheets and refresh it on-demand or upon the next scheduled run of the underlying report. Unlike a static Excel or CSV export, the Excel spreadsheet retains a dynamic link to a Crystal Report or Crystal Analysis file.

Figure 2: The Crystal Enterprise Add-In for use with Microsoft Excel enables you to extend the value of existing formatted reports by giving users access to live, up-to-date report data in Microsoft Excel.

Crystal Enterprise can also store and manage Excel spreadsheets, Word documents, and PowerPoint presentations. This allows end users to readily share their Excel analyses and other documents with other users.

► Guided Navigation

Most users need to consume multiple reports to monitor key aspects of the business. Often these reports look at different dimensions of the business to provide varying levels of detail around a specific subject area. With Crystal Enterprise, users can easily navigate through a package of related reports using hyperlinks, rather than finding and exploring each report separately.

Unlike a conventional hyperlink, Guided Navigation provides an intelligent linking mechanism between related reports or within a single report. Data context is passed through hyperlinks, guiding users to the exact location of interest in large reports. Hyperlinks and navigation paths are established by the report designer or a departmental power user.

► Alerting and Notification

Alert notification highlights critical information by delivering alerts (when triggered) directly to users' email. Administrators can specify individuals or distribution lists; they can also configure notification to provide a link back to the report, along with a set number of records from the report.

Your users can directly configure alerting through parameters. Users can specify alerting thresholds when scheduling a recurring report. By setting up schedules and thresholds for a number (or package) of reports, users can easily monitor a range of critical data points by email.

► Export Formats and Offline Use

Outputting web content to a variety of standard formats for printing, viewing, and further analysis is a key requirement for an information delivery system. Crystal Enterprise provides built-in support for high-fidelity output to Adobe Acrobat (PDF), Microsoft Excel and Word (RTF) and native Crystal Reports format. All exports are generated off "snapshots" of report pages to ensure high-fidelity output.

Powerful Report Authoring

Crystal Enterprise allows you to increase end user satisfaction with rich, flexible reports.

Crystal Enterprise integrates Crystal Reports and Crystal Analysis to enable rapid creation of interactive reports from virtually any enterprise data source.

With Crystal Reports, report designers can readily share and re-use common data access, formatting, and business logic elements to speed development cycles. A rich formula language and set of layout controls allow extensive control over data manipulation and report design.

Crystal Analysis gives analysts a powerful tool for exploring multi-dimensional data and building interactive reports for end users. It provides: connectivity to a variety of multidimensional data sources, extensive analytic functionality, data-based formatting and highlighting, and flexible controls for linking together multiple views into interactive briefing books.

Crystal Reports and Crystal Analysis' ease-of-use also extend report design capabilities to a broader base of users in your organizations. Instead of concentrating report design in an overworked, centralized group, you can spread designers across different business units and get them closer to the actual report consumers.

► Data Access

The most valuable reports are often the ones that combine data from multiple sources into a single view. For example: users need to understand customers from a variety of angles (e.g. purchasing history, technical support incidents, demographics, support contracts, ongoing projects, etc.).

Crystal Enterprise provides IT organizations with an unprecedented ability to simplify access to multiple data sources. Administrators can pre-define data sources for report designers, abstracting away the complexity of table joins, SQL statements and performance tuning. Report designers simply logon to the Crystal Enterprise system, navigate through a folder of pre-defined data sources and choose the subject area required for a particular report.
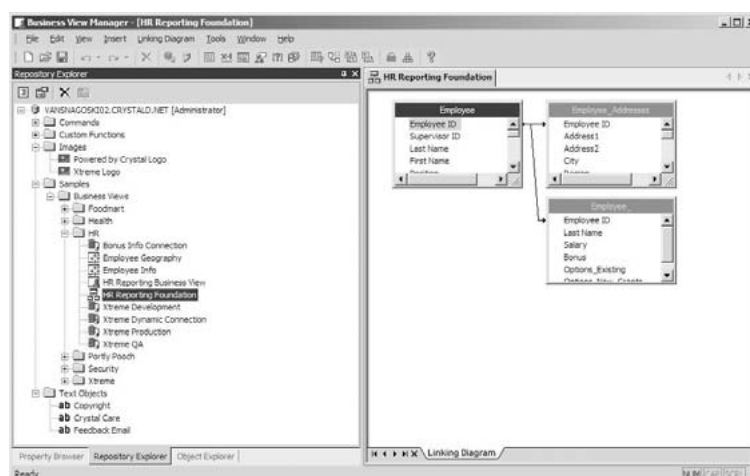

Figure 3: The Business View Manager helps you build simplified data sources for your report designers. You can integrate data from multiple sources, join tables, alias fields and apply row and column security. The resulting Business View is saved to Crystal Enterprise and can be used as the basis of a report design.

