Implementing SAS® Enterprise BI Server at HUD
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ABSTRACT
The mission of HUD’s Office of Policy Development and Research (PDR) is to provide impartial analysis, advice, and policy recommendations to the HUD Secretary, other HUD executives, Congress, and the President on HUD’s multi-billion-dollar housing subsidy programs. Considering the size and scope of these programs, PDR staff must analyze large, complicated, and disparate datasets and provide the information requested in a user-friendly format.

Our challenge was to rapidly create an enterprise-wide SAS® Business Intelligence platform, something unprecedented at HUD. It had to be accessible to, and shared by, multiple offices within HUD with different missions, planned usage, and data environments. Additional requirements included security for personally identifiable information (PII); ease of administration; seamless integration with the Department’s LAN authentication; seamless integration with Oracle and Sybase databases; user ability to move data between the server and their desktop PC; and, of course, the cost had to fit within the existing IT budget.

This paper outlines the steps HUD took to implement a powerful, secure, SAS Enterprise BI server that is meeting the needs of over 100 users. It will also discuss obstacles faced and identify potential future enhancements.

INTRODUCTION
The US Department of Housing and Urban Development (HUD) is the Federal agency responsible for increasing homeownership, promoting decent affordable housing, strengthening communities, and ensuring equal opportunity in housing. HUD’s Office of Policy Development and Research (PDR) provides impartial analysis, advice, and policy recommendations to the HUD Secretary, other HUD executives, Congress, and the President on HUD’s major programs. Considering the size and scope of HUD’s mission (provide housing assistance to tens of millions of citizens through several multi-billion-dollar programs), PDR must analyze large, complicated, and disparate datasets to provide the information requested on-demand and in a user-friendly format. PDR staff have used desktop SAS for many years in support of this research mission. However, each user in PDR has different data, processing, and storage needs, and there is no central metadata repository or any type of single-source data warehouse.

Another of HUD’s program offices is the Federal Housing Administration (FHA), which is responsible for insuring millions of single-family FHA mortgages. FHA operates the Single Family Data Warehouse (SFDW), a repository of complete mortgagee data for over 55 million active FHA loans. For many years, FHA’s Office of Evaluation used Microsoft® Access® and Microsoft® Excel® to extract and analyze SFDW data for trend identification, performance monitoring, and evaluation.

In 2006, both PDR and FHA realized they needed a more robust and integrated solution to manage their data and workflow. Neither had the financial or technical resources to do it alone, so FHA and PDR formed a partnership for purchasing, installing, configuring, and operating a SAS Enterprise Business Intelligence (BI) server.

This paper discusses how SAS Enterprise BI Server was implemented at HUD. It focuses on the major requirements the server solution had to meet, discusses the implementation solution, explains difficulties faced, and concludes with next steps and possible future enhancements.

REQUIREMENTS
Our challenge was to rapidly create an unprecedented enterprise-wide SAS platform that met the needs of both PDR and FHA. The project team selected for this endeavor identified six substantial requirements that had to be met before this project could be called a success.

In addition to the six requirements discussed below, the system also had to tie into HUD’s IT Investment Management strategy established in accordance with the 1996 Clinger-Cohen Act. This act requires Federal agencies to improve management of IT projects through centralized budgeting, technology standards, resource sharing, and reliance on best practices. HUD’s IT Investment Management strategy...
follows Clinger-Cohen by encouraging investments that rely on Commercial-Off-The-Shelf (COTS) solutions that can be shared across the agency, and discouraging single-use, and possibly redundant, home-grown systems built on now obsolete technology.

**REQUIREMENT 1: ACCESSIBILITY**
The first requirement was establishing a platform that was accessible to over 100 users who were bureaucratically and geographically separated, and using different database technology. Prospective users worked for various Offices and Divisions across the HUD enterprise; were located in Washington, DC headquarters and in several field offices around the country; authenticated to the HUD network via different LANs; had various levels of experience using SAS; and used various database technologies including Sybase® IQ and Oracle®. Once the server was fully operational, FHA proposed adding another larger group, possibly as many as 2,000, to be web report consumers.

**REQUIREMENT 2: DATA SECURITY**
The second requirement was ensuring security for personally identifiable information (PII) stored on, or connecting to, the server.

