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DocuTech Corporation

# Reliability & Scalability

White Paper



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# Reliability & Scalability

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More and more applications for mortgage lenders are web-based, replacing the common desktop application or the terminal-server model familiar to many enterprise customers. While the chore of managing multiple product licenses or updating individual computers with the latest versions of software is removed with the advent of web-based Application Service Providers (ASP), other concerns—namely reliability and scalability—become a significant issue when selecting an online software solution.

Today, it's not enough to select software that just solves a problem; it cannot also create new problems by slowing to a crawl during peak business hours. There are a few factors, beyond the feature list, to consider when evaluating a web-based software solution:

- How does the software provider ensure the web-based product is available, always?
- Can the product scale, or grow, with your company?
- If the product is scalable, when does scaling occur?

These questions are critical, because any feature is useless without adequate response time from the software.

In this document we look at DocuTech's ConformX solution and how reliability and scalability are considered in the physical and logical architecture. We also look at how DocuTech manages the business side of supporting ConformX, to see how proper decisioning supports the software design when scaling a solution. All these factors, considered together, ensure ConformX not only provides a convenient solution for customers' document and compliance needs, but helps customers improve business and increase revenue.

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## Reliability

When selecting a web-based product, customers expect no less than a highly available solution. As mentioned before, any feature is useless if not accessible by the user. To better understand what DocuTech has done to ensure reliability, we'll look at how the ConformX physical server architecture is designed. We'll also address ConformX's redundancy, failover and backup procedures. What we'll find is a reliable and cost effective answer to high availability.

## ConformX Physical Architecture Description

The ConformX Physical Architecture consists of two SAS70 Data Centers (DC) hosted at **Qwest Cyber Centers** (page 13) in Sacramento California and Sterling Virginia. DocuTech's IT administrators maintain both DCs by a Virtual Private Network (VPN) connection. If necessary, Qwest also provides onsite servicing for DocuTech in case of hardware failure.

The ConformX solution is designed as a multi-tiered architecture, which includes a web server layer, a print engine layer and a database layer. Each layer consists of multiple physical servers providing a redundant, highly available, and scalable architecture. Each server also contains redundant hardware components, further increasing the overall availability of the system. Below is a description of each tier within the ConformX Server Architecture. Please refer to the **ConformX Server Architecture Diagram** (page 4) for a visual description.

For information about ConformX, see the **Process Flow Description** (page 17) included with this document.

### Web Server

The web servers run in a load balanced *cluster*, with request managed out equally to all the servers within the cluster. If one server fails, the load balancing software detects the failure, removes the failed web server from the cluster, and then distributes the server load across the remaining web servers. This configuration can sustain multiple server failures and functionally manage the requests of the application. The cluster increases performance and load capacity, while providing local redundancy for hardware failures.