While data access can be simplified for report designers, this doesn't mean giving up control. Crystal Reports allows report designers to write custom SQL statements and access raw data as well.
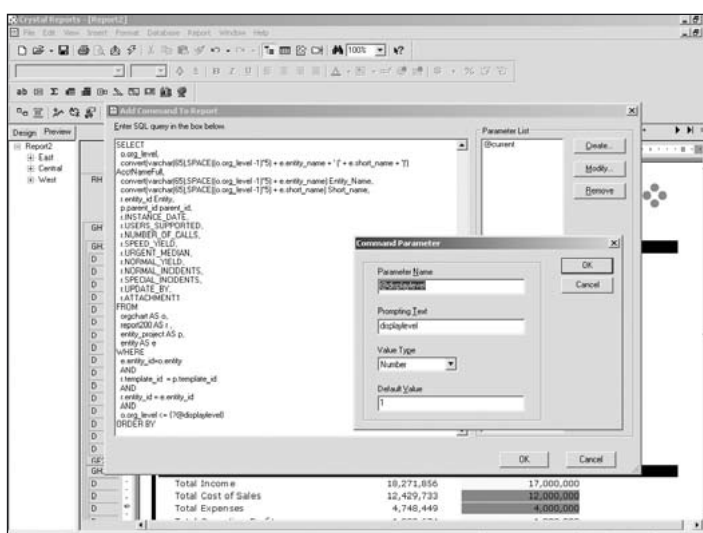

Figure 4: SQL commands give you complete control over data access in Crystal Reports. You can write custom SQL queries that return the exact data you need to build your report.

Most report design tools can access data via low-level standards like OBDC or JDBC; unfortunately, these mechanisms often compromise performance and flexibility. Crystal Reports provides a wide range of native drivers for major enterprise data sources. These drivers are optimized for specific databases and allow access to advanced features (e.g. Oracle-specific SQL commands). Crystal Analysis provides native connectivity to a wide range of OLAP data sources, including Hyperion Essbase, Microsoft SQL Server, and IBM DB2 OLAP.

► Formatting

Second only to interactivity and data access, flexible formatting is a key requirement for enterprise reporting. Crystal Reports allows IT to build high-quality reports that appeal to end users.

The Crystal Reports designer has consistently set the standard for intuitive, flexible formatting. Designers can easily mimic existing business documents (e.g. financial statements) or completely revamp legacy report design to better meet user needs.

Our banded approach to report design enables very complex report designs with multiple summary and drill-down levels. While a hierarchical report is often the best way to navigate complex, detailed information, you can also use hyperlinks to provide alternate paths within a single report or between multiple reports.

You can combine sophisticated graphical features like charts, geographic maps, and conditional highlighting to help users quickly understand the information in a report without browsing through multiple pages.

Finally, Crystal Reports provides the additional flexibility of multiple output formats. While most reports will be delivered to users in DHTML, users can readily export them to PDF, Excel, Word, and a variety of other formats.

By separating designer tasks from consumer tasks, an analytic report design tool should offer a broad range of powerful analytic functions. This should include extensive calculation capabilities, granular highlighting controls, charting utilities, and configurable controls to transition users through different views of the data.

Crystal Analysis offers a completely visual, drag-and-drop design environment that allows designers to rapidly assemble rich reports. Powerful calculation capabilities and charting functions are built into the tool, as are extensive highlighting options. Crystal Analysis also incorporates Analysis Buttons™, which are configurable controls that allow designers to link related views of multi-dimensional data to create briefing books. These controls preserve the user's context as they move from view to view (e.g. the specific product the user has chosen to analyze travels with them as they move to a different view of the data). See the figure below for more detail.

Figure 5: Crystal Reports gives you the flexibility you need to connect to any data source and the power to build rich reports for end users.

▶ Formulas

Reporting is all about adding value to data before presenting it to an end user. Formatting is one way to add value; actually putting the data into business terms and metrics is another.

Crystal Reports includes a powerful formula language that directly controls data returned from the underlying database. Like with most other Crystal Reports features, you can define formulas through intuitive experts that step designers through the process, or directly in the formula editor.

