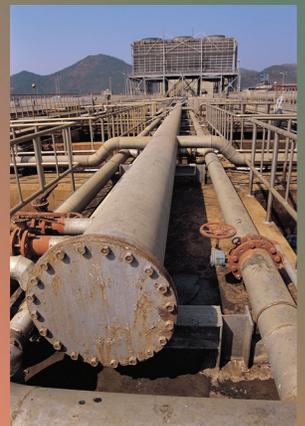


U.S. International Trade Commission

Audit of Citrix Remote Access



OIG-AR-13-01

October 19, 2012



Office of Inspector General

The U.S. International Trade Commission is an independent, nonpartisan, quasi-judicial federal agency that provides trade expertise to both the legislative and executive branches of government, determines the impact of imports on U.S. industries, and directs actions against certain unfair trade practices, such as patent, trademark, and copyright infringement. USITC analysts and economists investigate and publish reports on U.S. industries and the global trends that affect them. The agency also maintains and publishes the Harmonized Tariff Schedule of the United States.

Commissioners

Irving A. Williamson, Chairman

Daniel R. Pearson

Shara L. Aranoff

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David S. Johanson

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UNITED STATES INTERNATIONAL TRADE COMMISSION

OFFICE OF INSPECTOR GENERAL

WASHINGTON, DC 20436

October 19, 2012

IG-KK-017

Chairman Williamson:

This memorandum transmits the Office of Inspector General's final report, *Audit of Citrix Remote Access*, OIG-AR-13-01. This audit focused on whether the Commission's Citrix platform provided the capabilities necessary for Commission staff to effectively and efficiently perform their work remotely. In finalizing this report, we analyzed management's comments to our draft report and have included those comments in their entirety as Appendix A.

The audit identified several problem areas that contributed to a decrease in staff productivity while working remotely. This report contains 11 recommendations to address the problem areas. In the next 30 days, please provide me with your management decisions describing the specific actions that you will take to implement each recommendation.

Thank you for the courtesies extended to the auditors during this review.

Philip M. Heneghan
Inspector General

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Results of Audit

The purpose of this audit was to answer the question:

Does the USITC's Citrix platform provide the capabilities necessary for Commission staff to effectively and efficiently perform their work remotely?

No. The Commission's Citrix platform does not provide the capabilities necessary for Commission staff to effectively and efficiently perform their work remotely.

The Commission has implemented a Citrix platform to provide remote access for its staff. This Citrix platform provides users with remote access to data and a subset of standard work applications.

The Commission's Addendum to the Strategic Plan for Fiscal Years 2009-2014 states the following: "*Management Goal 4: Use information technology to support productivity gains.*" To support this goal, this audit focused on the quality of the user experience when using Citrix remotely. In order for Commission staff to work remotely in a productive manner, the Commission should provide an application that appears and functions like the desktop of a standard office workstation, correctly configure the system to minimize user effort, and use a complete set of information to facilitate management and support of that system.

The Commission's remote access system does not meet these criteria. Its Citrix implementation provided a time-limited web application that required users to individually launch applications as a separate window. The system required redundant data entry and unnecessary delays to login, and each application launch caused additional delay. Standard operations by users resulted in errors due to Citrix configuration or other infrastructure problems, and the data generated by the platform provided only partial information that was insufficient to manage the system.

