Federal Data Center Consolidation Plan

2011 Data Center Consolidation Plan
&
Progress Report

Version 1.0

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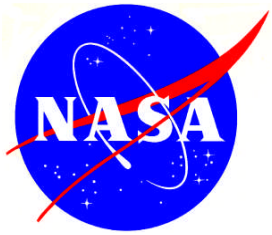

National Aeronautics and
Space Administration

NASA Headquarters
Washington, DC

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1 Introduction

The National Aeronautics and Space Administration (NASA) is comprised of eleven major Centers (and a small number of satellite facilities) that each execute various aspects of NASA's four major missions. Except for NASA Headquarters (which occupies one building in Washington D.C.) each facility is a campus environment (owned by NASA) with controlled physical access. In a few cases, the NASA footprint actually has a tenant arrangement on land owned by another federal agency. The combined civil servant and contractor on-site population across NASA is approximately 70,000 people.

With oversight from a single NASA Agency CIO, each NASA Center also has its own Center CIO (who reports directly to the NASA CIO) and through governance NASA achieves a balance between IT centralization and Center IT autonomy. The Agency IT governance body is the IT Management Board which contains CIO representation from each NASA center.

Over the past 5-10 years, NASA has moved towards more centralization of IT infrastructure services by consolidating the Wide Area Network (WAN), migrating to a single forest, single domain Active Directory infrastructure servicing the entire Agency, consolidating to a single Agency email infrastructure, standardizing desktop management, implementing enterprise license management for licenses such as Oracle and Maximo, and deploying a single, centralized identity and IT access management infrastructures. The CIO community has awarded and is in the process of implementing 4 broad IT service contracts (the I3P program) that will further consolidate the provisioning of IT infrastructure services. Mission specific IT requirements are funded and provisioned directly by the missions, although increasing progress is being made to work collaboratively with the CIO community and utilize centrally provided services wherever possible.

Housing for servers and storage systems at NASA has typically evolved organically over time as the field of information technology has matured. The industry is now reaching a level of maturity where we understand that there are service improvements and savings to be realized by a deliberately planned and ordered approach to hosting applications, management of computing capacity and storage systems.

NASA believes that the biggest cost savings resulting from data center consolidation will be the reduction of energy costs through more efficient use of the existing conditioned spaces, employing best practices in room design, proper temperature settings, optimal rack and floor space densities and life cycle replacement of old and inefficient hardware. We believe that we can also create cost avoidance by better utilizing the existing data center infrastructure so that expensive increases in power and cooling capacity are not necessary.

Although NASA has no leased real estate supporting data center requirements, server housing has expanded into unconditioned office spaces over time. By consolidating that sprawl into existing underutilized conditioned facilities we believe we can return floor space back to the NASA Centers for reutilization. Some additional savings may be garnered from reductions in personnel. Perhaps the

biggest improvement for customers is the improved service levels achieved when equipment is relocated into spaces with proper infrastructure to support disaster recovery and continuity of operations.

Data center consolidation offers an opportunity to modernize aspects of the IT infrastructure, introducing enhancements and efficiencies delivered through virtualization technology and cloud computing. NASA is already exploring the cloud potential with our Nebula offering.

NASA has implemented an automated IT discovery and application mapping capability to collect and maintain hardware and software configuration information within an enterprise configuration management database (CMDB). This near real-time information will be used to support enterprise architecture design and analysis activities, application rationalization and datacenter consolidation planning and validation effort .

There are numerous opportunities for improvements in the data center arena and NASA intends to leverage each appropriately.

2 Agency Goals for Data Center Consolidation

The Agency's goal for the desired end-state for NASA's data center services can be described as follows:

- Provide the NASA community access to cost and power efficient data centers to meet all NASA computing requirements
    - Fully utilize existing data centers
    - Implement data center energy saving best practices
    - Incorporate strategic improvements to strengthen the health and efficiency of key data centers
    - Provide a comprehensive view of NASA's computing service delivery
- Transformation of the data center environment
    - Aggressively work to eliminate "server rooms"
    - Consolidate and eliminate underutilized data centers, systems and applications
    - Virtualize systems and applications as appropriate
    - Utilize cloud services where possible instead of building new NASA owned infrastructure
    - Leverage planned life-cycle investments to make improvements and create efficiencies, in order to avoid the need for large capital investments
- Ensure a seamless customer friendly interface for the delivery of a comprehensive set of NASA computing services

In the original FDDCI data call, NASA reported 79 data centers. To date, we have closed 14 data centers. After a physical assessment of all data centers, we removed 21 from the list because they did not meet the definition of data center. Our end goal is to have 22 data centers, which leaves us with 22 yet to close. NASA supports the moratorium on creation of new data centers (and its terms and provisions), and discussions are occurring throughout NASA as new projects and programs are launched regarding how new work will leverage the 22 existing data centers that we intend to keep.

