CloudBridge Technical Overview

Learn more about the capabilities of the CloudBridge platform and how they can accelerate application delivery and optimize virtual desktop delivery.

Contact SWC, LLC for more information including a free assessment and Statement of Work for Citrix CloudBridge implementation.
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Businesses rely on branch offices to serve customers, to be near partners and suppliers— and to expand into new markets. As organizations adopt virtualization and cloud networking and data consumption increases, IT managers face the risk that these trends will impose a performance penalty on branch users due to latency, congestion and bandwidth constraints of wide area networks (WANs). This same risk applies to mobile users. However, simply upgrading network bandwidth does not address underlying WAN performance issues caused by lack of visibility into services traffic or distance and application behavior. Adding bandwidth capacity is also expensive.

Citrix CloudBridge™ provides a unified platform that connects and accelerates applications and optimizes bandwidth utilization between branch offices and enterprise data centers and public clouds. As the only WAN optimization solution with integrated, secure and transparent cloud connectivity, CloudBridge allows enterprises to augment their data centers with the infinite capacity and elastic efficiency provided by public clouds. CloudBridge delivers superior application performance and user experience for branch and mobile workers through a broad base of features, including:

- Unique enhancements for the Citrix XenDesktop® user experience
- Secure, optimized networking between clouds
- Acceleration of traditional enterprise applications
- Unparalleled visibility into per-application performance
- Sophisticated traffic management controls and reporting
- Faster storage replication times and reduced bandwidth demands
- Integrated video delivery optimization for branch offices

This white paper provides an overview of the technologies within the CloudBridge platform that deliver these features.

CloudBridge technical overview

To provide a superior experience to users at branches or other remote locations, CloudBridge merges WAN optimization and in-depth application visibility with seamless support for cloud architectures in a unified platform that delivers maximum functionality. This platform provides the following set of technical capabilities that work together to provide a unique WAN optimization solution for the enterprise network of tomorrow.

Adaptive TCP flow control

CloudBridge adaptive TCP flow control dynamically detects real-time WAN link conditions to mitigate TCP performance penalties from packet loss and retransmission.

All WAN optimization controllers can regulate or meter the flow of data packets onto the WAN link. However, CloudBridge imposes transparent, lossless flow control on each segment of a connection: the LAN segment between branch users and the branch-based CloudBridge device; the WAN segment between the branch and datacenter CloudBridge devices; and the LAN segment between the datacenter CloudBridge device and the server or application.

By splitting a connection into three parts, CloudBridge can independently manage the flow control and utilization for each segment independently. This is important when a connection's speed needs to be ramped up or down quickly to its fair bandwidth share and to ensure maximum advantage is taken of enhanced WAN optimization and compression algorithms.

The greedy nature of the TCP protocol means every TCP connection continually attempts to increase its bandwidth usage. In response, CloudBridge uses TCP flow control to keep the TCP connections flowing at the highest rate possible for the given WAN connectivity. Flow control means the WAN link is never overrun, queuing latency is minimized and packet losses are reduced or eliminated. TCP flow control also prevents long-running connections, which have time to seize all available bandwidth, from squeezing out short-running, latency-sensitive interactive connections.

These benefits are illustrated in Figure 1.

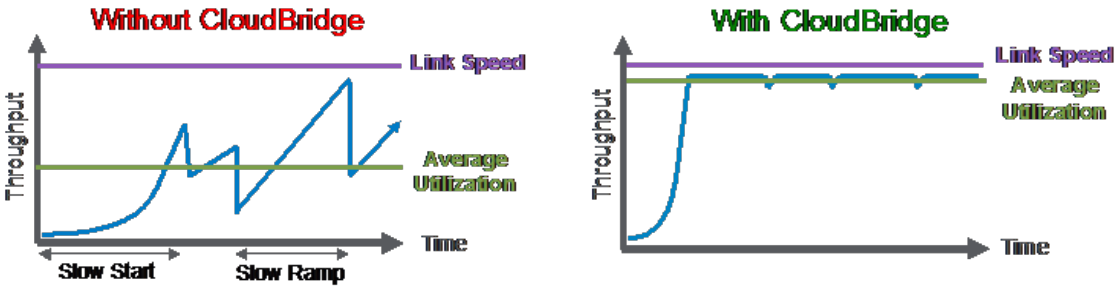

Figure 1. How CloudBridge increases bandwidth utilization

In summary, CloudBridge adaptive TCP flow control keeps all connections traversing the WAN at the highest possible utilization.

