Closing the Application Performance Visibility Gap Inherent to Citrix Environments

Dynatrace for Citrix XenApp/XenDesktop
<table>
<thead>
<tr>
<th>Page</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Executive summary</td>
</tr>
<tr>
<td>4</td>
<td>Introduction</td>
</tr>
<tr>
<td>5</td>
<td>What is a Citrix environment?</td>
</tr>
<tr>
<td>5</td>
<td>The challenges</td>
</tr>
<tr>
<td>6</td>
<td>Insights into capacity and load</td>
</tr>
<tr>
<td>8</td>
<td>Visibility into end-user experience</td>
</tr>
<tr>
<td>9</td>
<td>Correlating Citrix user sessions with application performance</td>
</tr>
<tr>
<td>11</td>
<td>End-to-end monitoring</td>
</tr>
<tr>
<td>12</td>
<td>Summary</td>
</tr>
</tbody>
</table>
Executive Summary

Many companies have invested in Citrix XenApp and XenDesktop solutions to enable their internal users, employees, partners or customers to connect to their corporate applications from any device. The business benefits of desktop virtualization have resulted in its widespread adoption. However, as with most technology shifts, virtualization can be complex, introducing a new set of visibility and performance optimization challenges which, left unaddressed, limit your ability to understand, diagnose and improve business application delivery. This paper will discuss these challenges, identifying proven solutions that will allow you to deliver your applications with confidence.
Introduction

There are many proven benefits to be achieved by adopting Citrix XenApp and XenDesktop technology, including:

- More effective management. Citrix helps reduce the cost of deploying and managing applications on end-user desktops with centralized management from the Citrix server.
- Device independence. Today, BYOD is a reality, and Citrix optimizes the delivery of virtual desktops and applications to virtually any device.
- Network cost reduction. Citrix HDX technology and the ICA protocol have been designed to optimize the user experience while using less bandwidth than their native application counterparts.
- Latency mitigation. Many native applications are inherently sensitive to WAN latencies; by decoupling the client logic from the presentation tier, Citrix reduces or eliminates this sensitivity.

When application performance issues arise, Citrix is often blamed when the real issue exists elsewhere. In fact, the added complexity of the Citrix environment introduces new performance questions, including:

- How do we measure performance and the quality of service experienced by Citrix users?
- When users complain, how fast can the issue be identified? Is it the network, the Citrix environment, the application server or the database that is at fault?
- How do we measure load within the Citrix environment? How many users can one Citrix server support, and is the load distributed efficiently? Is existing network bandwidth sufficient to service all the users and the applications they run?
- How do we isolate visibility into the users and the applications they are using when this traffic competes for bandwidth?

The very nature of desktop virtualization solutions — decoupling the client presentation layer from the client application logic — results in a performance visibility gap. This gap becomes quite challenging in a 24/7 operations environment where service degradation or business application downtime impacts more than users - it affects the whole business.

“The very nature of desktop virtualization solutions results in a performance visibility gap.”
What is a Citrix environment?

A Citrix environment includes three core components:

1) The Citrix client connects to a Citrix server over the network, using the ICA protocol. The ICA protocol fundamentally sends information about screen updates to the client and allows the client to communicate mouse movements and keyboard entries back to the server; it may also carry other client services such as print spooling, audio and video streaming, and file copy traffic. Each of these services uses a separate ICA channel.

2) Citrix servers support multiple clients, allocating an active user session for each connected user. Within each session, the end user can interact with different applications (browsers, native Windows applications, fat client apps, etc.) using a Citrix thin client terminal, or full desktop computer or other device that acts as a Citrix terminal.

3) The Citrix server (or server farm) is connected to the back-end applications (often in the same data center), and acts on behalf of its connected clients, issuing requests and receiving responses locally.

The challenges - details you need to know

This Citrix performance visibility gap limits IT’s understanding of application delivery service quality in a number of ways, presenting new monitoring challenges:

• Limited insight into capacity and load
• Reduced visibility into end-user experience
• Lack of correlation between the Citrix user sessions and backend application transactions
• Lack of end-to-end transaction monitoring

Let’s take a closer look at identifying and addressing these challenges.

