



Scaling the Data Tier with Citrix NetScaler SQL Intelligent Load Balancing



Executive summary

The growth of social networks, video, mobile and the Web in general has resulted in an explosion in information and sparked a major industry shift around data management. Providing visibility and business intelligence to the vast stores of structured and unstructured data is placing increasing demands on traditional databases, cloud storage models and unstructured file systems, like Hadoop. This has led to an inflection point in elevating customers' needs to effectively scale, secure and optimize data infrastructures. To address this exponential growth in data today, Citrix NetScaler is addressing the challenge with a native SQL data load balancing solution. Leveraging its expertise in web applications, NetScaler is the first ADC (application delivery controller) to extend the benefits of scalability, availability and security for the web tier to the data tier.

Managing the Data Explosion

Growth of Structured and Unstructured Data

In the last few years, there has been an explosion in the amount of data that's available. Whether we're talking about online transaction records, government data, mobile video with different bitrates, online digital media, tweets or facebook updates, there is a huge growth in both "structured" and "unstructured" data. The ever expanding Web and mobile applications has internet users spending more time online, and leaving a trail of data wherever they go. Structured data in particular has been experiencing this data tsunami due to the direct consequence of Web 2.0 and of Moore's Law applied to data.

Inflection point

With the growing number of enterprises and cloud providers targeting x86 based database server solutions to achieve scale and elasticity in contrast to mainframe like systems, the industry is at an inflection point that requires IT departments to rethink their solutions. The traditional databases especially pose a formidable challenge for enterprises to cost-effectively scale, secure and achieve high availability. For instance, simply scaling vertically with the large SMP (Symmetric Multi Processing) systems is prohibitively expensive. Smarter ways to achieve the same scalability is being demanded to satisfy performance, elasticity and overall security and compliance, especially with unstructured data coming to the forefront. All this has created a watershed moment for customers which requires a seamless solution that can scale on demand with cost effective high availability, all without forklift upgrades of their existing infrastructure.

Why are current approaches falling short ?

Traditional approaches of scaling up, scaling out:

- **Scale up:** Some enterprises ‘scale up’ vertically by leveraging database clustering technologies to add more capacity to a single database resource. Only after the ‘scale up’ projects like Oracle RAC (Real Application Clustering) are underway, however, do companies realize that the requisite hardware and licensing costs can quickly become prohibitive, and that their desired solution state is unable to scale incrementally on demand.
- **Scale out:** Alternatively, enterprise IT managers ‘scale out’ by provisioning more databases, each possessing a fully replicated data store front ended by traditional TCP load balancers or open sources SQL proxies that only address some of the scaling issues and provide limited availability due to lack of SQL awareness and advanced monitoring. As a result, scaling out databases with a generic TCP load balancer does not address the real customer pain points.

From a High Availability (HA) perspective, both scaling options when architected with HA can get expensive and complex with reduced ROI on new infrastructure. Database security using agents on each database server is cumbersome and expensive and record generation is not centralized leading to poor incident response times.

What is needed ?

The database tier challenges today are very similar to those of the web tier that was seen during the explosion in Internet growth in the late 1990s. Today all enterprises deploy an HTTP load balancer to address the web tier challenges and achieve scalability, reliability, availability and security; drawing from this a load balancing solution for the data tier should have these key capabilities:

- A native SQL proxy like solution to perform SQL connection management and offload for database scale up scenarios to increase SQL connection limit.
- A TDS protocol and SQL transaction intelligent load balancer that can accurately monitor backend server status including slave replication backlog to optimally distribute load in database scale out setups.
- High Availability that can address both Master/Master and Master/Slave replication deployments to complete the database scaling solution. Both scaling approaches also need advanced, clustering-like automated IP failover for lower cost high availability with commodity hardware.
- Database security encompassing transaction activity logging tied to user logins for compliance purposes to be generated from a central location to simplify record management.



Introducing NetScaler Database Load Balancing

NetScaler introduces the industry's first database load balancer that offers native data format, protocol and transaction support for scaling database infrastructures. Structured Query Language (SQL) which is the de-facto data format, TDS (Tabular Data Stream) and Oracle MySQL, protocols that are widely deployed, are natively parsed and interpreted in NetScaler's high speed processing engine, providing all of the advance policy framework available to act on data connections and transactions. Applying all of the same HTTP acceleration technologies to SQL, NetScaler is able to provide the same benefits to the data tier. NetScaler is a non-intrusive solution that requires no application or OS modifications or custom scripting to achieve SQL load balancing, SQL connection multiplexing, content switching and extensive server monitoring.

Netscaler features

SQL Connection multiplexing

NetScaler's SQL transaction intelligence enables NetScaler to act as a SQL proxy and terminate SQL connections from both client and server. Client to server connection multiplexing ratios of 50:1 or more is achievable depending on the application, number of unique database user logins and character sets in use.

SQL Load balancing

Armed with SQL transaction awareness, NetScaler can switch one client's many SQL transactions in a single TCP connection to several different servers. This feature allows for a more optimal load balancing of SQL traffic since the load distribution is more granular when compared to a TCP load balancer.