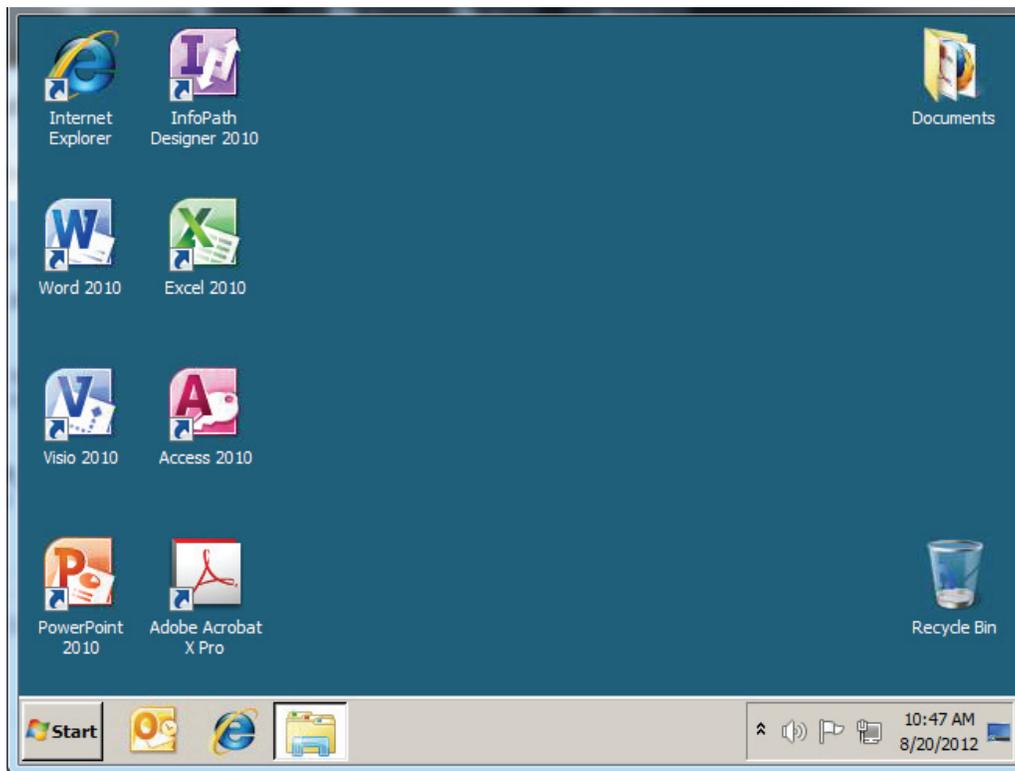
We identified three problem areas with the Commission's implementation of Citrix remote access. Below, we describe these three problem areas and their effect on productivity, and we provide recommendations to improve the productivity of the Commission's staff while using the Citrix remote access platform.

Problem Areas

Problem Area 1:
The Commission does not provide all staff with remote access that approximates the standard office PC experience.

When Commission users login to their PC (personal computer) in the office, their screen presents them with a desktop providing access to their applications and data. Citrix provides this function with its “Desktop” application. An example of the Citrix published desktop application is seen below:

Figure 1: Example of a Citrix Desktop application:

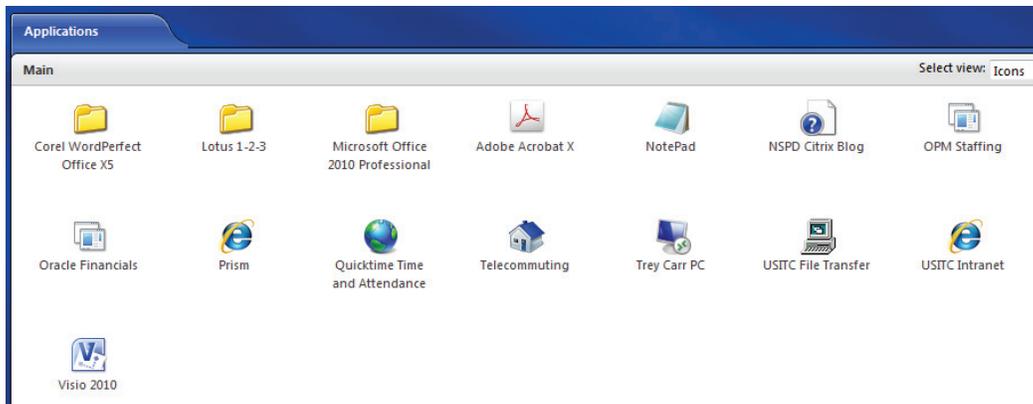


This feature allows users to efficiently launch a single application from Citrix remote access, where they can access their applications and data. Once the desktop application is launched, all specific applications such as Outlook, Word, and others launch instantly just as they would from an office-based PC, and their appearance is identical to that on their office PC.