PDR’s intent was to connect the SAS BI server to an Oracle server containing tenant records of the more than five million households receiving assistance through the Public Housing, Section 8 Housing Choice Voucher, and several other multifamily housing subsidy programs. These records contain names, SSNs, addresses, income, age, race/ethnicity, disability status, and other sensitive fields. PDR users query and analyze these records for their research projects, and often save extracts of these data on the server. PDR has permission to use this data only for specific research purposes, and is held responsible should any such data be used improperly or disclosed to the public.

FHA’s Singe-Family Data Warehouse (SFDW) contains loan-level records for all active FHA mortgages, including name, address, income, FICO score, loan amount, and other related fields. FHA users needed to perform queries and analysis in support of economic forecasting and performance evaluation. FHA users also are under warrant to protect this data from improper use or unauthorized disclosure.

**REQUIREMENT 3: PASSWORD INTEGRATION**
The third requirement we faced was seamless integration with the Department’s LAN password authentication. A single sign-on solution was desired to minimize the password administration burden. Since we only had resources for one server administrator for the entire SAS BI operation, we wanted her to maximize time spent optimizing the SAS BI tools, troubleshooting, and providing technical support, and minimize time spent assisting with password resets. We needed a solution that allowed automatic integration with HUD’s Windows Active Directory (AD) authentication, so that once a user establishes an account, his or her credentials would be automatically passed through to the server, even after required network password changes.

**REQUIREMENT 4: DATABASE INTEGRATION**
Fourth, the server had to seamlessly integrate with PDR’s and FHA’s databases. PDR’s assisted housing tenant data are in Oracle 9i databases and contain 14 years of quarterly snapshots of tenant records of assisted housing programs. Each snapshot contains over five million records, and includes data on program participants and their housing units. About 50 PDR staff needed access to this data for routine (i.e. calculating annual Fair Market Rents, routine program monitoring) and ad hoc (i.e. tabulating the number of public housing residents affected by Hurricane Katrina) reports and analysis. We wanted to establish metadata libraries in SAS BI so users could use Enterprise Guide to run menu-driven queries, create OLAP cubes, or run their existing SAS programs for their usual querying, analysis, and reporting duties.

FHA maintains the SFDW in a Sybase IQ database. The SFDW is the bread and butter of FHA Mortgage Insurance program operations, containing complete records of all 55 million active FHA mortgages in about 700 tables. Before the SAS BI Server, about 70 FHA staff in HQ and field offices would query SFDW using Microsoft Access and Microsoft Excel via ODBC for reporting and analysis. They wanted SAS BI tools such as OLAP Cube and Web Report Studio for more powerful querying, analysis, and presentation.

An additional part of this requirement was enough flexibility to connect to other yet unknown database sources in the future should additional requirements arise. As a research organization, it is difficult for PDR managers to predict the type of work requested of the organization in the future. We wanted a system
flexible enough so PDR will be prepared to respond to whatever priorities are established by the new political administration in early 2009.

REQUIREMENT 5: CLIENT-SERVER DATA TRANSFER
Another requirement was a request that all users could move data between the server and their desktop PC. Using Microsoft Windows Remote Desktop (WRD) to logon to the SAS BI server was not an option because WRD does not allow automatic mapping to the local drives. We had to find an authentication vehicle that automatically mapped the server to the user’s local desktop PC.

REQUIREMENT 6: COST
The sixth and final requirement was to fit the cost of software acquisition, installation, testing, and deployment into the existing IT budget. As is the case with most Federal government IT projects, this was one of the biggest challenges.

TECHNICAL SOLUTION

STEP 1: ESTABLISH WINDOWS CLIENT-SERVER ENVIRONMENT
HUD has an enterprise IT services contract (HITS contract) that consolidates network, desktop, server, and mainframe infrastructure services under one contract. The HITS contract is part of HUD’s response to Clinger-Cohen. HITS has been noted across the public sector as a best practice that has avoided several million dollars in annual maintenance costs for HUD by eliminating redundant services and hardware.