Compression, de-duplication and protocol acceleration

Whereas adaptive TCP flow control is focused on using all available WAN bandwidth, the CloudBridge platform includes a powerful trio of functions aimed at reducing both WAN bandwidth consumption and application response times. All of these features work together to ensure that maximum optimization is obtained.

Adaptive compression

Adaptive compression technology works between appliances residing on opposite ends of a WAN connection to reduce bandwidth requirements. It uses two different compression engines (Zlib and LZS) to optimize all application traffic at full WAN speeds. These compression engines perform duplicate string elimination and bit reduction, similar to the way PKZIP software works. The CloudBridge platform automatically chooses which engine to use based upon processing requirements. By achieving compression ratios as high as 5:1, the result is a WAN bandwidth savings of up to 85-90 percent.

De-duplication

CloudBridge also maintains a compression history that is shared across connections. This means that data sent earlier by one connection can be used later to optimize traffic flowing over another connection. Smaller data streams seen frequently are stored in memory for low-latency access. Larger data streams, such as bulk file transfers, are stored on disk. This large-history, multi- session compression technology erases the distinction between compressible and un-compressible data. For example, a JPEG image is normally considered un-compressible. However, when sent multiple times, the entire image can be replaced by a pointer to the data already in the receiving appliance's compression history, resulting in significant bandwidth savings. In addition, CloudBridge is not limited to referencing entire file objects. By leveraging pattern matching down to the block and byte level, it can also remove redundant data transmitted across different files and applications.

Adaptive compression automatically self-adjusts based on bandwidth, network conditions and type of traffic. In typical deployments, multi-level compression results in compression ratios ranging from 10:1 to 300:1, with peak ratios as high as 3500:1.

Protocol acceleration

When a branch office worker accesses an application or file from a remote datacenter, the WAN link introduces network latency between the server and the desktop. In such cases, the application's performance suffers, as depicted in Figure 2.

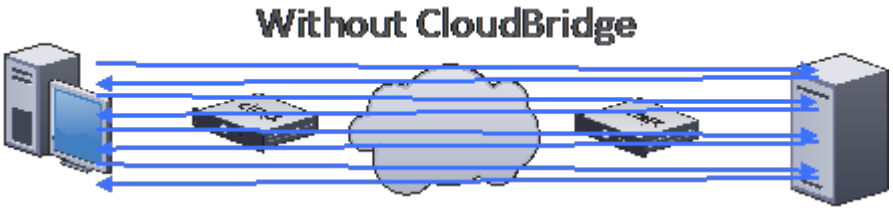

Figure 2. Protocol communications without CloudBridge

CloudBridge is fluent in a wide variety of application protocols including CIFS, MAPI, FTP and HTTP. CloudBridge immediately detects supported application protocols and applies the most efficient optimization methods. These include proxying client-server handshakes, reducing protocol

chattiness and optimizing payload. In the case of CIFS, the protocol used for Windows file sharing, CloudBridge accelerates drag-and-drop file transfers, folder copying and directory browsing by significantly reducing the number of round trips across the WAN. By analyzing the pattern of requests from the client and predicting the next action, CloudBridge can perform safe read-ahead and write-behind operations to improve the performance of CIFS by up to 30 times. This is illustrated in Figure 3.