It is impossible to predict at this time (due to new starts planned for the next 4 years, changes in technology and changes to the NASA budget) exactly how many racks and systems will be in each data center at the end state. As we consolidate the contents of closing locations into the objective data center locations, we will definitely demonstrate improved server densities in the final data center destinations, but it may not result in a gross reduction in the total number of systems, due to new IT product deployments and the additional consolidation of servers from server rooms and smaller data centers that were closed. While we have established a 2015 goal for how many data centers NASA will retain, it is very difficult to make detailed plans at this point that defines the exact number of systems to remain in 2015, because there are too many changes that can occur between now and then. We are

also making a strong push to consolidate “server rooms/closets” into our remaining objective data centers. The number of servers presently in these server rooms/closets has not been tracked through the OMB reporting process, so those quantities do not exist in current counts.

Extensive virtualization has already been implemented across NASA’s consolidated business applications environment and many science and mission environments. We will continue to evaluate opportunities to further consolidate applications and virtualize operating systems and storage environments. To minimize costs, we will leverage planned life-cycle upgrades and changes to introduce these consolidation efficiencies, including the potential for cloud hosting/computing.

Regarding Green IT, our hypothesis is that we can achieve approximately a 20% reduction in overall energy consumption through the use of energy and data center best practices, such as employing hot and cold aisles to improve airflow, operating with minimal lighting, and since modern IT equipment can operate safely at much higher temperatures than older equipment, running HVAC at the recommended ASHRAE data center temperature settings. Through these changes we believe we can generate savings with minimal additional expense. To validate our improvements we are working to implement power metering in the data centers that are part of our 2015 scenario. To date, 1 data center is fully metered and 6 more are underway. We also have the capability to do airflow analysis in the data centers using a CFD tool which has provided some interesting results, for example, identifying that we could turn off 3 CRACs in one data center because they were not impacting critical air flow.

Through strategic placement of differing generations of IT equipment we expect to realize efficiencies provided by these recent technology advances.

NASA already uses government shared services where available, for example, in payroll processing and public key infrastructure. The remainder of NASA’s business systems infrastructure has already been consolidated into a single location. We are also targeting other areas, for example, web services, as candidates for cloud or shared service offerings, and we have awarded four large Agency IT procurements which will each offer some additional opportunities for increasing consolidation, virtualization and shared services.

In order to achieve these various goals, the IT community will work collaboratively with Center Facilities Management and Energy Management personnel. In addition to the FDCCI metrics, there also exist data center consolidation and energy reduction metrics conveyed through the NASA Strategic Sustainability Performance Plan (which incorporates requirements from the Electronics Stewardship Plan) and our approach to meeting the FDCCI goals will also satisfy these other requirements.

3 Implementing Shared Services/Multi-tenancy

NASA makes extensive use of shared IT services Agency-wide. Over the last 10-15 years, NASA has implemented a series of projects designed to consolidate and condense a variety of decentralized IT services, resulting in better service delivery, reduced cost and simplified service management. In FY11, NASA awarded four (4) new procurements as part of the NASA Information Technology Infrastructure Improvement Program (I3P) that will further solidify the concept of shared IT services across NASA.

NASA consolidated its wide area networks into a single WAN offering many years ago. The I3P NASA Integrated Communications Services (NICS) contract will further consolidate networking by bringing all local area networks under a single delivery mechanism and ultimately into a single management interface. With WAN and LAN provisioned and managed through the same contract interface, it is NASA's goal to improve end-to-end networking services. Approximately 3 years ago, NASA created the NASA Security Operations Center (SOC) for the consolidation of IT security services. The SOC provides a single focal point for incident reporting, scanning, logging and forensics. The creation of the SOC pulled together a fragmented set of services provided in different locations and in different ways into a single cohesive set of security services.

During the effort to implement HSPD-12 requirements, NASA deployed a single comprehensive set of Identity and Access Management Services (ICAM). Besides a single identity management system to track all types of NASA identities, NASA also deployed the NASA Account Management System (NAMS) to track all user accounts on all NASA applications (to ensure account holders all have vetted identities and to control termination tightly upon departure of an account holder), an Agency-wide SAML based authentication system for web-enabled applications that accepts both tokens and PIV cards as forms of 2 factor authentication, PIV smartcard use to all Windows desktops (Mac desktops to follow soon), a consolidated RSA token infrastructure to eliminate the need to have multiple tokens (and reduce the cost via Agency-wide purchases) and a single consolidated Active Directory infrastructure to serve as the centralized authentication source for the Agency. Through this consolidation initiative overall, literally hundreds of systems were replaced with just a handful of systems, more than 1,000 different paper forms were eliminated and hundreds of thousands of usernames/passwords were retired. For one application alone (the NASA training system) the login and password related help desk calls dropped by 80% due to the simplification of the architecture. One notable retirement resulting from this initiative was the retirement of NASA's distributed X.500 infrastructure, replaced with a centralized LDAP directory service.