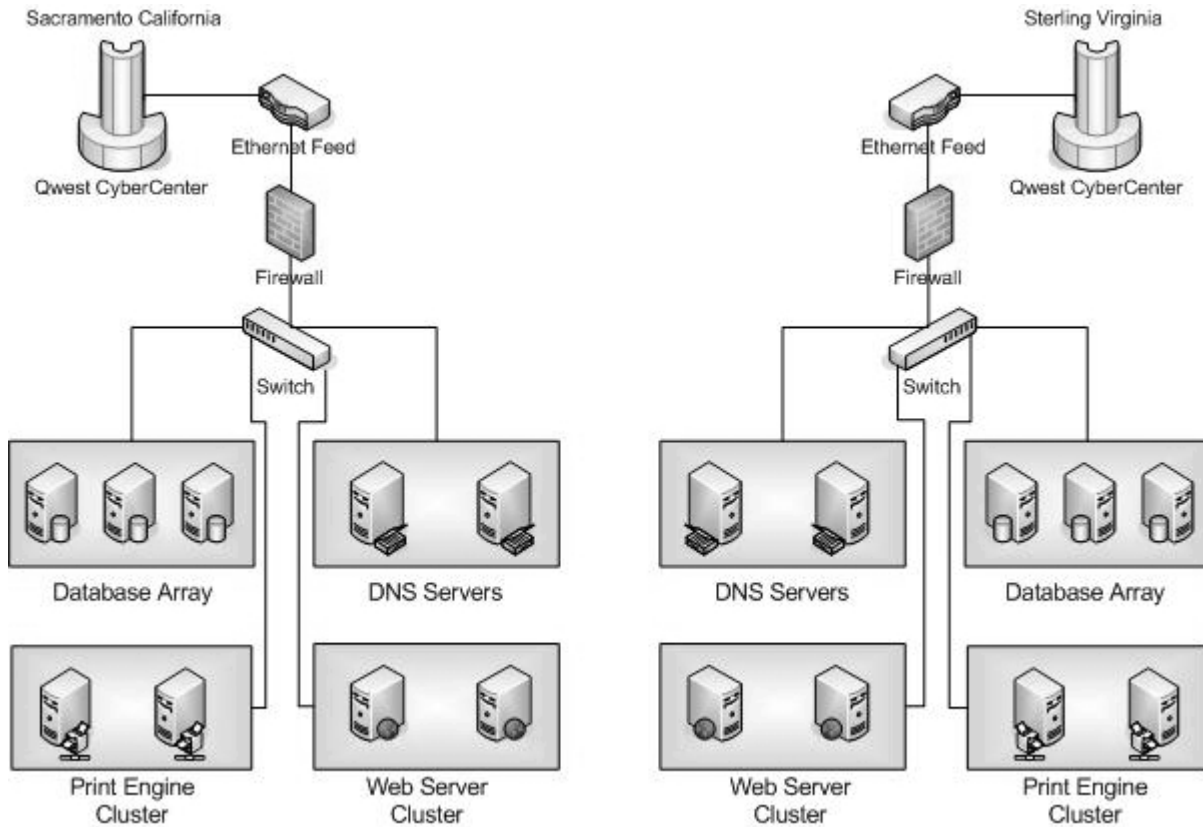
### Print Engine

The print engines convert XHTML information created by the web server and database into PDF documents. Similar to the web servers, the ConformX print engine also runs in a load-balancing cluster of servers. This cluster distributes the work to as many print engines as are available. The cluster increases performance and maximizes up-time in the event of a hardware failure. This layer is also easily scaled by adding additional print engine servers to the cluster.

### Database

The database layer is made up of an array of database servers, meaning multiple databases are used or clustered. One database server is designated as a backup server. The Administrative and default functions saved on the primary servers are copied to the backup database server providing a “spare” in the case of a complete server failure. The loan data stored in the database is then replicated to the mirrored hosting facilities backup database as part of a nightly cross data center backup. This configuration allows a single data center to remain functional in the event of a single database failure or even redirect requests to the mirrored data center if a complete data center is unavailable. The failover process requires only minimal reconfiguration and provides for high availability to all ConformX customers.

### ConformX Physical Architecture Diagram



## Monitoring

Each layer within the ConformX architecture is monitored for uptime. A log is kept tracking the server status at periodic intervals which then creates a report of the overall system up and down time. DocuTech's on-call IT administrator is also notified directly whenever monitoring shows a failed or unresponsive server. In general, the ConformX system maintains a statistically high availability. For the 5 month period between April 2006 and July 2006 the average availability for the ConformX server architecture was 99.877%.

Also monitored is the load, often measured in loans per hour, handled by ConformX. This data is gathered several points within ConformX and saved to a table within the database. Another utility used as a monitoring baseline is the billing system used to track customer transactions. Between these two monitoring systems thresholds are established for the ConformX throughput, which we will discuss later with scalability.

## Redundancy

To provide high availability the ConformX physical architecture contains multiple layers of redundancy that mitigate single points of failure. From top to bottom the ConformX architecture can manage failed hardware and maintain a consistent level of performance.

As described in the ***ConformX Physical Architecture Description*** (page 2) each hosting center contains a mirrored server structure and each tier within the server structure contains redundant hardware. Multiple layers of redundancy strengthen the ConformX server structure and improves failover capacity. Redundancy is also necessary to remove single points of failure, which could cripple an application should a non-redundant component fail. As it is, without a single point of failure, ConformX could withstand significant hardware failure while maintaining usable performance levels.

## Failover

In most cases, the ConformX server structure allows for transparent failover of key hardware. A transparent failover is ideal when considering web applications because the user is never aware that a problem has occurred and their work is not interrupted. For the few components where a transparent failover is not provided, a warm standby is available to replace the failed hardware. In general, to configure a warm standby requires 5-20 minutes once the point of failure is discovered.

To understand how failover occurs, lets look at each tier of the ConformX architecture.