Figure 6: The Crystal Reports extensive formula language includes over 160 built-in functions and operators, as well as user-defined functions for complete control over report formatting, complex logic, and data selection. It includes a codeless wizard, call stack, and auto complete for faster creation of any formula.

Designers can use the formula language to filter data, perform complex business calculations or format specific data values or areas of the report. Complex case logic and built-in date, financial, and formatting functions combine to give the designer almost limitless control over the results set returned from the database.
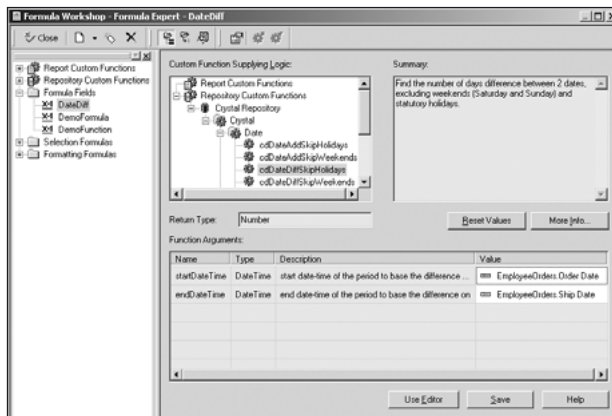
► **Re-use**

Building reports from scratch is a complex and time-consuming task. It requires intimate knowledge of both the underlying data and a solid understanding of the user's business requirements.

Crystal Reports makes it easier for groups of report designers (in the same department or spread across business units) to collaborate on designs and share common report elements. Complex business and formatting logic can be exposed as re-usable objects and shared via Crystal Enterprise. Commonly-used text objects and logos can also be stored in Crystal Enterprise. Rather than starting from scratch with each report design, designers can pull the relevant objects from Crystal Enterprise and assemble complex, consistent reports in a fraction of the time.

Reports that use shared objects in Crystal Enterprise also maintain a link to the source object, which means that changes can be made once and automatically rolled across all reports that use the object.

Flexible Developer Interfaces

By simplifying data access and presentation, Crystal Enterprise allows you to increase your productivity and get your applications to market faster.

Developers can integrate reports into an enterprise portal, automate repetitive administration tasks, or embed reports directly into the workflow of an existing application.

While a central reporting system can increase access to critical business information, the real productivity gain comes from integrating reporting directly into end user applications and centrally managing the content.

Data access and presentation is one of the most time-consuming and coding-intensive aspects of application development. You can access Crystal Enterprise functionality through our rich developer interfaces for Java, .NET and COM environments. Our developer interfaces provide complete control over report listing, processing, modification, viewing, and administration.

► Complete SDK

Most enterprise applications expose some level of API to enable customization. While this helps developers tailor the application for a specific user base, most enterprise application SDKs are designed for customization, not integration. Developers can alter look and feel, or they can toggle features on or off, but most of the functionality of the platform is available only to the vendor.

We engineered Crystal Enterprise as a powerful set of reporting services, exposed through an SDK. All of our end user interfaces are built on top of this SDK, ensuring that third-party developers can access all aspects of the system.

These object models encapsulate all the calls needed to extract content listings from the system, control the processing and delivery of content, view content, interact with content and administer the system. All the sample applications included with the product use this same, well-documented object models.

► IDE Integration

Accessing and presenting data is almost a universal application requirement. Most of these applications require tight integration, but not deep integration (e.g. all the administration, management, and modification features of Crystal Enterprise would be overkill). To ease the integration process, we provide direct access to our report processing and integration services from major .NET, Java and COM development environments. And in many cases —such as with Visual Studio.NET, Borland C# Builder, Borland JBuilder—Crystal Reports components ship along with the IDEs.
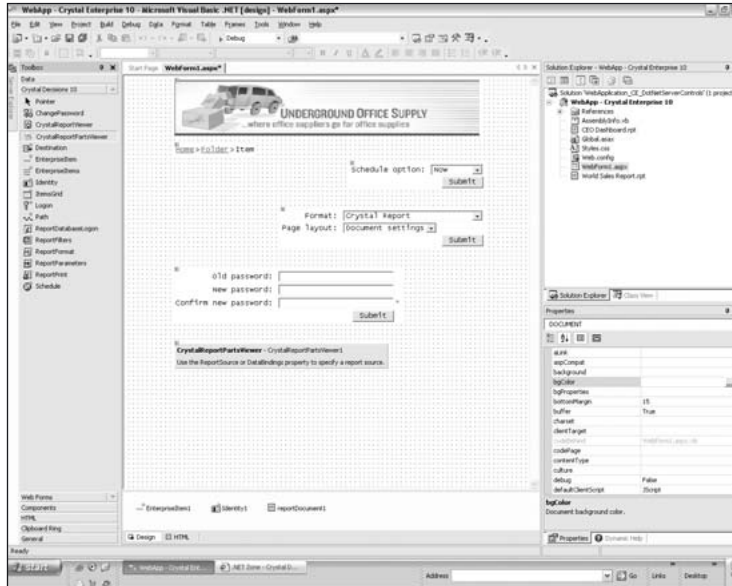
Figure 7: Crystal technology is already included in many major development environments. You can also use the Crystal Enterprise SDK to access advanced features and gain complete control over report integration, processing and management.