NASA has also completed a consolidation of its email infrastructure. The entire Agency is serviced by a single centrally managed Microsoft Exchange based infrastructure that protects NASA's users and data with several layers of spam and virus protection. Before the Agency-wide adoption of this centralized mail system, NASA had more than 700 SMTP-based email servers. As cloud services are maturing, we

are evaluating the use of externally provisioned email services, and also evaluating the virtualization of desktops.

NASA implemented a web services consolidation contract for public facing web service delivery about 5 years ago. This initiative has not enjoyed ubiquitous adoption, and NASA's proliferation of non-centralized web servers has been extensive due to the ease of deploying such servers and the culture at NASA of sharing scientific and educational information with the public. NASA is now working on a second generation web services contract and stronger policy guidance, we expect to achieve a greater level of adoption and consolidation into the centralized web services environment.

NASA has consolidated the development and operation of all enterprise business services into a single organization to be delivered under the I3P Enterprise Application Services Technologies (EAST) contract. SAP is used Agency-wide for financial management. All enterprise business services share a common set of infrastructure services, including testing, quality assurance, systems administration, data base administration and security, which ensures commonality in how these underlying elements are provided across all business applications. NASA does obtain shared personnel and payroll services through the Department of Interior National Business Center. NASA leverages all OPM and other federally provided business services such as FedTraveler and eOPF as available.

Collaboration services present one of the next challenges for NASA. Many instances of tools like SharePoint and Documentum have been deployed throughout the Agency. NASA's Enterprise Architect is currently exploring this technology space with the intent of delivering guidance on how collaboration tools should be implemented and managed at NASA.

As a companion to the I3P procurements, NASA has launched a helpdesk consolidation initiative labeled the "Enterprise Service Desk" (ESD). The intent is the consolidation of Tier 0, 1 and many Tier 2 helpdesk services across the Agency into a single service desk. NASA is deploying the ITIL process management infrastructure to facilitate the construction of the ESD. The ESD is accompanied by the Enterprise Service Request System (ESRS), a single service catalog and single ordering system for all Agency-provided IT services. An Agency Configuration Management Database (CMDB) will facilitate the global management of configuration items. The ESD is expected to go-live in Q1FY12.

NASA currently operates one shared service, multi-tenant Federal data center facility, the National Center for Critical Information Processing and Storage (NCCIPS) Center. The NCCIPS Data Center is located at Stennis Space Center in Mississippi. The primary tenant of the NCCIPS facility is DHS and the US Navy, although other tenants are expected over time. At this time, this is the only IT service that NASA anticipates providing to other Federal Agencies.

4 Agency Approach, Rationale and Timeline

NASA is organized into eleven major campuses or "Centers" and data center consolidation will occur within the confines of each Center to optimize consolidation costs. All NASA Centers will be executing their consolidation activities in parallel. A final data center count has been established by the NASA CIO for each Center location. Initial consolidation activities will focus on the absorption of the smaller or less efficient data centers and consolidation of server rooms into one of the final state data centers, with the intent to increase utilization density in the final state data centers. Subsequent consolidation activities will address increased use of virtualization, both of systems and applications, typically through the life cycle management process, leveraging planned lifecycle modernization funds to facilitate implementation. Several NASA campuses are experiencing significant building renovation and/or demolition. These activities impact data center consolidation activities from a timing perspective and some campuses are executing their consolidations in phases to accommodate the cascading effects of the facility activities. NASA has examined data center consolidation lessons learned from a variety of sources across government and industry and has factored key points from those experiences into the shaping of our approach.

Each data center that remains as part of the 2015 scenario is a candidate for power metering. Metering is being implemented in each of these data centers as funding is available. Until we can measure our current energy usage, we cannot quantify the effects and benefits of our consolidation activities and energy savings improvements.

NASA is actively tracking the evolution and applicability of federally compliant commercial cloud offerings. Presently, NASA has its own private cloud which is currently being used to support experimentation in performance of science and engineering computational workloads.

The NASA Enterprise Architect is engaged in an assessment of NASA's application portfolio to identify categories suitable for migration to cloud service environments. As this work matures, NASA will develop a candidate list of general purpose applications that may be candidates for hosting in various cloud environments.

NASA currently has many curious experimenters in various cloud delivery mechanisms both internal and externally provided, but until cloud gains a higher level of maturity with better defined SLAs, it will be difficult to attract NASA customers to commit to large scale hosting of critical production services in the cloud.

