TREASURY INSPECTOR GENERAL FOR TAX ADMINISTRATION

Virtual Server Technology Has Been Successfully Implemented, but Additional Actions Are Needed to Further Reduce the Number of Servers and Increase Savings

March 30, 2012

Reference Number: 2012-20-029

VIRTUAL SERVER TECHNOLOGY HAS BEEN SUCCESSFULLY IMPLEMENTED, BUT ADDITIONAL ACTIONS ARE NEEDED TO FURTHER REDUCE THE NUMBER OF SERVERS AND INCREASE SAVINGS

Highlights

Final Report issued on March 30, 2012

Highlights of Reference Number: 2012-20-029 to the Internal Revenue Service Chief Technology Officer.

IMPACT ON TAXPAYERS

The IRS implemented server virtualization technology to reduce the number of Wintel servers needed for tax administration and lower operational costs to the taxpayers. As of the end of Fiscal Year 2011, the IRS estimated that server virtualization had saved approximately $10.2 million in equipment costs, and it expects to save approximately $1.3 million annually in decreased electrical costs beginning in Fiscal Year 2013. The number of Wintel servers could be further reduced for increased efficiency and cost savings of approximately $7.73 million.

WHY TIGTA DID THE AUDIT

This review was included in our Fiscal Year 2011 Annual Audit Plan and addresses the major management challenge of Modernization. The overall objective of this review was to evaluate the effectiveness and efficiency of the IRS's efforts to consolidate and virtualize its servers. In addition, the Federal Data Center Consolidation Initiative was passed in February 2010, mandating a reduction in the number of Federal data centers.

WHAT TIGTA FOUND

The IRS successfully implemented server virtualization technology to improve server efficiency and realize cost savings. The Server Consolidation and Virtualization Project focused on establishing a virtual server infrastructure and moving approximately 2,500 physical Wintel servers at 13 data center locations to the virtual

environment. As of the end of Fiscal Year 2011, the IRS had approximately 1,800 virtual servers operating on 234 physical host servers in the virtual environment, resulting in the previously stated decrease in equipment and electrical costs.

The IRS does not have a plan for virtualizing Wintel servers at its field offices outside of the 13 data center locations. The IRS estimates there are approximately 650 Wintel servers in its field locations that can be decommissioned and added to the virtual server environment. By virtualizing these servers, the IRS estimates it could realize additional savings of approximately $7.73 million ($7.26 million in equipment savings and $0.47 million in electrical savings over five years). Aside from the cost savings, these actions also help the IRS to meet Federal Data Center Consolidation Initiative goals.

WHAT TIGTA RECOMMENDED

TIGTA recommended that the Chief Technology Officer 1) develop and implement a process to identify servers currently located in field offices that can be virtualized and 2) create and implement a plan to virtualize those servers.

In their response to the report, IRS management concurred with both recommendations. The IRS plans to 1) develop and implement a process to identify servers located in field offices that can be virtualized and 2) create and implement a plan to virtualize those servers.

DEPARTMENT OF THE TREASURY

WASHINGTON, D.C. 20220

**TREASURY INSPECTOR GENERAL
FOR TAX ADMINISTRATION**

March 30, 2012

MEMORANDUM FOR CHIEF TECHNOLOGY OFFICER

FROM: Michael R. Phillips
                   Deputy Inspector General for Audit

SUBJECT: Final Audit Report – Virtual Server Technology Has Been Successfully
                   Implemented, but Additional Actions Are Needed to Further Reduce
                   the Number of Servers and Increase Savings (Audit # 201120014)

This report presents the results of our review of the Internal Revenue Service's efforts to
consolidate and virtualize its servers. This review was included in the Treasury Inspector
General for Tax Administration's Fiscal Year 2011 Annual Audit Plan and addresses the major
management challenge of Modernization.

Management's complete response to the draft report is included as Appendix V.

Copies of this report are also being sent to the Internal Revenue Service managers affected by the
report recommendations. Please contact me at (202) 622-6510 if you have questions or
Alan R. Duncan, Assistant Inspector General for Audit (Security and Information Technology
Services), at (202) 622-5894.

Table of Contents

**Virtual Server Technology Has Been Successfully Implemented,
but Additional Actions Are Needed to Further Reduce
the Number of Servers and Increase Savings**

Abbreviations

FDCCI   Federal Data Center Consolidation Initiative

IRS   Internal Revenue Service

***Virtual Server Technology Has Been Successfully Implemented,
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Background

In 2007, the Internal Revenue Service's (IRS) Infrastructure Roadmap Initiative concluded that the IRS's diverse and widely deployed server infrastructure would benefit from the results of a consolidation and virtualization project. The initiative recommended a highly centralized, consolidated, and virtualized future state for the IRS's computing environment. In 2007, the Virtualization Project Office was established to design and implement an enterprise-wide virtualization environment. The Server Consolidation and Virtualization Project was initiated in February 2007 and closed in December 2010.