The first part of establishing the SAS BI environment was to set up a Windows 2003 server at the HITS contractor’s off-site data center. We requested the most powerful Windows server available, which was a Dell® 6850 with 8 CPUs, 32GB of memory, and access to about 1TB of SAN storage. The server was given the name PARIS (Policy And Research Information Server), and an official HUD system code. This action recognized PARIS as a legitimate part of the Department’s infrastructure, meaning hardware maintenance would be the responsibility of the HITS contract, rather than PDR or FHA. By tapping the centralized HITS infrastructure, the PDR and FHA program offices only had to pay for the software licenses, helping to meet the cost constraints of Requirement 6.

STEP 2: ESTABLISH SIMPLE, SECURE SERVER ACCESS
After the server hardware was put in place, the next step was determining how users would connect to it. Requirements 1 (accessibility), 3 (password integration), and 5 (client-server data transfer) were addressed through Citrix® Metaframe and ICA Client. Citrix is a secure “tunneling” solution that provides single-sign on capability, allowing users across an enterprise to authenticate via AD using their existing LAN userID and password. The Citrix solution eliminated the need for onerous password administration. Citrix also helped to meet Requirement 2 (data security) as we made authentication on the HUD LAN a prerequisite for PARIS login. Controls built into Citrix prevent users from accessing any client or network drives other than their own.

Citrix was only part of the security solution. Much of the PDR and FHA Data contains PII, and by law cannot be disclosed.1 To begin, the server had to be a non-public facing system. We wanted to limit access to the server only to approved, authenticated HUD employees or contractors inside the firewall. Next, we had to establish a robust yet flexible and user-friendly authentication process. The process we established combines four components: agency-wide AD that establishes a unique userID and password for each HUD employee; Citrix, which passes authentication through the network from client to server; Windows 2003 Server that is set to synchronize with AD for users with a server profile and permission to log in; and SAS BI itself, which allows the administrator to set custom user and group rights to SAS modules and data libraries. All four components have to synchronize to make our SAS BI authentication model work. Having these four layers of authentication has proven successful in controlling access to the server. Forcing users to present a valid HUD-issued userID as a prerequisite to obtaining server access has delegated much of the password risk and responsibility to the HUD IT Security Office, reducing administrative burden for PDR and FHA.

An additional key feature of the Citrix/Windows AD authentication solution is that it gives users access to any data or SAS modules they need, regardless of geographic location. Most server users are in HUD headquarters in Washington, DC, but at least 30 work in various field offices around the country. Field users

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1 Privacy Act of 1974, as amended.
access the server in the same way as Headquarters users, other than having to specify their unique Field Office LAN at sign-in. This feature satisfies the accessibility needs identified in Requirement 1.

Requirement 5 (client-server data transfer) was for bidirectional read-write access between local client and server. Citrix was again an obvious solution, as it allows automatic mapping to the user’s local client. Users can seamlessly transfer SAS code, data, or output to and from the server from their desktop PC. The only drawback is that file transfer speed depends on the current network capacity. As with most organizations, the network speed varies throughout the workday. For small files, such as transferring some SAS code from a user’s PC to the server, network speed is irrelevant. However, if a user wants to transfer a 4GB data file, he or she might find the transfer works faster in the early morning or late evening. Users reported that files of this size typically take anywhere from 1 to 25 minutes to transfer, depending on network speed.

STEP 3: ACQUIRE SAS BI SOFTWARE

PDR and FHA pooled resources to purchase the following SAS BI modules: Enterprise Guide, OLAP Cube Studio, Web Report Studio, Access for PC Files, SAS/Base 9.1.3, SAS/STAT, SAS/GRAPH, SAS/ETS, SAS/FSP, SAS/AF, SAS/IML, SAS/Assist, SAS/Connect, SAS/Insight, SAS/MDB Server, SAS/Access Interface to Oracle, Management Console, Stored Processes, and Information Map Studio. The initial software purchase cost approximately $500,000, plus about $200,000 each additional year for license maintenance. PDR’s administrator participated in training, which was an additional cost to PDR. Most of the funds for initial software acquisition came from unobligated project funds in FHA’s portfolio of IT investments. PDR made an in-kind contribution by assigning two full-time contract staff to install, configure, and tune the software. Out-year license costs were added to the base HITS infrastructure contract.

Software media were delivered to the HITS contractor’s off-site data center. HITS technicians loaded the media to the server’s drives. However, because the HITS contractors had no experience with SAS BI, and installation/configuration of SAS was outside the scope of their contract, PDR’s own contractors did the work.