Figure 1 – Data Centers Closed (as of Sep 2011)

No.	Data Center	Agency Component	Location	Prior Closed Q/CY	Current Status
	ARCDC2	ARC	Moffett Field, Ca	Q1 / 2012	Closed
	ARCDC3	ARC	Moffett Field, Ca	Q3/2010	Closed
	DFRCDC2	DFRC	Edwards, CA	Q1/2011	Closed
	GRCDC5	GRC	Cleveland, OH	Q4/2010	Closed
	GRCDC7	GRC	Cleveland, OH	Q4/2010	Closed
	GSFCDC9	GSFC	Greenbelt, MD	Q3/2010	Closed
	GSFCDC11	GSFC	Greenbelt, MD	Q4/2010	Closed
	GSFCDC12	GSFC	Greenbelt, MD	Q3/2010	Closed
	GSFCDC13	GSFC	Greenbelt, MD	Q3/2011	Closed
	GSFCDC15	GSFC	Greenbelt, MD	Q1/2011	Closed
	JSCDC12	JSC	Houston, TX	Q3/2010	Closed
	JSCDC17	JSC	Houston, TX	Q4/2010	Closed
	LARCDC2	LRC	Hampton, VA	Q4/2010	Closed
	SSCDC3	SSC	Stennis Space Ctr, MS	Q3/2010	Closed

Figure 2 – Data Centers to be closed

No.	Data Center	Agency Component	Location	To Be Closed Q/CY	Current Status
	GRCDC1	GRC	Cleveland, OH	Q4 / 2014	Stage 1: Inventory
	GSFCDC3	GSFC	Greenbelt, MD	Q3 / 2015	Stage 1: Inventory
	GSFCDC4	GSFC	Greenbelt, MD	Q3 / 2015	Stage 1: Inventory
	GSFCDC5	GSFC	Greenbelt, MD	Q3 / 2015	Stage 1: Inventory
	GSFCDC14	GSFC	Greenbelt, MD	Q3 / 2014	Stage 1: Inventory
	JSCDC6	JSC	Houston, TX	Q4 / 2014	Stage 1: Inventory
	KSCDC2	KSC	Kennedy Space Center, FL	Q3 / 2013	Stage 1: Inventory
	KSCDC3	KSC	Kennedy Space Center, FL	Q3 / 2014	Stage 1: Inventory
	KSCDC4	KSC	Kennedy Space Center, FL	Q3 / 2015	Stage 1: Inventory

	LARCDC5	LRC	Hampton, VA	Q2 / 2014	Stage 1: Inventory
	LARCDC6	LRC	Hampton, VA	Q3 / 2014	Stage 1: Inventory
	LARCDC7	LRC	Hampton, VA	Q4 / 2013	Stage 1: Inventory
	LARCDC11	LRC	Hampton, VA	Q2 / 2015	Stage 1: Inventory
	LARCDC13	LRC	Hampton, VA	Q4 / 2014	Stage 1: Inventory
	LARCDC14	LRC	Hampton, VA	Q3 / 2015	Stage 1: Inventory
	MSFCDC5	MSFC	Huntsville, AL	Q2 / 2012	Stage 1: Inventory
	NSSCDC1	NSSC	Stennis Space Center, MS	Q4 / 2011	Stage 3: Migration Planning
	SSCDC1	SSC	Stennis Space Center, MS	Q1 / 2012	Stage 3: Migration Planning
	DFRCDC4	DFRC	Edwards, CA	Q2 / 2012	Stage 1: Inventory
	DFRCDC6	DFRC	Edwards, CA	Q2 / 2013	Stage 1: Inventory
	GRCDC8	GRC	Cleveland, OH	Q4 / 2014	Stage 1: Inventory
	KSCDC5	KSC	Kennedy Space Center, FL	Q3 / 2015	Stage 1: Inventory

5 Agency Governance Framework for Data Center Consolidation

NASA will use the IT Management Board (ITMB) comprised of the NASA Center CIOs and Mission Directorate CIOs to enact sustained governance across the Agency. The NASA Data Center Consolidation team will enforce the data center architecture, develop a common set of measures as a basis for executive decisions on infrastructure and data centers, establish and evaluate SLAs for "in house" data centers and shared services and track performance measures in data centers across the Agency. Briefings at the weekly ITMB teleconference will be utilized for routine review of relevant data from the NASA Data Center Consolidation Team.

For each data center consolidation initiative at each NASA center, a team will be established that includes a Project Sponsor, a Project Manager, the Data Center Manager and Component/System POCs for all systems that are being impacted. This ensures proper representation from all stakeholders. These consolidations/migrations will occur per the included schedule from FY12-FY15.