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To attain the highest level of productivity while working remotely, select CIO staff had access to this desktop application when using Citrix remote access. Other Commission staff did not have access to the desktop application, and had to individually select and launch the applications from the Citrix Web Interface in their Internet browser:

Figure 2: Application menu in Citrix Web Interface:



Each of these applications must be launched one at a time. For example, launching Microsoft Word opens a window for only this application. To use an additional application, the user must return to the web browser on their local PC, access the Citrix Web Interface application menu, and launch their next selected application. If the user had not accessed the Citrix Web Interface application menu in the last 15 minutes, they would be required to login once again. We recorded an average of 39 seconds to launch the initial application from the Web Interface. In some cases, launching subsequent applications will require a similar delay.

Not all standard applications are available when using Citrix remote access. For example, Mozilla Firefox and Adobe Flash are found on all office PCs, but these applications were not available in Citrix. When users work in Citrix, their saved settings such as Internet Explorer favorites were missing. There is no technical reason preventing Firefox, Flash, and settings such as Internet Explorer favorites from being made available to Citrix users.

The effect of the lack of a remote access desktop application is that staff productivity is reduced while working remotely and using Citrix. Doing routine work requires a cumbersome method of accessing data and applications, and staff may not have access to the information or programs they need to get their work done. The Commission can improve productivity for all remote access users by providing them with the desktop application, and ensuring that it offers all standard applications and user settings. We spoke with two Federal agencies providing Citrix remote access, and both provide the desktop application to all staff.

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Recommendation 1:

Provide all Commission staff an interface, such as a desktop, that offers access to programs similar to that of the office PC.

Recommendation 2:

Synchronize all possible user-configured desktop settings including Internet Explorer favorites with users' remote access profiles.

Recommendation 3:

Provide all standard applications in remote access.

Problem Area 2:

The Citrix configuration caused unnecessary delays and errors.

A well configured Citrix remote access platform should allow staff to work efficiently anywhere by providing a streamlined login process and error-free operation. The Commission's Citrix configuration causes redundant data entry and delays in the login process, and prompts users with unnecessary errors and warnings when used for standard operations.

1. Login inefficiency:

The Commission's Citrix login process can be configured to provide a single login screen, similar to that provided by the Commission's webmail application. Two other Federal agencies were surveyed during the course of this audit, and both of them provide an efficient, single login screen, an example of which is seen below:

Figure 3: Example of a single login screen:

The screenshot shows a login interface with the following elements:

- Welcome** header.
- A warning message: "Warning! This is an official U.S. Government computer system."
- A detailed disclaimer paragraph regarding unauthorized access and data handling.
- A blue padlock icon on the left side.
- Three input fields: "User name:", "Passcode:", and "Password:".
- A "Log On" button at the bottom right.

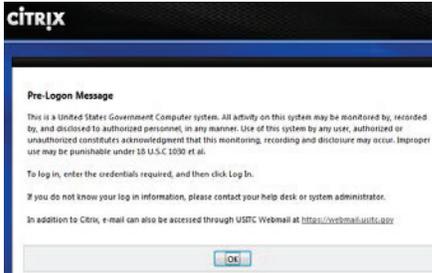
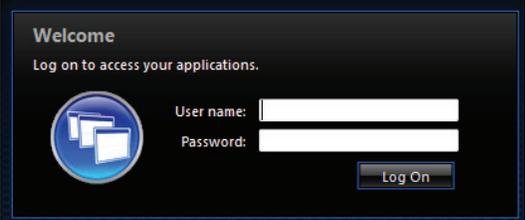
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This login screen prompted the user to read an access disclaimer, enter their user name, passcode, and password, and then press “Log On” to access their Citrix applications.