## Data Centers

Each of the Data Centers (DC) hosting ConformX are a warm standby for the other. If for any reason a DC is unavailable or the internet connection at a DC is severed, requests are routed to the mirrored DC. As shown in the **ConformX Server Architecture Diagram** (page 4), DocuTech maintains its own DNS servers to route requests to ConformX as quickly as possible, mitigating as much DNS caching as possible within DocuTech's control.

Failover for a complete DC failure is a manual reconfiguration performed by DocuTech's on-call IT administrator. As mentioned before, all levels of the DocuTech Data Centers are monitored and any failure, software or hardware, is logged and reported.

## Web Server & Print Engine

With the web servers and print engines load balanced there exists an instant and transparent failover. Should one server fail the software managing the load balance removes it from the request queue and disperses the load among the remaining servers. This manor of failover is very reliable and efficient.

## Database

Like the web servers and print engines, failover of a database relies on redundancy to maintain availability. If a database fails, and is not recoverable within a reasonable amount of time, the data coming from the web server is directed to the remaining databases. If the performance level is not sufficient or load surpasses established thresholds, the backup database at each DC can quickly be configured as a warm failover to replace the failed database.

As mentioned before when we looked at monitoring, the database tier has a high uptime ratio in general. The overall load placed on the ConformX server structure in not high enough to create an unstable environment. When we look at scalability later, we'll see how DocuTech maintains acceptable throughputs by testing and setting thresholds to preserve performance.

## Backup

The database is the primary concern when creating data backups capable of restoring the ConformX system, (i.e. in case of a natural disaster or terrorist attack.) The **Qwest Cyber Centers** (page 13) where ConformX is hosted already provide superior protection against physical attack, but the ability to access loan information even in extreme circumstances could be hindered without additional backup measures. To ensure access to your loan information at any time the Admin and System Default data is replicated periodically from the database array to a designated backup server by recording the delta, or changes, made to the database. A delta copy (a record of changes made from the last update) of the data is also moved to the mirrored data center as part of a nightly backup. This system allows for general recovery of loan data beyond the redundancy and failover measures already discussed.

## Storage

Although ConformX is not designed as a system of record for customers' loan information, a grace period is given for loan data to reside on the ConformX database, allowing users to redraw and make adjustments to imported loan data. Once the redraw period expires, the loan document (the PDF) is archived. Another period of time may be granted for archiving before the file is eventually erased. The time allowed between initial import of data to ConformX and the redraw period depends on the contract signed with DocuTech and is negotiated on a per-customer basis. The archive period is also negotiable.

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# Scalability

To faithfully meet customer needs, a product must grow and adjust. As we've looked at the physical design of ConformX we can see hints at how scaling is included in the overall architecture. In this section we look at the road map established for scaling ConformX in response to customers' needs.

## Load Balancing

The ConformX architecture makes extensive use of load balancing to ensure proper scaling of the application and database. Let's look at the application layers and database layers individually in regard to load balancing.

### Web Server & Print Engine

Both the web server and print engine, (where most of the ConformX application resides) run in an active/active load balanced configuration. Each server within the web server or print engine architecture tier communicates with the other servers to determine which is available to accept requests. Each web server and print engine is an exact copy of the other, managing only the input and output of data in a stateless configuration. Since no data, except the ConformX application, is stored on either of these layers the process of replacing or adding hardware is easily accomplished. If a web server, for example, fails to communicate its status then the remaining servers distribute the load amongst themselves. Management of the load balancing is shared among all the servers in the tier by Microsoft's Network Load Balancing software.

### Database

The database tier is stateful in nature and requires loan information to be tracked across the database farm using a token, or unique identifier, that assigns the loan data to one database. As requests come through the web server layer, from any of one the servers, the token is read for the loan data and routed to the correct database containing the loan data.

The only exception to this database clustering process is when making administrative changes to a ConformX institution. When accessing the ConformX Admin menu to adjust default settings or manage user accounts, the customer or their DocuTech Account Manager accesses one master server, which then applies the changes to the other databases in the cluster. The changes are applied by the **backup database** (page 7) as part of the periodic delta and nightly backup.

## Performance & Capacity

The driving factor behind scalability is to maintain and improve performance for customers. Again, any feature is meaningless if the software cannot perform the task in an acceptable amount of time. We've already looked at how DocuTech monitors ConformX to ensure availability, but let's look at how performance information is acquired to maintain acceptable throughput as new features are added.