As part of the Information Technology (IT) Infrastructure Integration Program (I3P) NASA has established a Computing Services Service Office (CSSO), under the direct governance and management control of the NASA Office of the Chief Information Officer (OCIO) to serve as the focal point for the management and business activities of all Agency computing services and related data center consolidation activities.

The CSSO is based on a shared cooperative accountability model with three NASA Centers providing the required support to effectively and efficiently deliver service management and service delivery oversight. This construct of shared accountability is intended to help the Agency achieve increased efficiency and reduce costs though standardization and commonality, while providing the means to build specialized solutions when mission needs require them.

The scope of the CSSO includes all Agency data center consolidation activities, cloud computing and other computing services as offered by the NASA OCIO and delivered by the host Centers to include:

- OCIO provided data center services
- Compliance to the Federal Data Center Consolidation Initiative (FDCCI)
- Data Center Power Monitoring
- IT Discovery and Application Mapping Services (IDAMS), operations and management
- Nebula Cloud services and/or other NASA private cloud services
- Commercial cloud service management
- Computing customer relationship management
- Implementation of policies and guidance of the NASA OCIO in the management and delivery of Computing Services and Computing Service infrastructure

NASA has also established a Computing Services Board (CSSB) reporting to the Service Executive for Computing Services to ensure that the Agency's Computing Services portfolio meets the needs of the NASA mission and that proper vetting has occurred to ensure quality service for all Information Technology (IT) users. The CSSB also supports NASA's IT requirements by ensuring consistent service and performance, in addition to facilitating collaboration across the Agency and recommendations on innovative solutions, while maintaining confidentiality, integrity, and availability of NASA's IT resources.

The CSSB fulfills its purpose by providing the following services to the Agency:

- Develops technical architectures recommendations for submission to the OCIO Technology and Innovations Division for possible incorporation into Enterprise Architecture Roadmaps.
- Develops standards, procedures, policies, and strategies required to establish and enhance the Agency's Computing Services and data center consolidation goals.
- Maintains high-level requirements for Computing Services, and reviews Computing Service projects for conformance to those requirements.
- Recommends enterprise architecture changes to the Enterprise Architecture Board, to the Enterprise Change Advisory Board (E-CAB) and ultimately the Enterprise Change Control Board (E-CCB) in order to support the Agency's mission, diverse workforce, and to protect NASA's information and technology investments.
- Interfaces with associated governance bodies, such as higher level decisional boards, other operational boards and Center-specific Computing Services/change boards as necessary to ensure that Computing Service focused architecture works within the overall enterprise architecture of the Agency.

NASA employs the procedural requirement of NPR 7120.7, Information Technology and Institutional Infrastructure Program and Project Management Requirements for the implementation of IT projects. Individual data center consolidation projects in excess of $500K or less in circumstances related to high risk, high importance, or high visibility to the Agency or Center will be conducted in accordance with these project management processes and include: life cycle reviews to ensure open and transparent communication and activity progress tracking, alternative cost-benefit analysis, risk management and mitigation, acquisition management and communications strategy. A high level project schedule will be created for each data center to be closed, transformed/optimized, along with a roll-up into a master data center consolidation project schedule for the Agency.

The support tools deployed across the enterprise ensure that power measurements and monitoring as well as performance, configuration and utilization data provided by the automated IT asset inventory and discovery tool will be available at the Agency level to all stakeholders in an open and transparent way, either through a dashboard or other presentation medium. As we enrich our body of data on the utilization and performance of data centers and systems in data centers, we can perform analysis that will lead us to an understanding of where we have additional opportunities for virtualization, cloud services and modernization. We will derive guidelines and thresholds of performance and utilization that would indicate some kind of consolidation or renovation is prudent.

Through the CSSB, appropriate policy guidance will be developed to govern how new requirements for applications and systems will be processed in order to preserve the Agency's data center architecture and the gains and improvements resulting from transformations to date.