“How do you measure the performance and application service quality delivered to your Citrix users?”
Insight into capacity and load

One important benefit from a Citrix solution is a reduction in bandwidth, enabling applications to overcome WAN challenges. By hosting the client application on the Citrix server, mouse movements and screen updates travel across the WAN to the Citrix client; the application’s client to server traffic, which can be much greater, occurs between the Citrix server and the application server. For simple interactive applications, the screen size and resolution and the number of screen updates dictate the bandwidth requirements for a single Citrix session. Other services, such as printing, audio, video, and disk mapping can change the equation dramatically.

In the table below, Citrix provides some guidance to help you understand each virtual desktop’s consumption of network bandwidth, ranging from 43Kbps to 1.8Mbps per session.

<table>
<thead>
<tr>
<th>Workflow</th>
<th>Avg User Load</th>
<th>Environment</th>
<th>Avg Bandwidth Consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>20</td>
<td>Native XenDesktop</td>
<td>43 kbps</td>
</tr>
<tr>
<td>Internet Browsing</td>
<td>10-12</td>
<td>Native XenDesktop &amp; Branch Repeater</td>
<td>31 kbps</td>
</tr>
<tr>
<td>Printing</td>
<td>1</td>
<td>Native XenDesktop &amp; Branch Repeater</td>
<td>553-593 kbps</td>
</tr>
<tr>
<td>(5MB MS Word &amp; PDF)</td>
<td>(server-rendered)</td>
<td>XenDesktop &amp; Branch Repeater</td>
<td>155-180 kbps</td>
</tr>
<tr>
<td>Flash Video</td>
<td>5</td>
<td>Native XenDesktop &amp; Branch Repeater</td>
<td>174 kbps</td>
</tr>
<tr>
<td>Standard WMV Video</td>
<td>4</td>
<td>Native XenDesktop &amp; Branch Repeater</td>
<td>464 kbps</td>
</tr>
<tr>
<td>(client-rendered)</td>
<td></td>
<td>XenDesktop &amp; Branch Repeater</td>
<td>148 kbps</td>
</tr>
<tr>
<td>High Definition WMV Video</td>
<td>2</td>
<td>Native XenDesktop &amp; Branch Repeater</td>
<td>1812 kbps</td>
</tr>
</tbody>
</table>

Table 1: Average Bandwidth per Session

This wide range is one of the reasons why it is important to be able to quickly identify and differentiate the traffic going through the Citrix “pipe” which is separated into what are known as ICA channels. These ICA channels can be used to measure the bandwidth that individual applications and services — such as SAP, print spooling, audio, etc., — each consume. This visibility helps in many ways; for example, it is often important to understand how much print traffic, and for which users, is delivered through Citrix, as this can have a significant impact on bandwidth consumption and system load.

Effective monitoring of ICA channels between Citrix clients and servers provides the granular visibility critical to identify, anticipate and avoid potential bottlenecks before they impact the end-user experience.
Dynatrace does exactly that by monitoring the characteristics of the ICA channel sessions between each remote end user and the data center where the Citrix servers reside. These measurements include key performance metrics that are analyzed to evaluate the network service quality experienced by users, and include:

- Network round-trip time
- Packet retransmission rate
- Effective network throughput (realized bandwidth)
- Network bandwidth usage per location, with per-application breakdown
- TCP connectivity availability from client to server

A scorecard showing Key ICA Performance Metrics

The monitoring view above highlights a few of these metrics, illustrating high loss rates and inconsistent round-trip time (RTT) that result in a negative impact on throughput and user experience.

One common and important question Citrix administrators must answer relates to system load: How many user sessions will a Citrix server support? For an organization implementing a new Citrix deployment to support 6,000 users, the difference between 15 users and 20 users per server is significant, resulting in a delta of about 100 servers. It is therefore important to understand the relationship between server resource demands, user experience, and active user sessions. This information provides insight into the usage and capacity of each server within the Citrix server farm, and is invaluable for performance analysis, tuning, troubleshooting, as well as capacity planning.