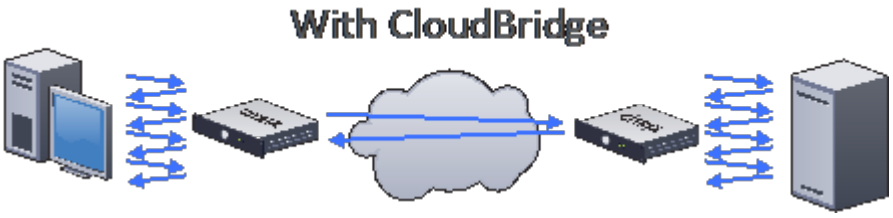

Figure 3. Protocol communications with CloudBridge

Consider a client requesting a 20MB file over a WAN. Without CIFS protocol acceleration, the CIFS client read limit might be as small as 4KB, requiring thousands of reads to retrieve the entire file. For a cross-continental WAN link, this behavior adds several minutes of unnecessary wait time. With CIFS protocol acceleration, instead of making thousands of requests, CloudBridge is able to read and deliver the data in much larger chunks. Users are able to retrieve the file over the same WAN link in a fraction of the time.

To develop the highest-performing and most robust acceleration possible, Citrix has licensed the CIFS protocol specifications from Microsoft. In addition, Citrix collaborates closely with Microsoft to stay abreast of impending changes and enhancements to its protocols. As a result, all optimizations maximize performance, maintain complete transparency to both the client and the server and never compromise data integrity.

Video delivery optimization

Although video provides a richer training, marketing and collaboration experience, it also makes large bandwidth demands. Low-quality video streams often consume several hundred kilobits per second, while HD video can require up to several megabits per second of bandwidth. As a result, even one stream of low- quality video can consume a large percentage of the WAN bandwidth available to a branch office. Left unmanaged, this can cause a diminished experience for other branch users simultaneously attempting to connect to their virtual desktops or other resources hosted in the datacenter (e.g., Microsoft Exchange or file servers).

To address this situation, CloudBridge provides a full suite of video delivery optimization capabilities, including accurate identification, classification and traffic-shaping for video content; video caching to reduce duplicate downloads; and object-level compression. Refer to Figure 4.

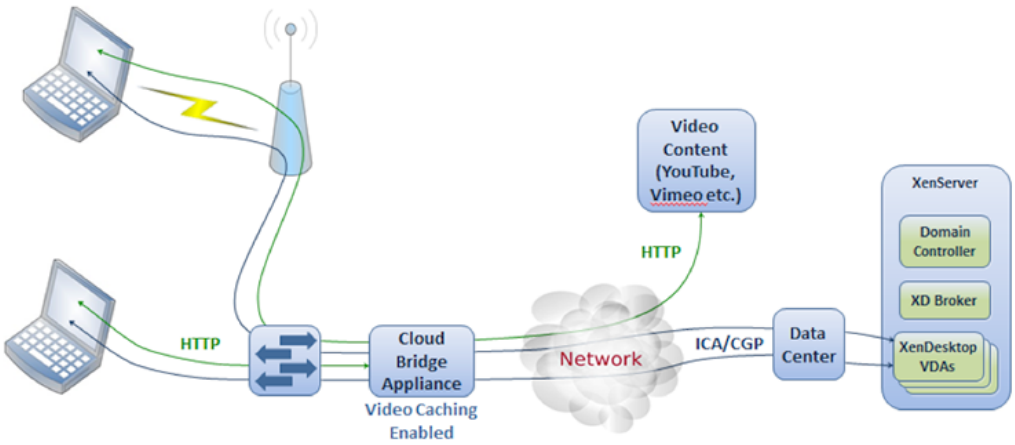

Figure 4. CloudBridge video delivery optimization

The CloudBridge video caching function supports a wide range of video codecs and formats sourced from popular websites such as YouTube, Vimeo, MetaCafe and YouKu. Enterprises can add other video sources such as internal enterprise video content sites. When a user requests video from the video content source, the video cache for the CloudBridge device located at the branch is populated with that particular content. Once the video has been stored locally, it can be streamed locally for successive viewings. This saves a significant amount of bandwidth while providing a better viewing experience. Video caching can easily provide a 40-fold reduction in content download times.