ID	Task Name	Start	Finish
0	**FDCCI NASA Timeline**	**Mon 10/3/11**	**Wed 9/30/15**
1	**Data Center Closures**	**Mon 10/3/11**	**Wed 9/30/15**
2	**DFRC**	**Mon 10/3/11**	**Mon 7/1/13**
3	**DFRCDC4**	**Mon 10/3/11**	**Mon 7/2/12**
4	Plan Phase	Mon 10/3/11	Sat 3/31/12
5	Execute Phase	Mon 4/2/12	Fri 6/29/12
6	Complete	Mon 7/2/12	Mon 7/2/12
7	**DFRCDC6**	**Mon 10/3/11**	**Mon 7/1/13**
8	Plan Phase	Mon 10/3/11	Fri 6/29/12
9	Execute Phase	Mon 4/2/12	Fri 6/28/13
10	Complete	Mon 7/1/13	Mon 7/1/13
11	**GRC**	**Tue 10/1/13**	**Wed 10/1/14**
12	**GRCDC1**	**Tue 10/1/13**	**Wed 10/1/14**
13	Plan Phase	Tue 10/1/13	Fri 3/28/14
14	Execute Phase	Tue 4/1/14	Mon 9/29/14
15	Complete	Wed 10/1/14	Wed 10/1/14
16	**GRCDC8**	**Tue 10/1/13**	**Wed 10/1/14**
17	Plan Phase	Tue 10/1/13	Fri 3/28/14
18	Execute Phase	Tue 4/1/14	Mon 9/29/14
19	Complete	Wed 10/1/14	Wed 10/1/14
20	**GSFC**	**Mon 4/1/13**	**Wed 7/1/15**
21	**GSFCDC3**	**Tue 4/1/14**	**Wed 7/1/15**
22	Plan Phase	Tue 4/1/14	Fri 12/12/14
23	Execute Phase	Fri 1/2/15	Tue 6/30/15
24	Complete	Wed 7/1/15	Wed 7/1/15
25	**GSFCDC4**	**Tue 4/1/14**	**Wed 7/1/15**
26	Plan Phase	Tue 4/1/14	Tue 12/30/14
27	Execute Phase	Fri 1/2/15	Tue 6/30/15
28	Complete	Wed 7/1/15	Wed 7/1/15
29	**GSFCDC5**	**Tue 4/1/14**	**Wed 7/1/15**
30	Plan Phase	Tue 4/1/14	Tue 12/30/14
31	Execute Phase	Thu 1/1/15	Mon 6/29/15
32	Complete	Wed 7/1/15	Wed 7/1/15
33	**GSFCDC14**	**Mon 4/1/13**	**Tue 7/1/14**
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35	Execute Phase	Thu 1/2/14	Mon 6/30/14
36	Complete	Tue 7/1/14	Tue 7/1/14
37	**JSC**	**Mon 10/3/11**	**Fri 1/2/15**
38	**JSCDC6**	**Mon 10/3/11**	**Fri 1/2/15**
39	Plan Phase	Mon 10/3/11	Fri 9/28/12
40	Execute Phase	Tue 4/1/14	Tue 12/30/14
41	Complete	Fri 1/2/15	Fri 1/2/15
42	**KSC**	**Mon 10/3/11**	**Wed 9/30/15**
43	**KSCDC2**	**Mon 10/3/11**	**Mon 7/1/13**
44	Plan Phase	Mon 10/3/11	Fri 9/28/12
45	Execute Phase	Mon 10/3/11	Fri 6/28/13
46	Complete	Mon 7/1/13	Mon 7/1/13
47	**KSCDC3**	**Mon 10/3/11**	**Tue 7/1/14**
48	Plan Phase	Mon 10/3/11	Fri 9/27/13
49	Execute Phase	Mon 1/2/12	Fri 6/27/14
50	Complete	Tue 7/1/14	Tue 7/1/14
51	**KSCDC4**	**Mon 10/3/11**	**Wed 9/30/15**
52	Plan Phase	Mon 10/3/11	Mon 9/29/14
53	Execute Phase	Wed 10/1/14	Mon 6/29/15
54	Complete	Wed 9/30/15	Wed 9/30/15
55	**KSCDC5**	**Mon 10/3/11**	**Wed 9/30/15**
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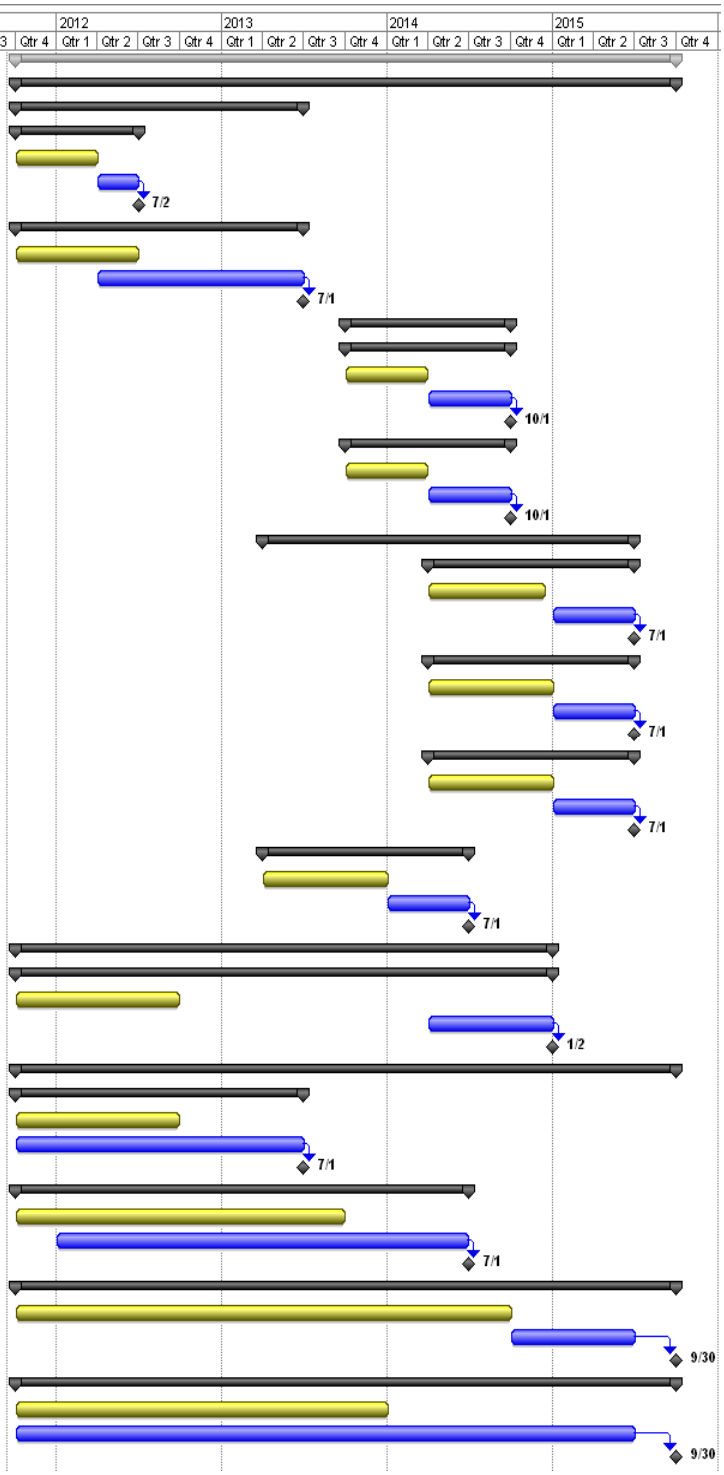
57	Execute Phase	Mon 10/3/11	Mon 6/29/15
58	Complete	Wed 9/30/15	Wed 9/30/15