“Effective performance and capacity analysis relies on an understanding of the relationship between server resource demands, user experience, and active user sessions.”
The screen shot above graphs performance for two servers. The left x-axis graphs the number of sessions per server, while the right x-axis graphs load in terms of the percentage of memory, CPU and disk utilization; note that the right x-axis scales differ between the two images. While CPU and memory consumption are quite similar for each server (around 20 percent), disk utilization differs dramatically; the top chart’s server often reaches 60 percent, while the bottom chart’s server remains below 20 percent.

Understanding that the user load is well-balanced between the servers, this discrepancy calls for investigation, perhaps caused by a rogue process or a hardware issue.

**Visibility into end-user experience**

Inherent in a thin client solution is the decoupling of client presentation information (for Citrix, delivered via ICA) from the application logic (executed by the native application protocol); the XenApp server effectively separates these layers into two tiers. This architecture results in another challenge, limiting visibility into end-user experience and the quality of service users receive as they access back-end applications.

Seemingly straightforward questions that were traditionally answered by Application Aware Network Performance Monitoring (AA NPM) solutions — Which users are using which applications? How reliable and consistent is application performance to each remote location? — suddenly become difficult to answer. Monitoring the ICA tier doesn’t provide information on application performance or end-user experience, while backend application monitoring fails to provide the critical context of end-user or location; in short, IT is left driving in the fog.

To address this challenge and regain this lost visibility, Dynatrace analyzes the ICA tier in real time, identifying users, their network service quality, the applications they access, and transaction response times. This insight is valuable for many reasons, including the successful rollout and adoption of the Citrix solution itself, allowing you to anticipate performance problems, identify the rate at which your users adopt the new environment, and ensure your users are satisfied.

"End-user experience - not component performance - should be the primary indicator of IT service quality."

This screenshot above shows the applications accessed from a specific user’s location; it is clearly visible that only a portion of that location’s traffic is Citrix (ICA) traffic. Citrix traffic has to compete with other applications occupying the same network link, which may negatively impact the Citrix user experience.

The ICA connection itself can be analyzed in even more detail, with performance and usage information for each ICA channel. Refer to the following diagram for a conceptual view of ICA channels.
Graphical Representation of ICA channels

The report screenshots below show the breakdown of ICA traffic, including interactive screen updates, audio/video media, print and USB access; additionally, published Citrix application names are reported together with their channel names, facilitating precise and rapid fault domain isolation for any type of performance problem.

The ICA Protocol Decode Provides Insight Into Published Applications and Citrix Services

Correlating Citrix user sessions with application performance

We've already discussed how important it is to understand the service quality of the Citrix ICA tier. It is also important to understand the performance of the applications being delivered via Citrix, and to correlate these perspectives. As Citrix is introduced to new or existing application environments, this correlated visibility becomes a monitoring must-have.

As we've seen, Dynatrace monitors the Citrix ICA channels for key presentation-tier performance metrics. Dynatrace also analyzes the application traffic between the Citrix servers and the application servers, identifying discrete transactions by name, measuring their respective response times, and reporting any application-specific errors. These transactions are correlated to individual Citrix user names, allowing you to understand the performance of all transactions used by each user, providing the insight required to understand the business impact of application performance and availability issues. Dynatrace offers a wide range of application support, including web, SAP, Oracle E-Business Suite, Database, WebSphere MQ, SOAP, XML, CIFS, Siebel and many more.
The screen shot below shows response times for pages of a web-based application accessed via Citrix. The first row identifies a web page component (a search Java server page) with a high number of slow requests and, as a result, very low application performance, indicating a problem with this specific transaction; most other pages are performing well. Dynatrace identifies if and where there is a performance problem, highlighting how affects your customers or end users — in this case, exonerating Citrix as a culprit and including application-specific details to pass to the application team for corrective action.

Operations, Application Performance and Affected Users

The ability to correlate each Citrix user session to the respective back-end applications and transactions is critical for understanding the service quality received by end users and the overall perception of user satisfaction. It allows you to answer the important question “Which Citrix users are affected by degraded application performance?” — thereby arming you with insight into the business impact of poor performance.