STEP 4: INSTALL AND CONFIGURE SAS BI SOFTWARE

It took about two months for PDR’s two full-time administrators to successfully install all SAS components, integrate with Citrix and Windows 2003 server, synchronize Citrix password administration with Windows Active Directory, and establish automated drive-mapping to local PC upon login.

The Federal Government puts stringent controls on all web servers, even intranet-only web servers, and getting Web Report Studio to function with Tomcat. It took an additional two weeks of significant effort to make the web report module work. One part of the solution was having users change the browser local proxy settings on their PC granting access to the server.

An additional month of effort was needed to meet Requirement 4 (database integration). Establishing connectivity to PDR’s Oracle database was a tedious but not technically difficult task, as we used SAS/Access Interface to Oracle. The nature of our Oracle schemas necessitated loading each schema one at a time. Once our administrator learned how to do it, it became a mechanical but still time-consuming process.

Establishing a stable connection to the SFDW Sybase database was more difficult. Since the SFDW is built on Sybase IQ, we unfortunately could not use the SAS/Access Interface to Sybase module. SAS Technical Support confirmed that SAS/Access Interface to Sybase does not support Sybase IQ. Our workaround was to build a generic ODBC. However, problems arose almost immediately during initial testing. The SFDW was so large (some tables contain over 50 million records) that certain queries overwhelmed the generic ODBC and failed to execute. These failures caused memory leaks in the SFDW database. Minor tweaking continues to this day, over a year later, to maximize the size and complexity of queries that will succeed. We put several thick pieces of duct tape on the problem, and so far it is holding, but the problem has not yet been fully solved. A network diagram describing the server configuration and interconnections appears in Figure 1.

STEP 5: ACCOUNT ESTABLISHMENT, DOCUMENTATION, AND TRAINING

After the SAS software and all components were operational, the final steps were to begin adding users, and to provide initial training and technical support for new users. These two steps occurred simultaneously, one
user at a time. Some users had been using SAS for many years and did not need much assistance. Others were SAS neophytes and needed additional support until they felt comfortable using the tools.

The task of establishing user groups, determining appropriate permissions for each group, and adding users had to be repeated several times until we struck the right balance of controls and permissions for each user class, and dealt with several users who were exceptions.

Users request access to the server from the System Owner via email. If the request is approved, the System Owner sends the prospective user a User Guide that outlines the steps he or she needs to take to establish a user account. First, the prospective user must sign a document indicating they have read the User Guide, understand the Rules of Behavior, and agree to protect any PII data on or connecting to the server. Next, the user calls the national HITS customer service help desk and requests installation of Citrix ICA Client on their desktop. When the Citrix client is installed, the user contacts the SAS BI System Administrator, who creates the user’s SAS account and Windows server profile, synchronizes their Windows server profile with AD, and sets appropriate data access permissions. The user then follows simple instructions in the User Guide to establish a connection between their Citrix client and the server. Then, the new user may login to the server and begin working.

The User Guide also contains basic data dictionaries and other metadata about data available to users on the server. We posted an HTML-based version of the User Guide on an intranet webserver so users can refer to it any time. We update it periodically with any changes, and notify users via email when any changes are made. The User Guide also points users to a separate intranet documentation system for FHA’s SFDW tables. Our system is an example of how the service-based architecture of SAS BI Server benefits the enterprise. The unobtrusive architecture of SAS BI allows all data and documentation to reside on the “live” database, and the SAS interface merely reflects what is there. SAS BI allows database owners
to keep full control over their data and documentation, and lets analysts focus their time on their analytical work rather than creating redundant documentation.

If a new user is unfamiliar with SAS or using servers, our administrator can provide one-on-one training on server connections, storage, data connectivity, and file locations. FHA assigned two experienced SAS users as “cube managers” to train FHA staff on OLAP cubes. Additional training for server users occurred in mid-2007. PDR and FHA jointly funded three week-long, on-site SAS Enterprise Guide training sessions attended by over 40 server users. Additional training, including workshops for specific types of projects (such as setting up and surfacing web reports) is being planned for late 2008 or early 2009.

IMPLEMENTATION ISSUES

The SAS Enterprise BI server solution was a non-modified Commercial-Off-The-Shelf (COTS) approach to HUD’s reporting and analysis requirements. This type of approach is what Clinger-Cohen encourages, as it usually results in lower cost and risk when compared to a custom-built application. However, our approach was not a simple out-of-the-box solution. We encountered several significant issues that complicated our implementation plan.