Server virtualization is a technology that allows a number of virtual servers[1] to run on one physical host. The technology enables improved hardware utilization, electrical savings, and reduced server replacement costs. Virtualization helps an information technology organization improve efficiency and productivity by simplifying server deployment and administration. For example, the impact of any hardware issues on a virtualized server can be minimized because the applications and data on the affected server can be switched to other servers in the pool. This allows for decreased server downtime due to hardware failure because the system can continue running while the hardware is replaced.

Implementing virtualization technology at the IRS also supports the Federal Data Center Consolidation Initiative (FDCCI). In February 2010, the Federal Chief Information Officer launched the FDCCI, mandating a reduction in the number of Federal data centers. The FDCCI aims to:

- Encourage the use of Green Information Technology[2] by reducing the overall energy and real estate footprint of Federal Government data centers.

- Reduce the cost of data center hardware, software, and operations.

- Increase the overall information technology security posture of the Federal Government.

- Shift information technology investments to more efficient computing platforms and technologies.

The IRS has prepared a Data Center Consolidation Plan in response to direction from the Office of Management and Budget and the FDCCI. The IRS's approach to increase the efficiency of its

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[1] A virtual server is not a physical machine. It co-resides and shares computer resources with other virtual servers on a physical computer or host.
[2] Green Information Technology, also known as Green Computing, is the movement toward a more environmentally friendly and cost-effective use of power and production in technology.

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Wintel[3] server resources is to use server consolidation and centralization to reduce the total number of required physical servers and server locations. Wintel servers are located at IRS Enterprise Computing Centers,[4] campuses,[5] and many other locations across the IRS. A primary objective of the Server Consolidation and Virtualization Project was to reduce the number of physical Wintel servers. The Project created a virtual infrastructure at 13 targeted locations to virtualize approximately 2,500 physical servers managed by the IRS's Enterprise Operations organization. Wintel servers at other IRS field locations were not included in the scope of the Server Consolidation and Virtualization Project. The virtual environment consists of a series of high-end physical servers capable of hosting multiple virtual servers on each physical host. As of the end of Fiscal Year 2011,[6] approximately 1,800 virtual servers were operating on 234 physical host servers in the virtualized infrastructure.

We obtained Server Consolidation and Virtualization Project records and interviewed Project management located in Portsmouth, New Hampshire; Hartford, Connecticut; and Providence, Rhode Island, during the period March 2011 through January 2012. We conducted this performance audit in accordance with generally accepted government auditing standards. 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 objective. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. Detailed information on our audit objective, scope, and methodology is presented in Appendix I. Major contributors to the report are listed in Appendix II.

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[3] A Wintel server is a server running a Microsoft Windows operating system with an Intel microprocessor.
[4] IRS Computing Centers support tax processing and information management through a data processing and telecommunications infrastructure.
[5] The data processing arm of the IRS. The campuses process paper and electronic submissions, correct errors, and forward data to the Computing Centers for analysis and posting to taxpayer accounts.
[6] A 12-consecutive-month period ending on the last day of any month, except December. The Federal Government's fiscal year begins on October 1 and ends on September 30.

Results of Review

The Internal Revenue Service Has Successfully Deployed the Technology and Infrastructure to Consolidate and Virtualize Wintel Servers at Select Data Centers

The Virtualization Project Office teamed with the Hewlett-Packard Company to aid the Server Consolidation and Virtualization Project's design and installation. The collaboration helped ensure the IRS applied industry best practices to the project and allowed the IRS to prototype the installation at the vendor's facility to ensure the system would work properly. Through the IRS's Concept of Operations document, an Enterprise Life Cycle[7] Plan was developed specifically for an infrastructure deployment effort. At the project's conclusion, project management teamed with the contractor to produce a document of lessons learned, including recommendations and approaches that can be used for similar future infrastructure deployment projects.

The Virtualization Project Office began installing the virtual infrastructure at selected data centers in 2009. Monthly progress reports were sent to the Associate Chief Information Officer, Enterprise Operations. The IRS required the Hewlett-Packard Company to track issues during the project. The IRS Executive Steering Committee minutes and Business Performance Reports show the project moved successfully to its completion in December 2010.