“Dynatrace supports virtually all applications delivered via Citrix, including web, SAP, Oracle EBS, Siebel, Epic and SQL.”
End-to-end monitoring

Regardless of how you deliver applications to your users, visibility into the entire application delivery chain is paramount to a successful monitoring strategy. This is even more important given the additional complexity of a Citrix environment, which adds new points of failure at the same time it obscures application visibility. While our discussion of the challenges so far has focused on specifics, taken together these comprise our most significant challenge — that of an integrated, end-to-end view of performance, where Citrix is a key component of the application delivery chain.

An effective performance visibility solution allows you to identify when, where, and why an issue originates, who it affects, and how to correct it. It should help you answer all your important questions, including:

- How does the network contribute to a performance problem?
- What impact do Citrix services (printing, drive mapping, etc.) have on performance and on link utilization?
- Are there resource constraints or load balancing issues within the Citrix server farm?
- How well are the back-end applications — such as SAP, Oracle eBusiness, database apps — performing for specific Citrix users?

The above diagram shows how Dynatrace can monitor the entire application delivery chain including the Citrix infrastructure. The Dynatrace probe, also called the Agentless Monitoring Device (AMD), passively captures the network traffic between:

- Citrix clients and the Citrix server (the ICA presentation tier)
- The Citrix server and back-end application servers (the application tier)

In addition, Dynatrace gathers information from:

- The Thin Client Analysis Module (TCAM) agent, installed on the Citrix server. The TCAM provides information on Citrix user sessions, providing the correlation between user sessions on the ICA tier and transactions executed on the application tier. Additionally, the TCAM monitors resource consumption on the Citrix server (CPU, memory, disk I/O, and Citrix session counts) for insight into the effect of system load on performance.

- The Citrix NetScaler application delivery controller (ADC), typically present between the Citrix server farm and the end users. The Dynatrace network probe gathers NetScaler’s traffic measurements using Citrix AppFlow technology. AppFlow-delivered metrics complement the end-to-end picture of application performance collected by the network probe with additional visibility from the ADC perspective.

This visibility results in a full end-to-end picture of application service quality as delivered to your Citrix users; Citrix users on the ICA tier can be tracked through the Citrix infrastructure to the applications they use and to specific transaction performance, providing comprehensive fault domain isolation for the entire application delivery chain.

"An integrated end-to-end view of performance – including Citrix – is key to effective IT service delivery."
An Example of a Performance Dashboard for SAP Delivered Through Citrix

Summary

For many organizations, Citrix has become the foundation used to deliver business-critical applications and key services to their end users. Citrix XenDesktop and XenApp are enablers, improving the performance, security and management of these applications, lowering network costs and facilitating a BYOD workplace. At the same time, the additional complexity and loss of visibility present serious consequences if not addressed. These consequences include:

- Inability to measure an application’s service quality as delivered to end users
- No visibility into the business impact of performance problems
- Extended time to detect, isolate and correct performance problems
- Greater user frustration resulting from delayed service restoration

Dynatrace fills these gaps and provides deep insight into the quality of service each user receives, including:

- The industry’s most comprehensive performance visibility and fault isolation — from the user’s click through the Citrix NetScaler, Citrix XenApp and XenDeskop server farm to the application servers — and back
- The industry’s broadest support for business application protocols for deep transaction insight
- No sampling, with 100% of Citrix user transactions captured
- Unique correlation of front-end ICA user traffic through the Citrix server to backend application traffic
- Easy to implement, passive agentless technology, with auto-discovery, user recognition and transaction recognition for near-effortless configuration
- Inclusion of usage and performance measurements gathered by Citrix NetScaler on the application traffic it optimizes and delivers — all from the same Dynatrace network probe that can receive and analyze both Citrix AppFlow records and wire data in parallel

“Dynatrace provides the industry’s most comprehensive performance visibility and fault isolation for applications delivered via Citrix.”
Using Dynatrace you will be able to answer important questions, including:

- Which applications are being used in the Citrix environment, and by whom?
- Which applications, locations and users are impacted by poor performance?
- How can we optimize the use of network bandwidth to better service our most critical applications?
- How can we optimize back-end application performance to improve user satisfaction?
- What is the source of a performance issue?

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