Developers can integrate Crystal reporting functionality directly into their applications and run these applications in stand-alone mode or connected to a managed Crystal Enterprise deployment. We also offer a set of visual components for advanced integration with .NET applications.

► Developer Platform Support

Web application servers and accompanying middleware platforms are enabling companies to realize new efficiencies in application development, deployment, and integration. Many companies are using application server technology from organizations like BEA, IBM, and Microsoft to web-enable legacy applications, integrate disparate applications, and offer highly functional application interfaces to end users.

Crystal Enterprise provides tight integration with these powerful platforms via native COM, .NET, and Java software developer's kits. These kits are made up of robust components, sample applications, and documentation, and organizations can install them directly on BEA Weblogic, IBM Websphere, or Microsoft IIS. The kits provide a high-level API to control every aspect of Crystal Enterprise using popular scripting languages (VBScript and JavaScript) or native Java code.

▶ XML Support

XML is rapidly emerging as an effective protocol for exchanging data and structured information between disparate systems, applications, and devices. As an intermediate technology, reporting can apply business logic to raw data streams, generating much more usable and valuable output.

A reporting system becomes an extremely powerful translation platform when it can apply business logic to an existing data source (XML or relational) and then generate high-fidelity output for web consumers or an XML data stream (standard or custom schemas) for other devices, applications, or systems.

Crystal Enterprise supports access to XML data sources and the output of XML data streams. Developers can custom tag individual field objects to conform to standard XML schemas, or use our standard report schema to predictably extract and transform content from any Crystal Reports file.

Scalable Infrastructure

Crystal Enterprise ensures that business-critical information is always available.

Built-in distribution capabilities can automatically alert users of critical information via email or portals, or output reports in a variety of formats to specific destinations (e.g. email, FTP sites, network printers).

At the very core of Crystal Enterprise is a robust, cross-platform, multi-server infrastructure for organizing, managing, and delivering information across an organization.

► ## Reliability

Eighth-generation clustering technology, automatic load balancing, and a completely redundant architecture ensure your deployment will remain available under a wide range of load scenarios. Third-party tests have confirmed that Crystal Enterprise can deliver 99.999% uptime.

Multi-Server

Multi-server support is a critical component of a scalable architecture. The ability to split server components onto multiple physical machines allows an organization to selectively and incrementally add hardware resources where they will have maximum impact.

Crystal Enterprise is built on a distributed component architecture. This means you can decouple individual system components and spread them across multiple machines in a single deployment. Each major piece of back-end functionality is a separate component: scheduled report processing, system management, caching, report streaming, or real-time report processing and web delivery.

Fault-Tolerance/No Single Point of Failure

Uptime is a critical measure of cost of ownership for an enterprise system; it also has a substantial impact on user perception of the system's value and quality. To function as a true piece of enterprise infrastructure, a system must deliver complete fault-tolerance, which includes support for automated failover and the creation of redundant hardware and software services.

Crystal Enterprise provides failover at the system management tier (this tier manages schedules, security, external authentication and acts as a name server for other components in the system). The system also provides full support for replication of all server components. Redundant components will automatically take over the load in the case of hardware failure or excessive wait times.

Load Balancing

Intelligent load balancing algorithms eliminate bottlenecks and maximize hardware efficiency. In a multiserver environment, balancing load efficiently across multiple machines greatly enhances scalability and end user response time. Load balancing also ensures effective use of hardware and the minimization of performance bottlenecks.

