Federal Data Center Consolidation Initiative

2011 Data Center Consolidation Plan & Progress Report

Public Version

Date:
September 30, 2011

Contents

1.0 Introduction

The National Science Foundation (NSF) is the only federal agency dedicated to the support of fundamental research and education across all fields of science and engineering and all levels of science and engineering education. NSF is a single mission agency whose investments in research and education help to ensure the nation remains competitive, prosperous, and secure.

Centrally located in Arlington Virginia, NSF provides nearly half of federal support for non-medical basic research at America's colleges and universities through a competitive, merit based review process. Each year, NSF receives over 45,000 competitive requests for funding and makes over 11,500 new awards, supporting approximately 200,000 people including researchers, teachers, and students in all 50 states and nearly 2,000 institutions and universities.

NSF currently has one onsite, centrally-managed data center. Changes to the IT market and within NSF during the last decade caused NSF to assess and adopt a different approach for providing data center services:

- Changes in the IT market: Recognition that commodity data center services for mid-scale data center requirements could provide a return on investment (ROI) and subsequent expansion of competitive commercial alternatives.

- Changes affecting NSF include: A growing and increasingly complex programmatic workload, an increased demand for and dependence on rapidly evolving IT systems and services, and flat Full Time Equivalent (FTE) Federal staff levels.

- In addition, NSF's lease on its current Headquarters facility expires.

Since 2007, NSF has been transitioning from owning and operating a Federal data center to using a commercial data center facility and infrastructure services provider. NSF's plan is to operate using a hybrid model: a mixture of public and private cloud technologies with minimal infrastructure remaining on NSF premises. Plans are to decommission the NSF data center in the FY2013/2014 time frame, consistent with NSF plans to relocate to a new Headquarters facility.

NSF's adoption of commercial data center services and move towards cloud computing have allowed NSF to take advantage of economies of scale, reduce operating and maintenance costs, leverage best practices with regard to green IT, and avoid investments in IT infrastructure. Additional benefits include increased service availability, reduced dependence on NSF onsite power and infrastructure, freeing NSF building space for other purposes, and the opportunity to focus NSF IT staff on service oversight instead of execution.

NSF took several steps to verify the accuracy and completeness of inventory data included in the consolidation plan. NSF conducted physical inventories of existing equipment resident in the onsite data center, and mapped the results against property records and other electronic records as appropriate to ensure consistency of documentation and reporting.

2.0 Agency Goals for Data Center Consolidation

NSF currently has only one onsite, centrally-managed data center. Since 2007, NSF has been transitioning from owning and operating a data center to use of commercial data center services and emerging cloud computing options.

NSF's qualitative goals for this activity are:

- Improved agility and flexibility – faster time to market of solutions and services, increased flexibility and agility to respond to changing requirements;
- Improved service quality and reliability for technology infrastructure;
- Reduced need for on-site contractor workforce and related expenses (e.g., space, overhead, etc.)
- Reduced capital investment in hardware and software;
- Reduced spending on facilities and server maintenance and operations costs;
- Promote Green IT by reducing overall energy and real estate footprint of NSF data center;
- Comply with government guidance for IT business solutions management;
- Align with IT market approach for service delivery;
- Improved ability to leverage industry best practices and economies of scale.

3.0 Implementing Shared Services/Multi-tenancy

As part of consolidation activities, NSF plans to expand its use of both Government and commercial shared service providers. NSF has already successfully leveraged shared services in a number of areas and plans to expand its use of Government and commercial shared services to a number of other IT activities. Areas where NSF is leveraging or plans to leverage shared services include:

- Server and application hosting/web hosting – NSF is already using a commercial data center facility for hosting for its major IT modernization activities and plans to transition hosting of major legacy applications to the commercial data center in a phased approach with completion coinciding with the expiration of the NSF headquarters lease.

- IT inventory and asset management services – IT inventory and asset management services will be transitioned to the commercial data center provider, in alignment with the transition of NSF server and application hosting.

- Network management – NSF network management capabilities are included in the suite of commercial services NSF is acquiring to comply with the new Government-wide Trusted Internet Connection initiative.

- Cyber security services – Many cyber security services will also be included in the suite of commercial services NSF is acquiring to comply with the new Government-wide Trusted Internet Connection initiative.

- Email services – NSF is in the process of setting up email and instant messaging pilots to evaluate their operation in a cloud environment. NSF is currently evaluating commercial email and instant messaging Cloud Computing Software as a Service (SaaS) offerings.

- Collaboration tools - The Foundation has already successfully piloted SharePoint, the Foundation's primary collaborative technology, which supports staff across the Foundation in completing mission support activities, in a cloud environment. Based on the success of this pilot, NSF is looking into opportunities to host other collaboration tools in the cloud.