One of the most challenging parts of implementing SAS Enterprise BI server at HUD was getting the authorization to proceed from HUD’s Office of the Chief Information Officer (OCIO). The overarching HITS contract essentially gives the HITS contractors a legal monopoly for all hardware and software purchases. The three-way price negotiation between HUD, the HITS contractor, and SAS was a complicated four-month, back-and-forth process. This type of enterprise collaboration had never been attempted before under the HITS contract. The author speculates the final negotiated price may not have been the best value possible. Fortunately, however, the initial-year cost for all software modules fit just barely within the budget set aside by FHA for this purchase.

After software installation, we jumped immediately into a dual testing and adaptive maintenance phase. We added users one by one, and asked them to report any problems, inconveniences, or performance issues. Over the course of six months, we created about 105 user accounts. Tweaking user permissions, group permissions, and connections to data libraries continues to this day, but overall the server is performing well with very few complications. The server has become increasingly reliable, with availability increasing from an estimated 85% a year ago to over 95% now. Some of the 5% downtime we currently experience is caused by issues at the HITS datacenter, and are out of PDR’s and FHA’s control. We experience occasional down-time after virus signature updates, automated Windows operating system patches, and other pushes that happen on weekends. Frequently, after patch application and re-booting, some SAS services do not automatically start as they should. Other times, the Citrix connection is lost without warning, requiring a manual re-start of that service. The HITS team is often unaware that anything is wrong with the SAS software until we notice the problem and call the HITS help desk to report it. Although HITS is usually quick to respond and fix the connectivity problem, these examples highlight one risk of using a centralized, outsourced, off-site contractor to operate an agency’s entire infrastructure.

One of the most significant issues we discovered relates to the SAS installation instructions. The installation manual stated that you must create six mandatory system accounts under the SAS SERVER USER Group. However, Windows 2003 Operating System security controls repeatedly overwrote permissions within that Group, denying access to the SAS system users. However, as a workaround, we used the built-in USERS group on the server to accommodate the required SAS system accounts as well as the human users. Until we learned that we could deviate from the SAS instructions, we were stuck.

One problem that has persisted since inception is slow file transfer between client desktop and the SAS server. Although Citrix provides direct mapping from the user’s PC to the server, data transfer through Citrix is dependent on the overall speed of the network. Unfortunately, users have to live with this inconvenience as the speed of the HUD network and the amount of traffic on it is not within our control.

Another speed-related issue, as mentioned above, is access to the SFDW. Large queries can overwhelm the Sybase IQ ODBC connection. Large, complex queries can take a half-hour or longer to load, and sometimes do not successfully complete. One workaround is to break the query into multiple parts (either request all records but only a few fields at a time, or request all fields but limit the number of records, such as by choosing records from a few states at a time) then join the results in SAS. The SAS BI system administrator has a direct line of communication with the SFDW administrator. They speak to each other
whenever a problem is detected or any changes are made to the SFDW databases, helping to optimize the server’s performance. This outcome highlights the importance of good communication in establishing a SAS BI environment across multiple offices in an agency.

Although SAS BI software does not set concurrent usage limits, Citrix does. After the cost of SAS BI software was finalized, PDR and FHA only had enough funds to purchase 60 concurrent use Citrix licenses, even though we knew there would be over 100 server users. So far we have yet to experience more than 40 or so simultaneous logins, with an average of about 20 users on a typical workday. However, we are adding new users almost every month, existing users are exploring the functionality of the server, and work processes are migrating from less efficient technologies to SAS BI. It is quite possible we will approach the login limit within the next year or so. We keep the committee overseeing the HITS contract abreast of server performance, and have made them aware that additional investment in Citrix licenses may be needed.

An additional issue we faced was that the C:\ drive of the SAS BI server, at 60GB, is too small. The SAS Enterprise BI server software automatically directs temporary and work files to the C:\ drive. Technical support calls to SAS have recommended a larger C:\ drive for optimal performance and lower risk of server crash. However, budget limitations and the HITS contract have prevented us from acquiring a larger hard disk drive. Another solution could be redirecting temp and swap files to other server drives with more capacity. We tried this several ways, but when we did, some SAS services do not start properly when the server is rebooted. We still have a track open with SAS Technical Support and a ticket open with the HITS help desk, and continue researching a solution. The HITS contractors, who operate the servers in their off-site data center, are exploring the possibility of a virtual, seamless re-direction of the “C:\Documents and Settings” directory to SAN storage to fool SAS into thinking there is an additional 160GB of space on the C:\ drive.