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61		Plan Phase	Mon 7/2/12	Fri 6/28/13
62		Execute Phase	Mon 7/1/13	Fri 3/28/14
63		Complete	Tue 4/1/14	Tue 4/1/14
64		**LARCDC6**	**Mon 10/1/12**	**Tue 7/1/14**
65		Plan Phase	Mon 10/1/12	Fri 9/27/13
66		Execute Phase	Tue 10/1/13	Fri 6/27/14
67		Complete	Tue 7/1/14	Tue 7/1/14
68		**LARCDC7**	**Mon 1/2/12**	**Tue 10/1/13**
69		Plan Phase	Mon 1/2/12	Fri 12/28/12
70		Execute Phase	Wed 1/2/13	Mon 9/30/13
71		Complete	Tue 10/1/13	Tue 10/1/13
72		**LARCDC11**	**Mon 7/1/13**	**Wed 4/1/15**
73		Plan Phase	Mon 7/1/13	Fri 6/27/14
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76		**LARCDC12**	**Mon 4/1/13**	**Fri 1/2/15**
77		Plan Phase	Mon 4/1/13	Fri 3/28/14
78		Execute Phase	Tue 4/1/14	Tue 12/30/14
79		Complete	Fri 1/2/15	Fri 1/2/15
80		**LARCDC13**	**Wed 1/2/13**	**Wed 10/1/14**
81		Plan Phase	Wed 1/2/13	Tue 12/31/13
82		Execute Phase	Thu 1/2/14	Tue 9/30/14
83		Complete	Wed 10/1/14	Wed 10/1/14
84		**LARCDC14**	**Tue 10/1/13**	**Wed 7/1/15**
85		Plan Phase	Tue 10/1/13	Mon 9/29/14
86		Execute Phase	Wed 10/1/14	Mon 6/29/15
87		Complete	Wed 7/1/15	Wed 7/1/15
88		**MSFC**	**Mon 10/3/11**	**Mon 4/2/12**
89		**MSFCDC5**	**Mon 10/3/11**	**Mon 4/2/12**
90		Plan Phase	Mon 10/3/11	Fri 12/30/11
91		Execute Phase	Mon 1/2/12	Fri 3/30/12
92		Complete	Mon 4/2/12	Mon 4/2/12
93		**NSSC**	**Mon 10/3/11**	**Mon 1/2/12**
94		**NSSCDC1**	**Mon 10/3/11**	**Mon 1/2/12**
95		Plan Phase	Mon 10/3/11	Fri 12/30/11
96		Execute Phase	Mon 10/3/11	Fri 12/30/11
97		Complete	Mon 1/2/12	Mon 1/2/12
98		**SSC**	**Mon 10/3/11**	**Mon 4/2/12**
99		**SSCDC1**	**Mon 10/3/11**	**Mon 4/2/12**
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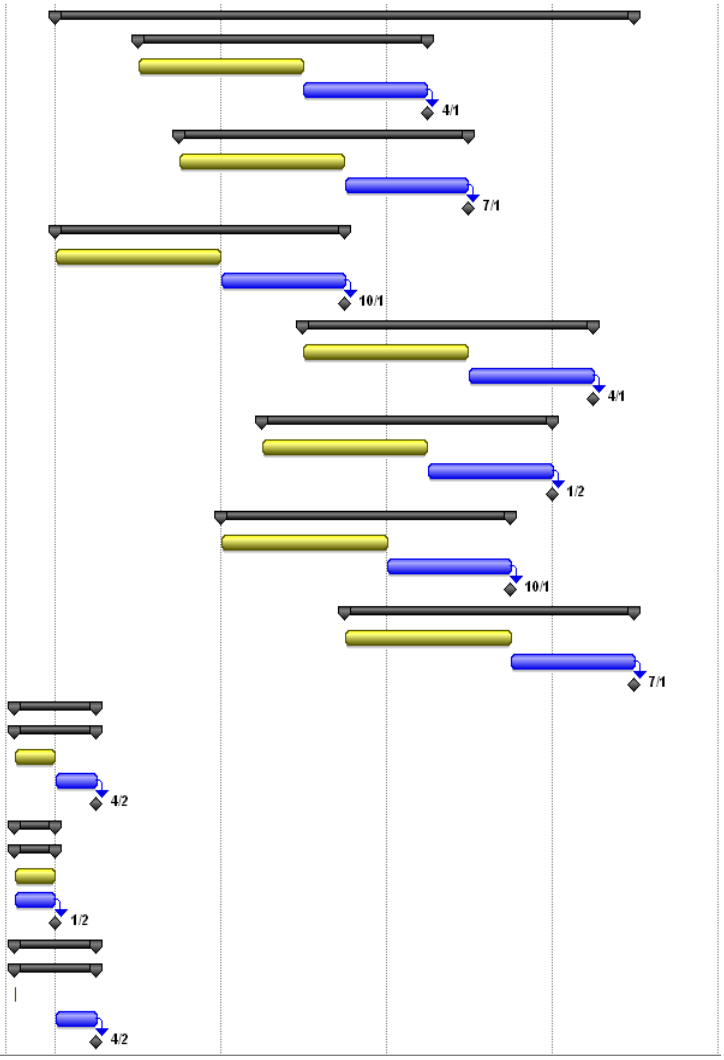
101		Execute Phase	Mon 1/2/12	Fri 3/30/12
102		Complete	Mon 4/2/12	Mon 4/2/12