In contrast, the Commission’s Citrix login process had been configured to be inefficient, requiring unnecessary steps, delays, and redundant data entry across three separate screens. The steps to login to the Commission’s Citrix system were as follows:

Figure 4: Commission Citrix Log On process:

<p>1. On the first screen, users were required to enter their user name, then passcode, then press the “Log On” button and wait for the next screen:</p>

<p>2. On the second screen, they were presented with a pre-login message where they must press the “OK” button and wait for yet another screen:</p>

<p>3. On the third screen, they again entered their user name, then type their password, and press “Log On” to finally access the list of Citrix applications.</p>


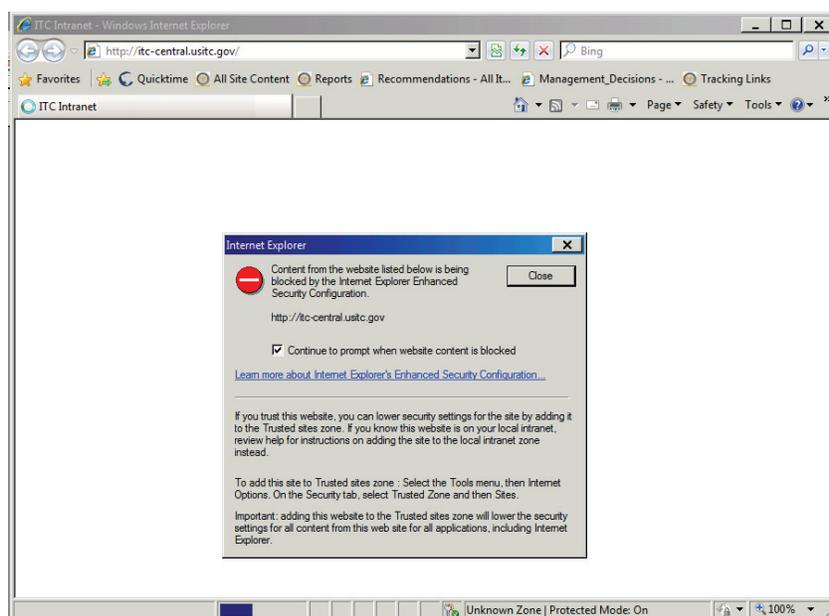
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This redundant and inefficient process was the result of the Commission’s configuration of Citrix, and was not due to a lack of capability on the part of Citrix. Citrix can be configured to provide a single login screen, similar to that provided by the Commission’s webmail application.

2. Unnecessary Warnings and Errors:

The Commission configured Citrix to prompt users with errors and warnings when accessing standard applications. For example, users that launched the “USITC Intranet” application would encounter this if it happened to load from server 1.

Figure 5: Unnecessary warning:



This message indicates that content from the site is being blocked for security reasons. In our analysis of the root cause of this issue, we found that the Citrix “USITC Intranet” application could be loaded from one of four servers. Three of the four servers do not exhibit this warning. This indicates that the servers were not configured consistently, resulting in a potentially different experience each time users access an application.

Users also experienced errors indicating that specific applications were not available. Our review of the Citrix configuration found that applications were sometimes not installed on the Citrix servers, and at other times, servers hosting applications were either shut down or otherwise offline. In one specific instance, Microsoft Visio was a published Citrix application. The Citrix web Applications menu indicated that it was available for use in Citrix. However, it was impossible to load because Citrix had been configured to launch the Visio application from a server where it was not installed. This problem was

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solved by configuring Citrix to load the application from a server which did have Visio installed.

The CIO maintains a listing of “Non-essential Servers”, and at least one of the Citrix servers on this list was the only server performing a specific function, in this case, providing Microsoft Visio. The fix for Visio in Citrix was short-lived, because the Visio server was taken offline from May 25-31 when the office of the CIO turned off several servers to reduce heat in the server room. During this time, Visio was once again unavailable from the remote access platform.

The delays and unnecessary errors due to the remote access configuration frustrates staff by forcing them to learn new and inefficient ways to perform routine tasks, and trains them to expect errors and warnings when performing standard operations. When users expect errors, it undermines their confidence that they can be productive while working on the Citrix remote access system.

Recommendation 4:

Implement a single login screen.

Recommendation 5:

Implement a standard, consistent baseline configuration for all remote access servers.

Recommendation 6:

Update the Commission’s list of Non-Essential Servers to include the impact of taking down specific remote access servers.

Recommendation 7:

Manually test and confirm all existing applications to ensure they operate error- and warning-free on all servers.

Recommendation 8:

Implement or update existing procedures to test all newly published applications to ensure they operate error- and warning-free on all servers.