Similar to the standard de-duplication feature, CloudBridge also maintains a compression history for video traffic traversing the WAN. Generated by powerful block-level pattern-matching algorithms, this history – which is maintained within the CloudBridge devices at either end of the WAN connection – allows duplicate elements of video content to be replaced by simple pointers. Overall, this approach is especially effective when multiple users access identical video content. Repetitive access to the same video can be delivered from the cache, resulting in more efficient use of the WAN.

HDX WAN optimization

CloudBridge HDX™ WAN optimization functions optimize desktop and application performance and decrease network bandwidth utilization for branch offices by compressing, caching and prioritizing HDX traffic. CloudBridge can look deeply into the ICA® traffic to gain an understanding of what is happening at the user level. See Figure 5.

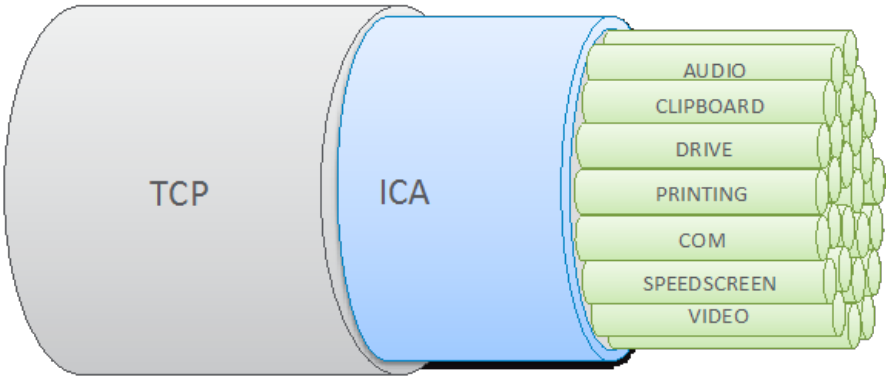

Figure 5. CloudBridge is ICA aware

TCP flow control, adaptive compression, protocol acceleration, traffic prioritization and video delivery optimization capabilities all apply to HDX traffic. However, CloudBridge has implemented additional functionality specifically for HDX to reduce network traffic generated by XenDesktop and Citrix XenApp®. More specifically, CloudBridge can decrypt the HDX packet flow and parse the HDX protocol for additional processing.

CloudBridge also includes a nano-pattern matcher that understands the protocol patterns associated with mouse movements, keyboard entry and screen updates. The nano-pattern matcher provides additional compression for these actions, while CloudBridge disk-based compression algorithms provide compression for printing, file downloads and other bulk operations.

In addition to optimizing the HDX traffic, CloudBridge automatically categorizes the different HDX streams or channels and ensures interactive traffic is given priority over bulk data transfers.

In combination with the other CloudBridge functions, the HDX WAN optimization capabilities ensure reliable performance of XenDesktop and XenApp traffic, even over congested networks.

Deep application visibility and granular control

CloudBridge provides in-depth visibility into performance on a per-application basis coupled with intelligent and adaptive mechanisms to guarantee Quality of Service (QoS) and a high-definition user experience. Using these CloudBridge capabilities, IT can quickly and easily assess network usage, classify applications and services traffic, observe network congestion and delays that affect user experience and rapidly remediate related problems quickly to minimize support calls.

Industry leading application-level visibility is provided through support for Citrix AppFlow® and Insight Center. An open, standards-based technology, AppFlow supplements the network-level data readily available via IPFIX/NetFlow with per-flow usage and performance data for individual applications, including XenDesktop and XenApp. A high-speed AppFlow collector, Insight Center

includes embedded correlation capabilities that automatically organize collected records by resource (e.g., by user, application, and CloudBridge device). Administrators can then view reports of both real-time and historical statistics from a variety of corresponding entry points, while also leveraging multi-level drill-down capabilities to examine underlying data and reveal the actual source of any ongoing, imminent, or potential future application performance issues.