SQL Content switching (read/write split)

NetScaler can interpret SQL transactions and decipher between "select", "drop", "insert", "update" and other SQL statements and perform a split between read and write transactions. Splitting the reads and writes simplifies application servers, offloading the decision making and policy enforcement to NetScaler.

SQL Health monitoring

NetScaler intelligently load balances SQL requests, by selecting the database server that will return up-to-date data the fastest at the time of the request and sending the read request to only that server.

Automated IP failover

NetScaler's Virtual IP address solution is based on automated IP failover implementation where the virtual IP is assigned to the master node and switched over to the secondary node upon heartbeat/monitor failure.

Security

NetScaler can apply granular user access policies to each database user. It also provides a consolidated log of all SQL transactions and user accesses for complete visibility, without taxing the database server. SQL protocol validation is also available with advanced Policy Infrastructure (PI) regular expressions.

How it works

NetScaler is a SQL proxy that terminates client SQL TCP connections and opens separate SQL TCP connections to the backend server. With NetScaler, instead of passing each SQL connection from the client to the server in a 1- to-1 manner, many separate client SQL connection requests are pooled into relatively few SQL connections to the server. With SQL transaction awareness NetScaler can switch SQL requests from the client's single SQL connection to many different backend servers. The "Virtual IP" interface will be the manner in which external processes, applications and users will access the active/passive database nodes connected to the NetScaler. If the master node fails, then another node within the load balanced farm will start up an interface for this virtual IP address and use "gratuitous ARP" to ensure that all traffic bound for this address is processed by this node. In the event of database server failure, NetScaler automatically and transparently reroutes outstanding SQL requests against the failed server to another available server without terminating client side SQL connections. SQL extended content verification health monitors are replication state aware that can estimate how far behind the slave servers are from the master. Since the SQL protocol and transaction is natively parsed the policy and logging frame work now can use name value pair of SQL Query parameters for advanced user access control policies and content switching rules.

NetScaler Database LB for Oracle MySQL

NetScaler features an advance slave lag replication monitor for Oracle MySQL databases. With the slave lag replication monitor the health monitoring estimates the time the slave is behind the replication master by inspecting the replication backlog and the last executed query. This allows for advanced health monitoring that enables optimal scale out and high-availability.

NetScaler Database LB for Microsoft SQL Server

TDS protocol awareness enables NetScaler to operate as a SQL proxy for both SQL server 2005 and SQL Server 2008/2008 R2. With Microsoft Systems Center integration, an available virtual appliance on Microsoft Hyper-v, and SQL Server fluency NetScaler offers for a tightly-integrated solution for Microsoft SQL Server.



NetScaler Solution Benefits

Scale up

The challenge is to achieve server consolidation to reduce server sprawl and reduce operational expenses without sacrificing database growth and performance.

With SQL connection multiplexing NetScaler is able convert a large number of short-lived client connections into fewer persistent server connections achieving TCP connection scale-up. Since NetScaler acts as a SQL proxy, it offloads the connection management from the server, relieving database server CPU and memory for more critically needed database activity. Scaling up with NetScaler achieves server consolidation with tangible TCO reduction in database server infrastructure.

Scale out

The challenge is to have a high performance scale out solution that does not require application modifications and distribute load evenly across the read-only server pool.

NetScaler with SQL intelligent load balancing is able to optimally route SQL requests to the most available servers based on extensive health monitoring capabilities. NetScale's SQL aware content switching policy engine is able to perform the read/write split between the read and write server pools. NetScaler's SQL connection offload with SQL load balancing enables high performance, allowing the customer to keep adding more servers and expand its website capacity easily, with no increase in latency.

High Availability

The critical requirement here is the ability to monitor the replication state of the servers as to how far behind they are with respect to the master. Due to the nature of the unbalanced queries where some queries take minutes to complete versus others executed within milliseconds it is essential to have a monitoring solution that is aware of this condition.

NetScaler, in addition to its VIP based automated IP failover, provides for a replication aware monitor that can estimate the amount of time the slave server was behind the master. This replication aware monitoring in conjunction with the SQL request switching enables NetScaler to redirect SQL queries to other active servers in the pool while allowing existing queries to the slow server to run to completion without aborting application connections. Netscaler can front end Master-Master replication deployments for high availability and Master-Slave replication deployments for scalability. NetScaler with peer-to-peer replication provides multiple low cost options for high availability when compared to a pure high end clustering solution with mirroring.

Security and Threat Control

The challenge is to have a centralized logging of user and data access activity for compliance and regulatory needs on many replicated servers without affecting database server performance.

NetScaler with SQL aware policy engine applies and enforces user access control. With NetScaler in front of the database infrastructure it can generate aggregated transaction logs for all data accesses meeting compliance and regulatory needs. Since there are no monitoring agents on the database servers, query performance is not reduced and it also simplifies database security.

Summary

As the industry's first SQL aware load balancing solution, NetScaler addresses the scaling and availability needs of the data tier, leveraging its HTTP ADC technology for the web tier. NetScaler's SQL connection multiplexing scales connection limits for database scale up, native SQL load balancing optimizes database scale-out, SQL transaction logs simplifies database security and replication aware monitors with Virtual IP based failover enables cost-effective high-availability.



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