- Business support services (human resources management, payroll, acquisition, and budget) – NSF was an early adopter of many opportunities to leverage Government-wide shared services available through the cloud. NSF successfully adopted Government-wide shared travel, payroll, and personnel systems and has decommissioned its legacy applications to support these functions. Additionally, NSF plans to leverage public or private shared services for its new financial system.

4.0 Agency Approach, Rationale, and Timeline

Agency Approach and Rationale

- NSF has one onsite, centrally-managed data center located at Foundation headquarters to manage and operate its IT applications, desktops and end-user devices, storage systems, computing/servers, networks, and communications capabilities.
    - NSF depends heavily on its comprehensive suite of IT systems and services to support the Foundation's staff of 1,700, as well as the individuals involved in NSF programs and activities world-wide.
    - NSF's IT systems support mission activities to plan and manage programs, conduct the merit review process, make awards, provide post-award oversight, and disseminate the results of research investments. In addition, administrative applications to address stewardship and management processes are also hosted in the NSF data center.
    - Changes during the last several years caused NSF to assess and adopt a different approach for providing data center services.
    - In 2007, NSF established a contract to acquire computer/server, network, databases, and operating system services from a commercial provider using a commercial data center facility to support major IT system modernization activities, specifically the Research.gov suite of systems and services. Research.gov is NSF's next generation proposal and award management system. All infrastructure and supporting services for Research.gov are provided commercially at an off-site data center.
        - Activities to date include establishing service level agreements based on NSF requirements; delivery of high availability server, database, and operating system services; and support of a large-scale commercial data center that has redundant, bunkered power and cooling, integrated physical security, and highly redundant multi-carrier network capabilities.
    - Based on benefits realized, NSF's plan is to complete transition of major legacy IT systems in a phased approach, with completion coinciding with the expiration of the NSF headquarters building lease.

- During the transition, NSF continues to actively consolidate IT infrastructure at the NSF Data Center and work to minimize data footprint.
    - NSF is leveraging virtualization technologies and creating virtual servers as the need for new computing devices emerges. Research.gov is primarily built on virtual server technologies such as VMware and Sun Containers. The Research.gov infrastructure utilizes 21 physical servers that are hosting more than 115 logical servers. In addition, NSF is in the process of converting the hosting platform of multiple small and specialized applications to virtual servers.
    - Where possible, NSF is choosing to lease versus procure new equipment at the NSF Data Center when virtualization not an option. During the transition to commercial data center services, NSF will utilize staging hardware to ensure all applications will continue to function as designed. All hardware used to build the transition environment is leased and will be returned upon completion of the transition.
    - Finally, NSF is taking every opportunity to reduce its IT infrastructure footprint by consolidating when possible. One example of such consolidation is the merging of multiple separate Sybase databases into a single database server that is able to accommodate the database needs of various applications. Another significant

consolidation is the conversion of the storage area network (SAN) to hierarchical data storage; instead of building on multiple storage silos, NSF will expand one main SAN that is used by multiple systems at a variety of access speeds and purposes.

- Cloud computing is an integral component of the NSF approach. NSF has already adopted Federal shared services/cloud payroll, travel, and training application services, and has initiated e-mail as a cloud application pilots.
    - NSF was an early adopter of many opportunities to leverage government-wide shared services available through the cloud. NSF adopted travel, payroll, and personnel systems successfully, and has decommissioned its legacy applications to support these functions. NSF plans to leverage commercial or shared service provider solutions in modernizing its financial system.
    - The Foundation has already successfully piloted SharePoint, a collaborative technology that supports staff across the Foundation in doing their work, in a private cloud environment.
    - NSF has established email and instant messaging pilots to evaluate their operation in a private cloud environment. NSF is evaluating email and instant messaging Cloud Computing Software as a Service (SaaS) offerings from two major vendors. The pilots will examine user experiences, security posture, operational efficiencies, adherence to federal government and NSF standards, and the capability of the services to accommodate agency requirements and adjust to changing needs.
    - Based on the success of pilot activities, NSF plans to move application services and other key services such as web hosting, Voice over IP/Unified Communications, and Collaboration services to cloud providers.

Agency Timeline (Master Program Schedule)

No.	Agency Component	Data Center	Location	Action to be Taken	Action Taken During Fiscal Year
1	NSF	NSF Headquarters	Arlington, VA	Decommissioned	FY15

5.0 Agency Governance Framework for Data Center Consolidation

NSF will use existing IT investment governance structures to conduct oversight of the IT modernization activities and ensure the appropriate mitigation of risk.