A process was set up to continue to virtualize servers at the target locations after the project completion date. As of the end of Fiscal Year 2011, the IRS has virtualized all targeted servers at the Andover, Massachusetts; Brookhaven, New York; and Philadelphia, Pennsylvania, Campuses. Approximately 1,500 remaining Wintel servers at the targeted locations are expected to be virtualized by the end of Fiscal Year 2012.

The goals of the Server Consolidation and Virtualization Project were successfully achieved on time and within budget. The goal of the Project was to deploy the virtualization infrastructure and begin converting physical servers to virtual machines. By the end of Fiscal Year 2011, the project team had succeeded in establishing a virtual server environment with approximately 1,800 virtual servers running on 234 physical host servers at 13 data center locations (nine campuses, three computing centers, and the New Carrollton Federal Building). This conversion of physical servers to virtual servers is helping to reduce energy and server replacement costs and improve operational efficiency. Reducing the number of physical servers also supports the goals of the FDCCI.

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[7] Enterprise Life Cycle is the approach used by the IRS to manage and effect business change. It provides the direction, processes, tools, and assets for accomplishing business change in a repeatable and reliable manner.

Reducing the number of physical servers has also resulted in significant cost savings associated with lower electrical output for fewer servers and hardware savings over one-for-one server replacement. As of the end of Fiscal Year 2011, the IRS estimated that server virtualization had saved approximately $10.2 million in equipment costs. The IRS also expects to save approximately $1.3 million annually in decreased electrical costs beginning in Fiscal Year 2013. The virtualized servers help lower operational costs through standardization, making it easier to load or remove a server from the operating environment. Other benefits of virtualization technology include decreased server hardware downtime and automatic load balancing.[8] Virtualization technology enables the system to move data and processing before a server fails. Automatic failover involves automatically moving an application to a standby server during a failure or service event to prevent application downtime. The IRS realized failover benefits on two separate occasions since it deployed its virtual infrastructure.

Plans Are Needed to Study and Address the Challenges of Virtualizing the Remaining Wintel Servers and to Maximize the Benefits of Server Virtualization

The Server Consolidation and Virtualization Project did not include Wintel servers in IRS field offices outside of the 13 targeted locations. The Project has been closed for one year; however, the IRS does not have a plan for virtualizing Wintel servers at its field office locations spread out across the country. There are approximately 1,000 Wintel servers at remote locations that have not been virtualized.

The objective of the Server Consolidation and Virtualization Project was to virtualize physical servers at 13 targeted locations: nine campuses, three computing centers, and the New Carrollton Federal Building. All of these locations have similar network characteristics, enabling a standardized installation at each site. Servers outside of the targeted locations were eliminated from the scope of the project due to network limitations that prevent these servers from being virtualized and moved from the remote locations to one of the targeted locations. The Windows Server Strategy Solutions and Standards Report from the Infrastructure Roadmap Initiative states: "The capability of the enterprise network is a potential constraint when addressing consolidation or virtualization. By centralizing all of the computing resources to a few locations, the application traffic will change and could impact the network. There must be enough bandwidth and throughput on the network to handle the new traffic patterns at each location. The network latency between users and servers must be minimized to provide the response times required by users. This must be taken into account when designing a consolidation and virtualization plan."

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[8] Automatic load balancing refers to the even distribution of processing across available resources such as servers in a network.

The IRS's Data Center Consolidation Plan includes a goal to virtualize physical servers from field locations into an appropriate data center virtual environment. The IRS cannot realize maximum cost savings until it virtualizes the Wintel servers at its field locations and moves these virtual machines onto host servers at the computing centers. IRS management estimates approximately 650 of 1,000 Wintel servers in its field locations can be decommissioned and added to the virtual server environment. By virtualizing the remote servers, IRS management estimates it could realize additional savings of approximately $7.73 million ($7.26 million in equipment savings and $0.47 million in electrical savings over five years). These actions would also help the IRS reduce data center space and meet FDCCI goals.

The longer the IRS waits to virtualize the physical Wintel servers in its field locations, the older these servers become. The IRS's server inventory showed that 39 percent of the Wintel servers in the non-targeted field offices reached end of life[9] status during Fiscal Year 2011. For Fiscal Year 2012, the percentage of aged Wintel servers will reach 48 percent. By effectively and efficiently virtualizing the aged and remaining Wintel servers, the IRS will ensure it continues to support the FDCCI and meet its own Data Center Consolidation Plan goals.

Recommendations

Recommendation 1: The Chief Technology Officer should develop and implement a process to identify servers currently located in field offices that can be virtualized.

> **Management's Response:** The IRS agreed with the recommendation. Enterprise Operations will develop and implement a process to identify servers currently located in field offices that can be virtualized.