With each release of ConformX, DocuTech's Quality Assurance (QA) department runs a series of tests that push different types of loan programs and loan types through ConformX as fast as the system will allow. Different loan types require different calculations and run different process, creating unique strain on the system. As many conceivable permutations are run to test different parts of the ConformX system. By administering these tests the QA department can report changes in ConformX's performance from previous releases and establish a capacity, measured in loans per hour, that ConformX can handle.

Performance tracking and planning is vital to maintain ConformX. In just a year, from June 2005 to June 2006, web hits to ConformX increased by over 200%. Fortunately, by improving efficiency and scaling hardware, the average time to access a web page has maintained steady overall and even decreased with certain releases of the software. The overall trend for this 12 month example period shows faster response with increased load. All this points to the scaling power ConformX has, even when taking on a substantial amount of new traffic.

## Thresholds

We've looked at how capacity is determined by stress testing and performance testing, but as a business DocuTech must make decisions based on the information gather to ensure ConformX performs optimally for customers. Standard thresholds are applied for each ConformX release according to the performance testing run by the QA department. Server load is monitored and then compared to the capacity for the version of ConformX, allowing management to project the amount of time available before software improvements or hardware scaling is necessary. The initial threshold, the *Red Flag* stage, is when 60% of capacity is reached. The second threshold, the *Action* stage, is crossed when ConformX is over 70% capacity.

As an example, if a release of ConformX establishes the performance capacity at 100 loans per hour, when the current throughput is 50 loans per hour at the peak 'end of month' period, and sales projections suggest a 20% increase in loan volume, then planning for the next release cycles will include performance and scaling improvements. Performance and scaling are given high priority as the need to handle more loan data and server requests is projected.

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## Summary

DocuTech has taken considerable measures to ensure consistent reliability and increased performance of the ConformX architecture. We've seen how redundancy, monitoring and backup apply themselves to scalability, load balancing and performance. What customers are provided is a complete solution, not only from the feature list, but also the reliability.

If you have and questions regarding this overview of the ConformX architecture, contact your DocuTech representative or visit our website at [www.DocuTechCorp.com](http://www.DocuTechCorp.com).

# Appendix

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## Qwest Cyber Center Feature List

DocuTech uses the latest in data center technology and security by hosting ConformX from two Qwest Cyber Centers.

The following information is taken from Qwest's marketing material and web-site. For a Virtual Tour and Multimedia overview of the Cyber Centers, see Qwest's web site at <http://www.qwest.com/about/qwest/QwestCyberCenters/>

Qwest Cyber Centers are staffed 24/7 with highly trained technical engineers. In addition, the Qwest Customer Call Center adheres to a strict escalation procedure to help ensure your company's applications are available to you and your customers at all times. A design and development team will assist you in everything from strategic planning to quality assurance and stress testing of existing applications prior to Web deployment.

### ➤ *Security*

Data and systems security is especially critical in a Web hosting environment - and a primary objective of Qwest CyberCenters. Security features include:

#### Features

- 24/7 on-site security guard
- Indoor and outdoor security monitoring
- Badge/picture ID access screening
- Biometric access screening
- Escort requirements for access to raised floor areas

#### Benefits

- Predictable, reliable security of your critical systems

Constant monitoring of all critical areas

### ➤ *Disaster Control*

Each Qwest CyberCenter is designed to withstand disastrous conditions relative to its location, ensuring that your systems and equipment continue to run even under extreme conditions.

#### Features

- Fire detection and suppression systems for 24/7 operations of your critical systems
- Dual fire detection (photoelectronic/ionization and sniffer) systems to ensure early detection

- Central fire alarm system notification with a direct alarm to the local fire department for fast response
- Multi-zone pre-action dry pipe suppression system allows suppression to be contained to the affected area and not disrupt conditions elsewhere

#### Benefits

Round-the-clock availability, even under extreme conditions

#### ➤ *Connectivity*

Qwest CyberCenter facilities are equipped to support your system's Internet protocol (IP) connectivity and are directly connected to Qwest's 10 Gigabit-per-second (OC192) coast-to-coast backbone network. Dedicated Web Hosting is available throughout the domestic U.S. Qwest CyberCenter facilities are located in Burbank, CA; Sacramento, CA; Sunnyvale, CA; Denver, CO; Tampa, FL; Chicago, IL; Newark, NJ; Columbus, OH; and Sterling, VA.