NSF's IT investment governance process complies with the Clinger-Cohen Act of 1986 and is based on Office of Management and Budget (OMB) Circular A-130. It emphasizes careful analysis and selection of IT investments and seeks to ensure that NSF senior management obtains and reviews timely information regarding the progress of an investment in terms of its milestones, cost, and its capability to meet specified mission objectives.

NSF IT investments are managed out of the Foundation's Division of Information Systems (DIS) within the Office of Information and Resource Management (OIRM) and under the direction of NSF's Chief Information Officer (CIO).

Two Foundation-wide IT governance bodies support the CIO in overseeing NSF's IT investments:

- The Executive Information Technology Resources Board (ITRB) provides guidance and oversight of NSF's major IT investments, approves NSF's IT Budget, and ensures alignment of IT investments with NSF strategic goals and objectives. The Executive ITRB is chaired by the CIO and includes Assistant Directors and Office Heads from across the Foundation.
- The Capital Planning and Investment Control (CPIC) working group is responsible for reviewing NSF's IT investment portfolio and for making recommendations regarding NSF's IT investments to the Executive ITRB. The CPIC working group is co-chaired by a Deputy Assistant Director and the Director of the Division of Information Systems. Membership consists of Deputy ADs and Executive Officers from all of NSF's Offices and Directorates as well as other key management officials.

These groups make strategic decisions guiding NSF's investment in IT solutions and services; ensure NSF's portfolio of IT investments reflects NSF priorities; and ensure the Foundation is delivering IT solutions and services that are modern, innovative, and meet the needs of NSF staff and the research community. They will continue to review and validate NSF's ongoing plans for IT data center consolidation and cloud computing.

5.1 Cost-Benefit Analysis

The following cost-benefit analysis evaluates alternatives from a broad spectrum of hosting models, including:

- **Alt 1: In-House Operations -** This alternative represents the status quo
- **Alt 2: Offsite hosting/Collocation Hosting -** All infrastructure is hosted at commercial data center(s) and operations support is provided using the current model
- **Alt 3: Offsite hosting/Fully Managed Services -** All infrastructure is hosted at commercial data center(s) and the provider is responsible for meeting service level agreements
- **Alt 4: Offsite hosting/Cloud Computing –** Similar to the previous alternative with infrastructure hosted at commercial data center(s) and the provider being responsible for

meeting service level agreements. However, Cloud Computing offerings will be utilized where possible

This analysis was based on the following principles and guidelines:

- Improve IT operations and reduce cost where possible
- Become more environmentally friendly by reducing the amount of energy used to maintain our systems
- Enhance systems availability and institute more robust disaster recovery services
- Maintain and improve systems performance and user experience
- Improve scalability and flexibility of the systems and applications
- Maintain and improve systems security
- Be innovative and remain a government leader in application of new technologies

Cost-benefit analysis was conducted using a value measuring methodology where alternatives were evaluated qualitatively and quantitatively. We analyzed direct and indirect benefits and subjective variables. In our cost analysis, we estimated potential infrastructure costs for in-house, offsite hosted, or Cloud Computing infrastructures. We used fiscal year 2010 planned costs as the baseline and estimated costs up to fiscal years 2011 to 2014. Alternatives 3 and 4 presented a more cost effective solution. A risk analysis was completed as part of the cost-benefit analysis and its results were incorporated by adjusting the benefit and cost of each alternative accordingly.

Even though alternative 3 ranked slightly higher than alternative 4, the difference in benefit did not justify the increased cost, hence alternative 4 was selected. Among other benefits, the selected alternative will provide:

- Reduced cost of operations
- Ability to easily adjust service levels
- Ability to scale to meet current and future NSF requirements
- Improved disaster recovery capabilities for any major outages
- No single points of failure
- Predictable cost and budget for upcoming fiscal years
- Optimized infrastructure, resulting in lower server to service ratios
- Reduced energy consumption

5.2 Risk Management and Mitigation

As part of cost-benefit analysis, NSF completed a risk analysis that identified risks associated with each alternative. These risks were assigned a probability and an impact and were factored into the overall decision. There were more than 25 risks identified. Risks were grouped in the following categories:

Category	Description
Schedule	Risk associated with schedule slippages, either from lack of internal controls or those associated with late delivery by vendors, that result in missed milestones
Financial	Risk associated with "cost creep," miscalculation of life-cycle costs, reliance on a small number of vendors without cost controls, or (poor) acquisition planning
Technology	Risk associated with immaturity of commercially available technology and

	reliance on a small number of vendors; risk of technical problems/failures with applications and their inability to provide planned and desired technical functionality
Business/Operational	Risk associated with business goals; risk that the proposed alternative fails to result in process efficiencies and streamlining; risk that business goals of the program or initiative will not be achieved; risk that the investment will not achieve operational goals; risk that the program effectiveness targeted by the project will not be achieved
Organizational/Change Management	Risk associated with organizational-, agency-, or government-wide cultural resistance to change and standardization; risk associated with bypassing or lack of use or improper use or adherence to new systems and processes because of organizational structure and culture; inadequate training planning
Data/Information	Risk associated with the loss or misuse of data or information, risk of compromise of citizen or corporate privacy information; risk of increased burdens on citizens and businesses because of data collection requirements if the associated business processes or the project (being described in the Exhibit 300) requires access to data from other sources (Federal, state, and/or local agencies)
Security	Risk associated with the security/vulnerability of systems, Web sites, information and networks; risk of intrusions and connectivity to other (vulnerable) systems; risk associated with the evolution of credible threats; risk associated with the misuse (criminal/fraudulent) of information; must include level of risk (high, medium, basic) and what aspect of security determines the level of risk (e.g., need for confidentiality of information associated with the project/system, availability of the information or system, or reliability of the information or system)
Strategic	Risk associated with strategic/government-wide goals; risk that the proposed alternative fails to result in the achievement of those goals or in making contributions to them.

The following two risks were identified as the most impactful to the overall transition and mitigations steps were outlined:

- End-users could be adversely impacted by degraded performance or extended down-time as a result of the migration
  - Perform continuous real-time monitoring of application performance, availability, and end-user experience
  - Solicit end-user involvement throughout the whole process
  - Develop and deliver end-user training and information sessions to ensure that users remain up to speed with changes that are taking place
  - Ensure that there is a backup plan in every sub-component transition to reduce the possibility of extended outages
- Unpredicted interoperability issues between applications will make the transition to offsite hosting more challenging to implement and potentially extend schedule
  - Ensure that all systems are fully accounted and develop an interoperability matrix
  - Decouple systems, when possible, to make it easier to transition to offsite hosting and Cloud operations
  - Revise system documentation to reflect their current status and configuration

NSF tracks risks at the project, component/system, and data center levels, and reports the status of risks to management as appropriate. Risks are managed and tracked through the use of a risk management plan and a corresponding risk register.

5.3 Acquisition Management

NSF will follow Federal Acquisition Regulation guidance and standard Foundation acquisition procedures for all FDCCI – related investments. NSF will also develop strategic acquisition approaches for its FDCCI-related investments that leverage government-wide acquisition contracts (such as Apps.gov, Solutions for Enterprise-wide Procurement, and GSA's IT Schedule 70) and fixed price models for commodity services. Additionally, the Foundation will research and integrate acquisition lessons learned from data center consolidations and other similar implementations from the Government and the private sector into its approaches.

The Foundation will prepare comprehensive acquisition plans for investments to establish clear oversight and management procedures and assess risk and identify mitigation approaches. Additionally, Federal Acquisition-certified Contracting Officers and Contracting Officers' Technical Representatives will provide oversight on investments.

5.4 Communications Strategy

NSF will employ a communications strategy that emphasizes consistent and continual communications to help ensure a successful project:

- Conduct a stakeholder analysis to identify and analyze the impact of data center consolidation on stakeholders to inform strategic messages and vehicles used to communicate changes to stakeholders.
- Develop a comprehensive multi-vehicle, multi-channel communications plan around the strategic messages to effectively communicate changes to all relevant stakeholders. Key aspects of the plan include:
    - Ensuring organizational alignment and effective oversight of initiative activities by continually briefing and communicating with key management groups, including NSF's Capital Planning and Investment Control Working Group and Executive IT Resources Board.
    - Ensuring internal and external stakeholders are notified of changes impacting their ability to do business with or for the Foundation by:
        - Building relevant messages regarding data center consolidation changes into planned communications regarding the NSF headquarters move.
        - Leveraging robust, proven internal and external communications channels to inform impacted staff, such as established agency-wide IT announcements.
    - Establish clear, continual communication between all parties involved in implementation to ensure shared understanding of objectives and project schedule and activities, such as outlining schedule and format for reporting and status meetings.

6.0 PROGRESS

6.1 FDCCI Consolidation Progress

NSF did not have any planned data center closures in FY11, and will not have closures in FY12.

Consolidation Progress							
Dept/Agency Name	National Science Foundation (NSF)						
	Closed	Target Closing Numbers					
	4Q10	4Q11	4Q12	4Q13	4Q14	4Q15	TOTAL Closings Planned
Consolidation Targets- Facilities ≥ 100 sq. ft. - Reported in June 2011 Asset Inventory	0	0	0	0	0	1	1

6.2 Cost Savings

Because NSF's first planned data center closure is not until FY15, current cost-reduction efforts are focused on the savings to be achieved by virtualization and by utilizing a cloud computing model.