Recommendation 2: The Chief Technology Officer should create and implement a plan to virtualize the servers located in field offices that can be virtualized.

> **Management's Response:** The IRS agreed with the recommendation. Enterprise Operations will create and implement a plan to virtualize the servers located in field offices that can be virtualized.

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[9] End of life status describes a server that is aged and eligible for replacement after five years in operation.

Detailed Objective, Scope, and Methodology

Our overall objective was to evaluate the effectiveness and efficiency of the IRS's efforts to consolidate and virtualize its servers. We evaluated servers managed by the Enterprise Operations organization, as those were the servers included in the scope of the IRS's Server Consolidation and Virtualization Project. To accomplish our objective, we:

I.   Evaluated Server Consolidation and Virtualization Project management and results.

    A. Determined if project management for the Server Consolidation and Virtualization Project complied with the IRS Enterprise Life Cycle[1] requirements and industry best practices.

       1. Reviewed Internal Revenue Manual requirements for preparing an Enterprise Life Cycle project plan.

       2. Obtained the Enterprise Life Cycle plan, tailored for an infrastructure deployment effort, for the project. We reviewed the project explanation and justification for how the Enterprise Life Cycle was adapted to meet the specific needs of the project.

       3. Compared the Enterprise Life Cycle plan obtained in I.A.2. to the project plan requirements obtained in I.A.1. to identify any plan requirements not met.

       4. Identified industry best practices for Windows server virtualization.

       5. Evaluated the IRS's server virtualization project to determine if industry best practices were followed.

    B. Determined if the Server Consolidation and Virtualization Project was effectively implemented.

       1. Reviewed project documentation to identify the population of Wintel servers[2] in the IRS and the number of Wintel servers that were identified for virtualization during the project.

       2. Determined if the project maximized the number of servers virtualized.

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[1] Enterprise Life Cycle is the approach used by the IRS to manage and effect business change. It provides the direction, processes, tools, and assets for accomplishing business change in a repeatable and reliable manner.
[2] A Wintel server is a server running a Microsoft Windows operating system with an Intel microprocessor.

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3. Evaluated the decision to close the Server Consolidation and Virtualization Project with only 37 percent of the Wintel servers virtualized.

4. Evaluated procedures in place to continue virtualizing the remaining Wintel servers.

C. Evaluated the accuracy of calculations to support project costs, cost savings, and return on investment.

1. Obtained and evaluated for accuracy and reliability all documentation related to project costs and projected savings.

2. Obtained and evaluated for accuracy and reliability all documentation to support actual cost savings claimed.

D. Identified and evaluated actions that have been taken to address the lessons learned during the Wintel Server Consolidation and Virtualization Project.

1. Identified lessons learned and documented in the *Server Consolidation and Virtualization Initiative, Post Implementation Review Report*, dated November 17, 2010.

2. Identified actions taken by the IRS to address the problems in the lessons learned documentation and evaluated the sufficiency of the actions.

II. Evaluated the monitoring, management, and reporting of server virtualization results and performance trends.

A. Reviewed Executive Steering Committee minutes and Business Performance Review reports relating to server virtualization for Fiscal Years 2009, 2010, and 2011.[3]

1. Identified problematic trends in virtualized systems noted in these documents.

2. Obtained evidence that problems identified were effectively addressed.

B. Interviewed project management to determine how they monitor and measure program performance.

1. Identified the measures (*i.e.*, key performance indicators) established for Fiscal Years 2010 and 2011 such as application and server performance, downtime, and availability.

2. Identified tools used to monitor performance.

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[3] A 12-consecutive-month period ending on the last day of any month, except December. The Federal Government's fiscal year begins on October 1 and ends on September 30.

3. Identified the performance reports management used to evaluate strengths of virtualization performance (*i.e.*, success) and gaps or weaknesses (*i.e.*, nonsuccess).

4. Determined what load balancing and failover measures are in place to prevent or respond to failure of the host platform.

Internal controls methodology

Internal controls relate to management's plans, methods, and procedures used to meet their mission, goals, and objectives. Internal controls include the processes and procedures for planning, organizing, directing, and controlling program operations. They include the systems for measuring, reporting, and monitoring program performance. We determined the following internal controls were relevant to our audit objective: the IRS policies and procedures for deploying an information technology project. We evaluated these controls by interviewing management and reviewing supporting documentation.