Another implementation obstacle we faced is the inability of SAS BI to integrate with HUD’s existing Geographic Information System (GIS) database software. Much of HUD’s data contain geographic components, for instance, whether or not subsidized properties are located within certain Congressional districts, Census Tracts, high-poverty areas, or other political boundaries. Part of PDR’s work is to spatially analyze HUD program data in support of research projects. We store spatially-enabled extracts of many HUD databases in an ESRI® ArcSDE 9.0 Oracle database. About 50 HUD staff use ESRI ArcView desktop GIS software for mapping and analyzing HUD program data. We were hoping the SAS BI solution would integrate with our ArcSDE database for a powerful combination of GIS, data manipulation, and statistical analysis tools. However, we learned that we need to upgrade ESRI ArcSDE to the newer ESRI ArcGIS Server software in order to achieve this integration. This additional software purchase was not budgeted for, and cannot happen until we obtain the necessary budgetary resources. Until this purchase happens, HUD will not have full integration with SAS BI and GIS data. Figure 2 illustrates proposed changes to the SAS BI network diagram after purchase and installation of ESRI ArcGIS Server software.

We initially were concerned that having over 100 server users would limit server performance. However, since all processing takes place on the 8-CPU host server, we were pleasantly surprised with server response. Users have commented that large processing jobs run at least twice as fast on the server compared to running desktop SAS on a standard-issue HUD desktop PC. However, we have not done much load testing on this server to quantify performance. As time permits, more rigorous load testing is something we are considering in the near future.

One requirement we did not anticipate when planning the server implementation is remote access. Several server users are set up for teleworking via web-based Virtual Private Network (VPN). Naturally, as soon as these users received their initial server access on their office workstation, they wanted to know if they could access the server remotely on their telework days. Working with OCIO, we were able to establish a link on the VPN virtual desktop for Citrix ICA Client that allows approved server users to securely access the PARIS server. Although we were initially reluctant to allow remote access, we realized that remote access users would first have to authenticate through the HUD LAN and firewall, then authenticate via Citrix to the SAS BI server. Upon further review, we determined that Remote authentication through HUD’s VPN is essentially as secure as authentication from a PC within the HUD building. Additionally, since all users agree to the Rules of Behavior and PII data non-disclosure policy, we determined the risk was low and allowed approved server users who were also teleworkers to have remote access.
NEXT STEPS
HUD’s SAS Enterprise BI Server environment has been operational for over a year. After months of adjusting and tweaking, we are satisfied with its performance. As mentioned, availability is over 95%. Our ongoing server operations include continuing to adjust settings to optimize performance, particularly with the somewhat problematic ODBC connection to SFDW.

NEW DATA, NEW APPLICATIONS
The hardware, software, and contract labor employed to build HUD’s SAS Enterprise BI Server constituted a significant investment, and we are always looking for new applications and database connections to make the system even more useful. One example of a new data source recently added as a metadata library is Home Mortgage Disclosure Act (HMDA) data. HMDA data provides data about every mortgage issued in the U.S., summarized by Census Tract. Every time a citizen purchases a home, they receive a “HUD-1” settlement statement. Many fields on this form, including details of the mortgagee, lender, type of loan, interest rate, and loan value, are added to the HMDA database. The HMDA data are summarized at the Census Tract level, and thus does not contain any PII data and is considered public information. Now that it is available to server users, it is being used for fair lending analysis, overall mortgage market analysis, and to identify areas with untapped potential for marketing new FHA loans. Other potential uses are being explored, such as integration with PDR tenant data to measure impact of subsidized housing on house prices.