#### Features

- Built-in fail-over through redundant router and switch configuration in the CyberCenter LAN
- Dual ports available from unique switches
- A variety of billing options to choose from-Flat rate, Data Transfer or Burstable billing options
- Scalability through 10 to 1000 Mbps bandwidth ports

#### Benefits

High availability, scalability and reliability

#### ➤ *Infrastructure & Environment*

Whether running multimedia, corporate intranet/extranet or e-commerce applications, Qwest CyberCenter™ facilities provide a secure, reliable and scalable foundation for your success. Specifically designed to provide state-of-the-art hosting for mission-critical Web sites and enterprise applications, Qwest CyberCenters provide a compelling alternative to developing, deploying and staffing your own Internet data center.

#### Features

- Racks and cages to host your equipment in a secure environment. Choose 5' x 10' or 10' x 10'. Lockable cabinets also available.
- Raised floor hosting area accommodates your cabling and special wiring needs
- N+1 redundancy of cooling towers, water pumps and chillers
- Multiple air handling units provide an additional level of redundancy
- Cooling units maintain consistent environment temperature and relative humidity levels

Benefits

- Flexible and scalable hosting options (cages, racks and cabinets)

Consistent and reliable environmental support during common and extreme scenarios

➤ *Power Systems*

Web hosting support systems must always be available. The system availability is only as predictable as the power to those systems. Qwest CyberCenters are designed for redundancy and high availability of power to your critical server systems.

Features

- Dual power availability to each rack unit from independent Power Distribution Units (PDUs) removes PDU loss as a single point of failure
- N+1 redundancy of uninterruptible power supplies
- Redundant generator power supplies, in the event of a power failure from commercial power

Benefits

- Availability of power during extreme power outages

Availability of power during scheduled maintenance activities

➤ *System Monitoring & Management*

Each Qwest CyberCenter is equipped with sophisticated equipment and technical talent to provide 24/7 monitoring and management of your critical systems. Some tools used to ensure complete system management include:

Features

- Concord NetHealth (server health monitoring)
- Agilent FireHunter (throughput monitoring)
- Veritas Nerve Center (router and switch event correlation)
- HP Open View (base network monitoring)
- Remedy (problem tracking, trouble ticketing and resolution management)

Benefits

24/7 monitoring, management and trouble resolution

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# ConformX Process Flow Description

The ConformX Process Flow is a high-level summary of the primary ConformX functions. Please refer to the ***ConformX Process Flow Diagram*** (page 18) for a visual description.

The ConformX Process Flow consists of three primary subsystems; Export, Business Logic, and Print.

## Export

After the user has entered the loan information into the Loan Origination System (LOS), the loan data is exported to ConformX by a local application, usually residing on the user's desktop computer. The local application, often referred to as *The Push Tool* sends the loan information by Web Services over a 128-bit SSL connection.

After the loan data is exported successfully to ConformX, a URL is returned to the client, opening a web browser on the user's system. The browser will display a Doc List, (a list of all the documents to be printed), or display any number of Missing Fields screens prompting the user for information not provided by the LOS.