Problem Area 3:

The partial information reported by Citrix monitoring was insufficient to manage the remote access platform.

The Commission’s Citrix infrastructure consists of more than a dozen servers. It is difficult to understand the configuration without reporting tools, and impossible to manually gather and review the performance statistics and logged data of each of these

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servers. The Commission should implement and manage specific tools to understand the configuration and operations of its Citrix platform.

To manage and support the Citrix platform, the tools implemented should provide the following capabilities:

1. Live connection information: who is connected to what?
2. Up-to-date historical connection information: who was connected to what?
3. Session performance data as it pertains to the user experience:
 - a. Initial application launch delay: how long does it take to launch an application?
 - b. Session delay/screen latency: what lag do users experience? Is it just one user (problem with user PC or their Internet connection), or is it all of them (problem with Commission infrastructure or its Internet connection?)
4. Session shadowing: the ability to directly observe user issues and provide support and diagnosis in real-time.
5. Configuration reporting: how is the platform configured?

Once the tools are installed, they must be configured correctly and periodically tested to ensure they are operational.

The Commission is unable to effectively manage its Citrix platform because it relies on partial information, it doesn't use freely available tools to report on the configuration, and it does not supply its Help Desk staff with the tools to diagnose problems within the Citrix platform.

1. Partial Information

When we began this audit, we obtained access to the Commission's EdgeSight monitoring tool. This tool was included with the Commission's licensed version of Citrix and was used by the OCIO to collect performance data for Citrix operations. When properly configured, it can provide comprehensive performance and operational data that would be useful to identify and diagnose problems in the Citrix platform.

We planned to use EdgeSight data to understand the performance characteristics of the Commission's Citrix platform. After several days of testing, it became clear that significant amounts of data were missing from EdgeSight. A cursory review of the EdgeSight configuration showed that not all servers were reporting on the scheduled daily basis. In the example below, three of the ten servers did not report as scheduled:

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Figure 6: Servers not uploading data:

Device	Domain	Model	#@MHz	Last Upload ▲
ITCXENAPP7	ITCNET	VMware Virtual Platform	2@ 1995	8/19/2012 8:14 PM
ITCXENAPP1	ITCNET	PowerEdge M610	16@ 2394	8/21/2012 7:52 PM
ITCXENAPP2	ITCNET	PowerEdge M610	16@ 2394	8/22/2012 5:09 AM
ITCXENAPP8	ITCNET	VMware Virtual Platform	2@ 1995	8/23/2012 5:08 AM
ITCXENAPP4	ITCNET	PowerEdge M610	16@ 2394	8/23/2012 5:34 AM
ITCXENAPP6	ITCNET	VMware Virtual Platform	1@ 1995	8/23/2012 5:35 AM
ITCXENAPP10	ITCNET	VMware Virtual Platform	2@ 1995	8/23/2012 5:43 AM
ITCXENAPP3	ITCNET	PowerEdge M610	16@ 2394	8/23/2012 5:58 AM
ITCXENAPP11	ITCNET	VMware Virtual Platform	2@ 1995	8/23/2012 6:35 AM
ITCXENAPP9	ITCNET	VMware Virtual Platform	2@ 1995	8/23/2012 6:36 AM

An analysis of seven weeks of OCIO-provided data identified further evidence that EdgeSight was not properly reporting data. For different reasons, servers can periodically be taken down for maintenance. While it is possible for them to be taken down for extended periods of time, generally speaking, typical maintenance should only last a day or less. In a frequently used environment, it could be expected to see activity for most servers each day, and all servers each week. According to the Commission’s EdgeSight data, servers were operational for an average of 34% for each of the seven weeks reported. EdgeSight reported that three servers were never used, and only one server reported Citrix access for each of the seven weeks.