Another example of new data connectivity is financial data in support of the Federal Financial Assistance Transparency Act (FFATA). FFATA requires all cabinet-level agencies to report monthly financial assistance for all grants, contracts, and subsidies by state, county, Congressional district, and other geographies. We are currently exploring the viability of importing data from HUD’s financial systems into the SAS server to prepare the monthly FFATA reports.
PDR recently acquired a dataset from the United States Postal Service (USPS) that identifies the in-service status of all 9-digit ZIPcode points. This data essentially identifies the vacancy status of all addresses, allowing HUD to measure how neighborhoods grow or identify areas in decline. This data has not yet been incorporated into the SAS BI server but might be soon. We believe this data has potential use in future PDR research projects relating to urban change, gentrification, and vacancy caused by concentrations of risky, high-cost, and/or sub-prime loans.

Additional HUD program data could (and probably will) be added upon request from senior HUD decision-makers.

NEW SOFTWARE MODULES
After the acquisition negotiations between HUD, the HITS contractor, and SAS, we unfortunately could not afford all SAS BI software modules. SAS Data Integration Studio is a key module we regretfully could not afford. We will consider licensing this module pending availability of funds in the next Fiscal Year. One of the benefits of using this module might include easier integration with perhaps a dozen other databases for enhanced enterprise BI reporting.

SAS recently introduced the BI Dashboard, a module used for generating more complex web reports designed for an executive audience. SAS now includes Dashboard as part of the base Enterprise BI license. SAS will soon provide this module to HUD at no additional cost.

As mentioned above, much of HUD’s data is spatial. Examples include locations of public housing developments, census tracts with high concentrations of FHA mortgages, or census tracts with many Section 8 Vouchers. HUD currently stores all geographically-enabled data using ESRI ArcSDE 9.0. If HUD could afford an upgrade to ESRI ArcGIS Server 9.2, HUD could seamlessly integrate our GIS data with SAS metadata libraries for easy mapping and linked spatial analysis. Funding for this project is being pursued.

ADDITIONAL SECURITY CONTROLS
There is a new version of Citrix on the market, Publisher, that includes additional security controls to limit what users can do when they log on. Right now users can access all SAS components. With Publisher, we could limit access to the SAS Management Console and prevent users from tinkering with options or accidentally disrupting other user’s work. Implementing the new Citrix Publisher will allow us to publish only the SAS modules users need for their job. We will approach the HUD IT Investment Management board in the near future to request funding for the Citrix upgrade.

CONCLUSION
Implementing SAS Enterprise BI server at HUD was challenging but exciting. We successfully met all six requirements of accessibility, data security, password integration, database integration, client-server data transfer, and cost. Our plan conceptualized and implemented a technical solution consisting of establishing a Windows server environment in a contractor-run data center, modeled a simple yet secure authentication scheme using Citrix, pooled resources to acquire the SAS BI software, installed and configured the software, established user accounts, and provided documentation and training. Despite several issues, most of which were resolved, the plan was successfully executed. Over 105 employees of PDR and FHA, at all levels of SAS experience, are now using the server and are experiencing an acceptable level of performance.

Now that the server is operational and reliable, and FHA users have had a few months to develop some nifty web reports, work is underway to add an additional 2,000 FHA staff as “web report consumers.” These users are starting to use web reports based on SFDW data for program monitoring and regulatory decisions as part of their everyday business processes. Additionally, several staff in other HUD program offices, such as the Office of Public and Indian Housing, the Office of Community Planning and Development, and the Office of Fair Housing and Equal Opportunity, have become server users, making this server a true, multi-purpose enterprise solution.

Work is ongoing to close the unresolved issues, including Sybase connectivity, adequate storage for temporary work files, network speed, potential Citrix upgrade, and inability to integrate with GIS data. Additional data connections are being established as the user base grows and new ways to apply SAS Enterprise BI Server technology are discovered.
Having a dedicated, competent, and engaged project team made this effort a success. Open communication was key, especially concerning funding, database connectivity, and user permissions. Almost any technical issue can be overcome, however, solutions are much easier to find when all parties communicate and work together.

The SAS Enterprise BI Server environment implemented at HUD is a good example of what Clinger-Cohen intended. Multiple program offices within HUD combined resources to purchase an industry best practice technology that is being shared across the enterprise. Our accomplishment is also a noted success of HUD Chief Information Officer Lisa Schlosser’s “build once, service many” strategy to modernize HUD’s business operations.

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NOTE: The opinions expressed within this article represent that of the author, and do not necessarily reflect the opinion of the US Department of Housing and Urban Development or the United States Government.

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