Significant strengths of this approach include:

- Not having to having to rely on cumbersome and disruptive agents or network taps to instrument the network
- Not having to modify individual applications in any way to obtain essential performance data
- The ability to obtain an end-to-end view of application performance (as each CloudBridge device contributes to the overall picture)
- The ability to leverage 3rd-party tools that also support AppFlow – such as Splunk – to benefit from additional value-add capabilities, including consolidated reporting and advanced analysis methods

Once IT has a clear picture of what's happening on the network, granular traffic prioritization policies can be implemented based on protocol, application type, application location, user group, user or branch location and published group. Unlike traditional WAN optimization devices that have limited or no visibility into virtual desktop/application traffic, CloudBridge provides QoS guarantees to individual virtual channels within XenDesktop/XenApp HDX sessions. This allows organizations to granularly control and prioritize, for example, a graphic designer's virtual desktop over less-critical applications and/or background traffic such as printing.

Going beyond deep classification of HDX, CloudBridge classifies hundreds of pre-defined applications—TCP as well as non-TCP. Additionally, IT can use service templates to define and classify custom applications and service classes. Traffic shaping uses different priority levels applied to various parameters such as source or destination IP address, VLAN identifier, latency sensitivity or DSCP markings. CloudBridge traffic classifiers also honor DiffServ markings for per-hop behavior in received packets. On outgoing packets, internal priority levels are mapped to DSCP bits. Overall, bi-directional, standards-based traffic shaping ensures predictable end-to-end behavior and enables seamless insertion of CloudBridge optimization in an existing QoS network.

Significantly, traffic shaping applies to all traffic, not just the optimized protocols. Total WAN performance is greatly improved when traffic shaping is applied to both accelerated and pass-through traffic, especially UDP protocols. In addition, CloudBridge traffic shaping continues to work inside SSL/TLS encrypted tunnels using built-in, patent-pending technology. This is depicted in Figure 6.

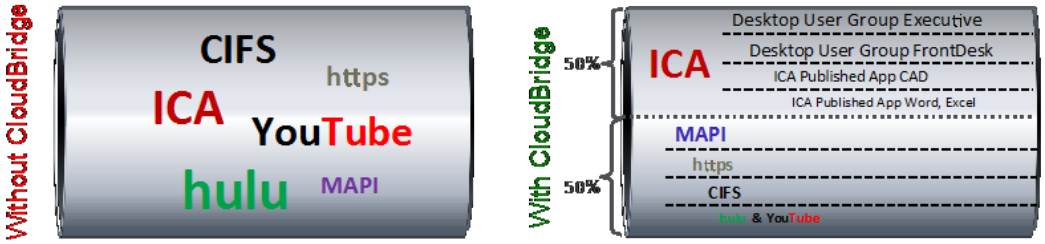

Figure 6. CloudBridge enables application classification and traffic shaping

The strength of CloudBridge's traffic shaping capability also derives from the choice Citrix made to base it on a standard hierarchical worst-case weighted fair queuing algorithm. Key advantages of this selection include that it:

- Provides tight delay bound for most efficient processing of real-time flows
- Has the smallest queuing delay in hierarchical packet scheduling
- Has a relatively low implementation complexity, so processing delay is not introduced

CloudBridge builds upon the standard algorithm in order to provide levels of priority among delay-sensitive traffic, and fairness among flows within each of those priorities. CloudBridge's competitors often allow higher-priority (e.g., to VoIP traffic), but their implementation's are not as effective at fairness, particularly within a class and certainly not between classes.

In addition to application-level visibility and extensive QoS/traffic shaping capabilities, CloudBridge provides a comprehensive, native reporting function that can be used to illustrate a wide range of informative data, including:

- Link utilization
- LAN to WAN compression
- Usage by application
- Usage by service class
- Acceleration by application
- ICA acceleration
- ICA connections and statistics
- Benefits of traffic shaping
- •Video cache hits and misses
- Traffic shaping
- CPU utilization