Table 1: EdgeSight Evidence of Per-Server Citrix Use:

EdgeSight Evidence of Per-Server Citrix Use								
Server Name:	7/2-7/8	7/9-7/15	7/16-7/22	7/23-7/29	7/30-8/5	8/6-8/12	8/13-8/19	Percent of Weeks Operational:
server1	X	X		X	X			57%
server2	X	X	X	X	X	X	X	100%
server3				X	X	X		43%
server4	X	X	X	X		X	X	86%
server6								0%
server7								0%
server8	X							14%
server9	X			X				29%
server10	X							14%
server11								0%
Average:								34%

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When we initially spoke with the OCIO about this discrepancy, we were told that the servers were most likely down due to maintenance. When we discussed the issue again, we were told that the three servers not reporting any data were reserved, and not in use. In an effort to further understand the environment, we reviewed the Windows server logs to see whether they were had recorded signs of Citrix activity during the seven week period. We found that the logs did contain information indicating Citrix activity and we analyzed this data to determine when the servers actively provided Citrix services to remote access users. The server logs reflect what the server actually did, and if EdgeSight was working correctly, it would have reflected this same information.

We compared the Windows server log data for two servers with the data reported by EdgeSight for the same seven week period. For one server, the Windows server log reported that Citrix was operational for four of the seven (57%) weeks, while according to EdgeSight, the server was operational for only one (14%). The other server was active for all seven weeks (100%), but EdgeSight reported no activity (0%). EdgeSight was not properly gathering data and the reported data was either absent, corrupt, or both. The CIO and his staff were unaware that their systems were not being monitored, and because the data was incomplete, they did not know which of their servers were operational. This meant that the OCIO had an inaccurate picture of the Citrix environment.

Table 2: Server Log Evidence of Activity Compared to EdgeSight:

Server Log Evidence of Activity Compared to EdgeSight								
	7/2-7/8	7/9-7/15	7/16-7/22	7/23-7/29	7/30-8/5	8/6-8/12	8/13-8/19	Percent of Weeks Operational
Server 8 Windows Application Log	X			X	X	X		57%
<i>Server 8 EdgeSight Data</i>	<i>X</i>							<i>14%</i>
Server 6 Windows Log	X	X	X	X	X	X	X	100%
<i>Server 6 EdgeSight Data</i>								<i>0%</i>

The Commission should identify the servers that are not properly reporting data, resolve these issues, and periodically monitor the health of EdgeSight to ensure that it is collecting data from all servers. Otherwise, EdgeSight cannot serve its intended purpose, which is to inform staff so they can support and manage Citrix effectively.

2. Configuration Reporting:

When Citrix applications are published, it is easy to misconfigure these applications if the administrator is unaware of the location of installed software. Citrix does not report on misconfiguration when an application is not available on the server specified in the Citrix configuration.

To help deal with this issue, Citrix provides a free software development kit (SDK) and instructions to generate reports on its configuration. These tools can be used to validate settings to ensure that everything is properly configured. The Commission did not use these tools or other methods to assess its Citrix configuration, and the OCIO's lack of knowledge of the platform's design led directly to some of the errors experienced by users.

These tools can efficiently document the installed applications of the Citrix servers, and facilitate verification of settings to ensure that users do not experience errors due to application misconfiguration.

3. Help Desk:

To determine the effectiveness of support provided to remote users, we interviewed a number of Commission users for this audit. Every person interviewed expressed frustration with the Citrix remote access system and all had difficulty getting specific help resolving their issues. In fact, we found that in one department, popular dissatisfaction reached a level that a single person was appointed as a liaison to the Help Desk to report on collective staff problems with Citrix.

The interviewees described a Help Desk troubleshooting process that focused on analyzing problems with their home PC. Many of the issues they described indicated a problem with the Commission's infrastructure, and not their home PC. None of those interviewed described being told that a potential problem with the Citrix infrastructure could be the cause of their issue, or that resolution of their problem would require escalation to operational staff.

We interviewed Help Desk staff to determine whether they had access to Citrix-specific tools to assist them as they attempted to resolve Citrix support requests. The staff responded that they were able to use tools to diagnose problems with login credentials, but they did not have access to tools to monitor or diagnose the Citrix platform. Help Desk personnel should be provided with access to Citrix-specific tools to quickly and accurately diagnose the cause of errors being experienced by users, or to escalate them to the appropriate operational staff for resolution.

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The lack of effective support for Commission staff experiencing remote access problems decreases their effectiveness and efficiency and results in reduced productivity when they attempt to work remotely.