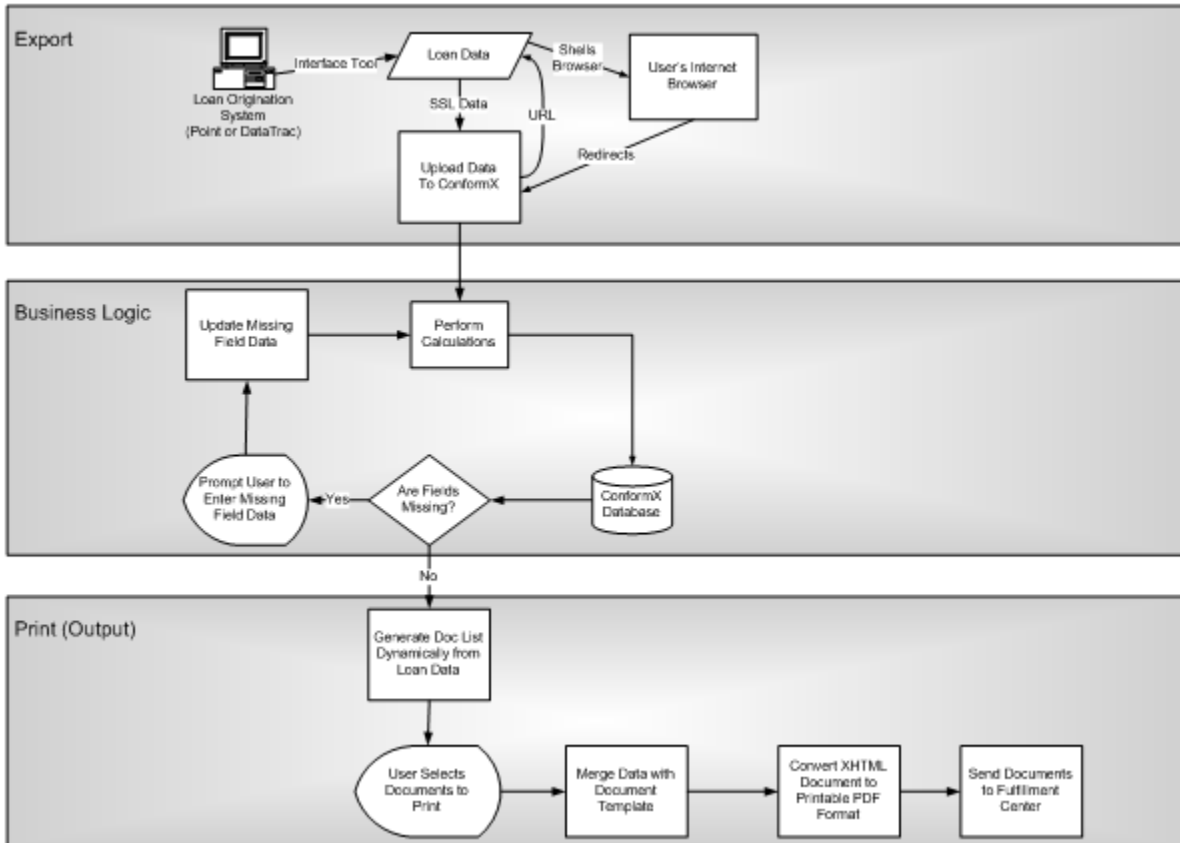
## Business Logic

Once ConformX receives the loan data, DocuTech's Business Logic verifies that all required fields (i.e. borrower name, Title Company address, etc.) are populated properly and generates a Doc List, or list of all documents in the loan package. If a field is not properly populated ConformX displays a Missing Fields screen, prompting the user to provide the missing information. Once all necessary information is received, ConformX re-executes the Business Logic, performs calculations, and generate the Doc List.

## Print

With the Doc List verified by the user and the desired documents selected, the user can print the documents locally to PDF, email the documents, or sends the documents to DocuTech's Fulfillment Center for printing and mailing.

## ConformX Process Flow Diagram



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# Glossary of Terms

## A

### ASP

An application service provider (ASP) is a company that offers individuals or enterprises access over the Internet to application programs and related services that would otherwise have to be located in their own personal or enterprise computers.

### Availability

The percentage of time that a system is available for use, taking into account planned and unplanned downtime. If a system is down an average of four hours out of 100 hours of operation, its AVAIL is 96%.

## D

### Database

Collection of data or information organized for rapid search and retrieval, especially by a computer. Databases are structured to facilitate storage, retrieval, modification, and deletion of data in conjunction with various data-processing operations. A database consists of a file or set of files that can be broken down into records, each of which consists of one or more fields. Fields are the basic units of data storage. Users retrieve database information primarily through queries. Using keywords and sorting commands, users can rapidly search, rearrange, group, and select the field in many records to retrieve or create reports on particular aggregates of data according to the rules of the database management system being used.

### DNS

The Domain Name System is the system that translates Internet domain names into IP numbers. A *DNS Server* is a server that performs this kind of translation.

## F

### Failover

Invoking a secondary system to take over when the primary system fails. Up-to-date copies of all required data and applications are maintained on the secondary system in order to respond immediately if the primary system becomes unusable.

## P

### Print Engine

The ConformX Print Engine converts XHTML strings into PDF documents.

## R

### Reliability

The trustworthiness to do what the system is expected or designed to do. Reliability metrics include:

- Probability of Failure on Demand
- Rate of Failure Occurrence
- Mean Time to Failure
- Availability (Uptime)

## S

### Scalable

Expandable. Referring to hardware or software, a "highly scalable" device or application implies that it can handle a large increase in users, workload or transactions without undue strain.

## W

### Web Server

A computer that is connected to the Internet and contains web pages (html files) that can be viewed using a web browser.

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