Crystal Enterprise includes built-in load balancing across all system management and report processing functions. We apply a mixture of active and passive approaches to maximize availability of each server and minimize response time.

► Manageability

Crystal Enterprise provides a central repository for organizing content, ensuring that users can readily access the latest information, as well as historical snapshots.

Unlike other enterprise reporting systems, Crystal Enterprise is also designed to support central management of distributed reporting applications. Change management technology, a unified data access model and delegated administration allow Crystal Enterprise to support multiple applications running on a single infrastructure.

Change Management

In a mission-critical system, development and testing environments must be isolated from production environments. This often requires strict change control processes, and separate databases for the preparation of reports. Crystal Enterprise allows system administrators to dynamically change the data source for a report without the need to open or modify the base report definition.

In addition, change control processes benefit from the implementation of Business Views. This allows for the storage and re-use of common objects across multiple reports, and introduces a mechanism for fast and easy updating of these objects in selected reports. Shared objects range from text and graphics, such as logos and legal disclaimers for example, to common calculations and functions for data transformation and SQL commands that define the data set to use within a report.
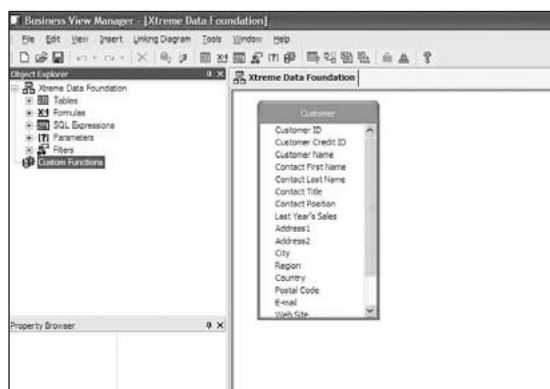
Figure 8: Commonly used report elements can be stored in Crystal Enterprise and accessed directly from Crystal Reports. Designers can readily share complex formulas and formatting elements.

Automated Administration

Regular administration and change management can be one of the most complex aspects of maintaining an enterprise software system. Administrative tasks are often repetitive and involve multiple steps, consuming great quantities of administrator time and introducing significant chances for user error.

Crystal Enterprise includes a full object model for programmatically controlling system administration. This allows companies to build custom routines to automate common or complex administrative tasks, or delegate these tasks to domain administrators, help desks, etc. Programmatic administration also allows companies to automate complex scheduling processes.

Cross-Platform Deployment

Providing support for multiple operating system platforms is a key requirement for any large-scale enterprise system. While it is often enough to support homogeneous deployment (single operating system across a deployment), the topology of some organizations' IT infrastructure demands multiple operating systems in a single deployment (e.g. development is done in Java on UNIX operating systems, but some system databases run SQL Server on Windows NT).

Crystal Enterprise provides support for cross-platform deployment, the ability to run system components on a mix of standard operating systems, including Windows 2000/NT, Sun Solaris, IBM AIX, and Linux. This allows organizations to easily fit Crystal Enterprise into their existing IT infrastructure.

► Performance

Crystal Enterprise is architected for maximum performance. Specialized services handle either on-demand data access/report generation or time- and event-based scheduling of reports.

Caching

Caching is a key web optimization approach that increases the responsiveness of an information delivery system. Caching stores previously accessed report pages in a rapid access file system so that they can be dispatched to other users, rather than processing an entire report again.

Our information delivery system includes a dedicated server component for report caching. This server component can be broken out onto a dedicated machine or set of machines to ensure fast delivery of frequently-accessed reports.

Report Streaming

Waiting hours or even days for a necessary report used to be the status quo. With the rise of the internet and the increasing deployment of reporting to the web, this type of lag time is no longer tolerable. Decision-makers expect real-time access to up-to-the-second information to react and respond at web speed.

Crystal Enterprise incorporates powerful technology called Report Streaming for ensuring rapid delivery of time-critical information. Report Streaming is designed to speed delivery of real-time reports by breaking the processing task into a number of small, fast-executing pieces and streaming the completed pieces to the user's browser. The result for the user is somewhat like HTML rendering: simple data is passed first, followed by more complex calculations, charts, maps, and graphics files, until the first page is delivered to the client; the rest of the report continues processing on the server, queuing up additional pages for the user to view.

Scheduled Processing

The second piece of report processing—scheduled execution of report requests—is optimal for recurring report jobs, reports that have to run in a specific time window, or larger reports.