Recommendation 9:

Resolve issues preventing remote access servers from reporting status.

Recommendation 10:

Implement tools to document and report on applications provided by each remote access server.

Recommendation 11:

Provide the Help Desk with tools to diagnose remote access problems.

Management Comments and Our Analysis

On October 18, 2012, Chairman Irving Williamson provided management comments on the draft report. He agreed with the three problem areas, and stated that the Commission will institute appropriate management decisions to address the recommendations. The Chairman's response is provided in its entirety as Appendix A.

Objective, Scope, and Methodology

Objective:

Does the USITC's Citrix platform provide the capabilities necessary for Commission staff to effectively and efficiently perform their work remotely?

Scope:

This audit focused on the implementation and capabilities of the Commission's Citrix remote access system as it existed on April 4, 2012.

Methodology:

1. We identified and interviewed users of the current remote access system.

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2. We reviewed performance statistics of the system, login duration, session latency, and other characteristics.
3. We identified factors that could affect system performance.
4. We analyzed resiliency of the current system, including single points of failure.
5. We identified causes of failure within the infrastructure.
6. We identified any features available on workstations not included in the Citrix system.
7. We compared ITC's Citrix implementation performance and capabilities against other Federal agency implementations.

We conducted this performance audit in accordance with Generally Accepted Government Auditing Standards (GAGAS). Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

U.S. International Trade Commission

Appendix A

Appendix A: Management Comments on Draft Report

Chairman



UNITED STATES INTERNATIONAL TRADE COMMISSION

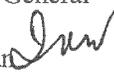
WASHINGTON, DC 20436

CO81-KK-011

October 18, 2012

MEMORANDUM

TO: Philip M. Heneghan, Inspector General

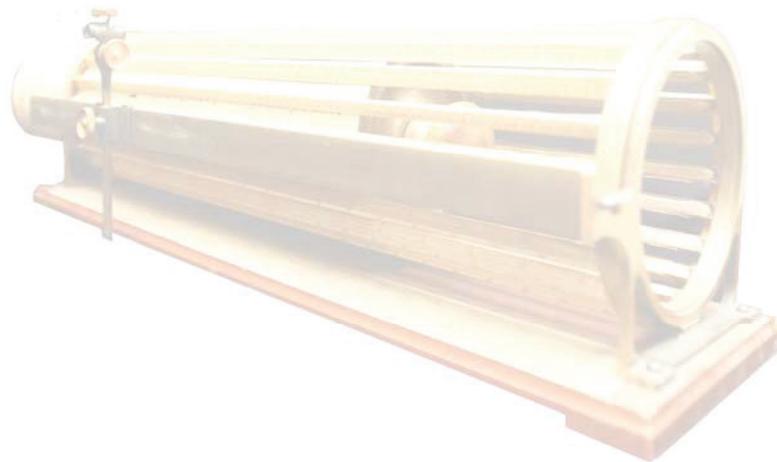
FROM: Irving A. Williamson, Chairman 

SUBJECT: Management Response to the Inspector General's Draft Report, "Audit of Citrix Remote Access"

I am in receipt of the Inspector General's report, *Audit of Citrix Remote Access*, dated September 6, 2012. I appreciate the opportunity to review the report and provide comments.

The Inspector General's report found that the USITC's Citrix platform does not provide the capabilities necessary for USITC staff to effectively and efficiently perform their work remotely. With regard to this finding, the report highlighted the following three specific problem areas. First, staff was not provided with remote access that approximates the standard office PC experience. Second, the Citrix configuration caused unnecessary delays and errors. Third, the partial information reported by Citrix monitoring was insufficient to manage the remote access platform.

We agree with the findings and the Commission will institute appropriate management decisions in response. Thank you for your thoughtful review.



“Thacher’s Calculating Instrument” developed by Edwin Thacher in the late 1870’s. It is a cylindrical, rotating slide rule able to perform complex mathematical calculations involving roots and powers quickly. The instrument was used by architects, engineers, and actuaries as a measuring device.

To Promote and Preserve the Efficiency, Effectiveness, and Integrity of the U.S. International Trade Commission



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