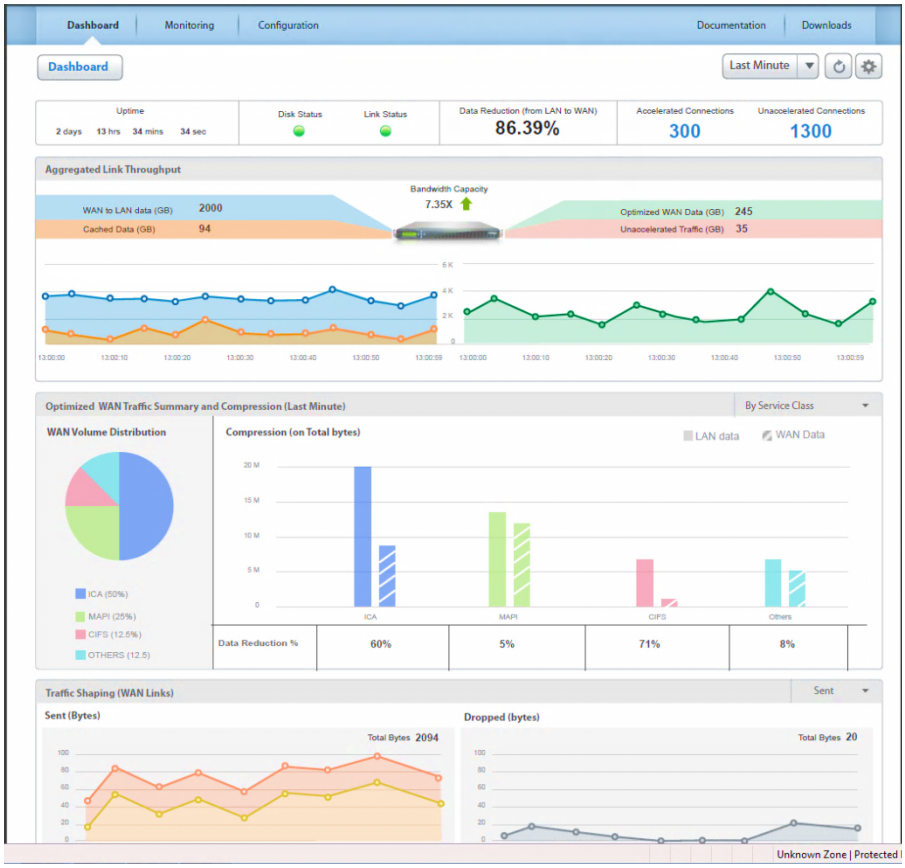

Figure 7. CloudBridge reporting interface

Cloud connectivity and optimization

Cloud delivery models – public, private and hybrid – are transforming today's businesses by providing a highly agile, scalable, resilient and cost effective way to deliver IT services. CloudBridge natively lowers the risk and reduces the effort and cost for enterprises to leverage cloud architectures and services for production purposes by:

- Utilizing IPSec technology to protect data in transit between different cloud data centers, be they public or private
- Implementing the Generic Routing Encapsulation (GRE) Protocol to allow different cloud networks and data centers to be seamless extensions of each other (thereby making it easy to migrate workloads without the need for onerous network and application configuration changes)
- Delivering pre-integration with popular cloud offerings – such as Amazon Web Services and Windows Azure – to simplify the process of connecting to related services and/or deploying CloudBridge virtual appliances in their environments

With other WAN optimization solutions enterprises must purchase separate devices and work through the integration details on their own to securely connect to and leverage the resources of remote clouds.

Conclusion

The challenge of delivering applications to branch offices with high performance has not gone away. If anything, the rise of cloud networking has made the issue more complex. Fortunately for enterprise IT, Citrix CloudBridge provides a unified platform that connects applications, accelerates performance and optimizes bandwidth utilization between branch offices, enterprise data centers, and public cloud environments. As the only WAN optimization solution to feature integrated, secure and transparent cloud connectivity, CloudBridge not only enables enterprises to seamlessly embrace cloud architectures and delivery models, but also allows them to: support more XenDesktop and XenApp users on existing network bandwidth; ensure prioritization for delay- sensitive applications; accelerate traditional enterprise applications; and reduce video bandwidth consumption.

These benefits result from innovative technical capabilities provided in the CloudBridge product family. From its advanced TCP flow control to its integral secure tunneling features, CloudBridge provides a uniquely powerful WAN optimization solution for the enterprise network of today and tomorrow.

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