**Virtual Server Technology Has Been Successfully Implemented,
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Major Contributors to This Report

Alan R. Duncan, Assistant Inspector General for Audit (Security and Information Technology Services)
Danny Verneuille, Director
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Joan Bonomi, Lead Auditor
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Kasey Koontz, Auditor

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Appendix IV

Outcome Measures

This appendix presents detailed information on the measurable impact that our recommended corrective action will have on tax administration. These benefits will be incorporated into our Semiannual Report to Congress.

Type and Value of Outcome Measures:

- Funds Put to Better Use – Potential; approximately $7.26 million in equipment savings (see page 4).

- Funds Put to Better Use – Potential; approximately $94,000 annually ($470,000 over five years) in electrical savings (see page 4).

Methodology Used to Measure the Reported Benefit:

The reported potential benefits are based on estimates calculated by and provided to us by IRS management. There are approximately 1,000 physical Wintel servers in IRS field offices that have not been virtualized. The IRS estimates that approximately 650 of those servers could be candidates for replacement with virtual servers. If the servers are added to the virtual environment and not replaced with new physical servers, the IRS estimates it would save approximately $7.26 million in equipment costs. The IRS also estimates that decommissioning the 650 physical servers in its field offices would generate annual energy savings of approximately $94,000 ($470,000 over five years) based on the electrical cost savings of the servers less the electrical cost of the additional hardware that would need to be added to the virtual infrastructure environment.

*Virtual Server Technology Has Been Successfully Implemented,
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Management's Response to the Draft Report

DEPARTMENT OF THE TREASURY
INTERNAL REVENUE SERVICE
WASHINGTON, D.C. 20224

RECEIVED
MAR 22 2012

CHIEF TECHNOLOGY OFFICER

MAR 22 2012

MEMORANDUM FOR DEPUTY INSPECTOR GENERAL FOR AUDIT

FROM: Terence V. Milholland *Terence V. Milholland*
               Chief Technology Officer

SUBJECT: Draft Audit Report – Virtual Server Technology Has Been
               Successfully Implemented, but Additional Actions Are Needed to
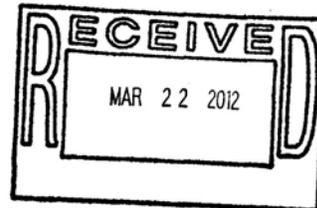   Further Reduce the Number of Servers and Increase Savings
               (Audit # 201120014) (e-trak # 2012-29743)

Thank you for the opportunity to review and respond to the subject audit report.

We appreciate your comments on how we implemented server virtualization technology
to improve server efficiency and realize cost savings. Thereby, our considerable efforts
to reduce equipment and associated electrical costs have been successful.

As indicated in the report, the IRS's Data Center Consolidation Plan includes a goal to
virtualize the remaining physical servers from field locations into an appropriate data
center virtual environment. We recognize that our existing plan requires further
development to realize full benefits of our virtualization program, therefore, we agree
with the recommendations. We also agree with the potential Outcome Measures and
upon implementation of the planned corrective actions the equipment and electrical cost
savings will be further realized.

We value your continued support and the guidance your team provides. If you have any
questions, please contact me at (202) 622-6800 or Andrea Greene-Horace, Senior
Manager of Program Oversight, at (202) 283-3427.

Attachment

***Virtual Server Technology Has Been Successfully Implemented,
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Draft Audit Report – Virtual Server Technology Has Been Successfully Implemented, but Additional Actions Are Needed to Further Reduce the Number of Servers and Increase Savings (Audit # 201120014)(e-trak # 2012-29743)

RECOMMENDATION #1: The Chief Technology Officer should develop and implement a process to identify servers currently located in field offices which can be virtualized.

CORRECTIVE ACTION #1: We agree with the recommendation. Enterprise Operations will develop and implement a process to identify servers currently located in field offices which can be virtualized.

IMPLEMENTATION DATE: September 1, 2013

RESPONSIBLE OFFICIAL: Associate Chief Information Officer, Enterprise Operations

CORRECTIVE ACTION MONITORING PLAN: We enter accepted Corrective Actions into the Joint Audit Management Enterprise System (JAMES) and monitor them on a monthly basis until completion.

RECOMMENDATION #2: The Chief Technology Officer should create and implement a plan to virtualize the servers located in field offices that can be virtualized.

CORRECTIVE ACTION #2: We agree with the recommendation. Enterprise Operations will create and implement a plan to virtualize the servers located in field offices that can be virtualized.

IMPLEMENTATION DATE: September 1, 2014

RESPONSIBLE OFFICIAL: Associate Chief Information Officer, Enterprise Operations

CORRECTIVE ACTION MONITORING PLAN: We enter accepted Corrective Actions into the Joint Audit Management Enterprise System (JAMES) and monitor them on a monthly basis until completion.