Crystal Enterprise includes a time-based scheduling system that enables report processing during specific time windows or on recurring schedules. Reports can also be scheduled based on internal/external events and custom business calendars.
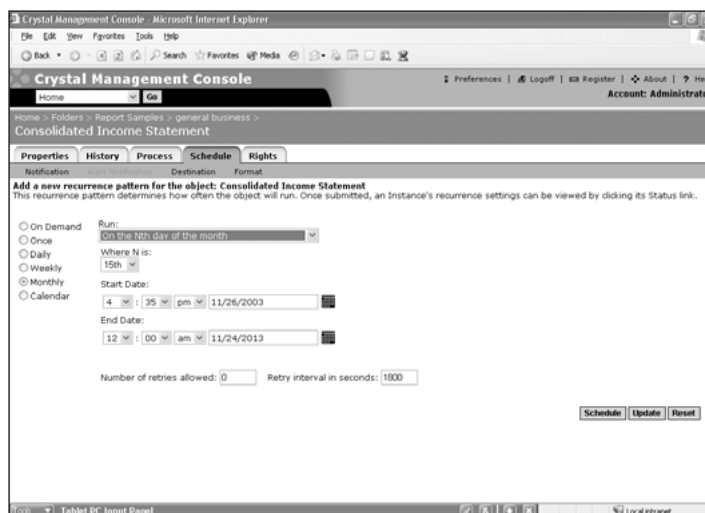

Figure 9: Crystal Enterprise includes extensive scheduling capabilities that allow you to automate the delivery of information across your business. You can create recurring schedules based on dates, events or custom business calendars.

Multi-Processor Support

Multiple processor machines can provide significant performance gains for highly multi-threaded applications designed to run on multi-processor hardware. Different processors can be assigned to different tasks and better throughput can be achieved through load balancing.

Crystal Enterprise is designed to take advantage of multiple processor machines to provide enhanced performance. All major system components are highly multi-threaded and designed to balance load across each processor.

► Security

Security is a critical success factor in the deployment of an integrated information delivery system. Organizations need tight, granular control over the restrictions and behaviors of each object in the system, but also need tools and mechanisms to make the set up of a security infrastructure as straightforward as possible. This includes support for third-party authentication methods, aggregation of users into groups and objects into folders and the ability to establish global settings for different deployments or user bases.

Crystal Enterprise incorporates a bulletproof security system for managing content delivery to broad internal and external user bases. Building on a hierarchical object-level security model, Crystal Enterprise enables the application of rights at both the folder and object level and supports full inheritance. Similarly, the product supports aggregation through a flexible, group-user membership model. Finally, the system provides for integration with third-party security systems, including LDAP and NT.

Often companies need to control security all the way down to the data level. Certain users are only entitled to see a small segment of the data, while others have access to broader sets of data, based on their role in the organization. The challenge is finding a way to deliver similar views of information to these different users, but filtering the data appropriately based on the user's permissions, all without excess hits on a production database.

Figure 10: With Crystal Enterprise, you can exercise complete control over your data security. By using Business Views to define data access rights, you can ensure that every report design and every user gets the right data.

Crystal Enterprise introduces powerful functionality that allows administrators to schedule one report, which is subsequently filtered at view-time (or schedule-time if desired) to deliver the appropriate information to each user. This secure mechanism allows a single report (and a single database hit) to serve the needs of multiple users. Unlike other mechanisms that require special report design considerations, the Crystal solution can be applied to any report and set up through the Business View Manager.

Conclusion

With all those tools in all those departments—and all those people to train and upgrades to install—it's no wonder that IT staffs are spread so thin and so many key projects are behind schedule.

Business Objects delivers a standard reporting solution for your enterprise. Designed to access and integrate data from virtually any source, and build interactive reports from relational and OLAP sources, our solution will enable any organization to consolidate its reporting and information delivery requirements into a flexible standard. Because it is a zero-client, web-based solution, our reporting software simplifies your user training requirements and handles all upgrades on the server, saving time and money. The result is a more cost-effective use of IT budgets and staff, and the freedom to address more projects in a timely, proactive manner.

Our collective understanding of the challenge of report creation, management, and delivery for large organizations is unparalleled. With tens of thousands of customers and more than 16 million reporting and information delivery licenses shipped worldwide, we know our business. And it's that experience—coupled with thousands of staff-years of research and development—that provides the rock solid foundation upon which we deliver Crystal Enterprise.

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