5.1 Cost Benefit Analysis

NASA analysis suggests that the primary cost savings from data center consolidation will be attributable to energy savings from more efficient use of data centers and implementation of energy savings best practices over time. Today, NASA is using its own model to calculate energy costs and savings.

The Agency is implementing an enterprise level real-time power monitoring solution to track data center facility power utilization and where possible more granular power monitoring at the rack & component level. The output results will be compiled into an Agency Dashboard that will calculate Power Use Effectiveness (PUE) for each data center. As data centers are closed, server rooms consolidated into the

remaining data centers and applications virtualized or migrated to the Cloud, NASA will be able to plan for and substantiate the associated power reductions and resulting energy savings.

All NASA data centers are located on NASA campuses in NASA-owned buildings. Consolidation and reduction of data centers will not result in termination of leases or other reductions in real property costs. All space released will be repurposed to other NASA use unless the entire facility is slated for demolition. As NASA already provides infrastructure (LAN, WAN, voice, cable plant, etc) to these buildings to service non-data center customers, it is unlikely that any substantial cost reduction will materialize due to elimination of shared infrastructure.

Initially NASA expects to realize savings primarily from implementing greening concepts to reduce energy consumption and energy costs. As stated above we will be deploying meters to all data centers beginning CY11Q1, establishing our baseline and obtaining trending data on an on-going basis. The first consolidation push will be to move the contents of "server closets" into existing legitimate data centers. Power consumption within the affected data centers may rise slightly, but utilization densities will also increase correspondingly. As the approach to consolidation matures, NASA will begin to realize savings from server virtualization activities and the transition of services into cloud environments.

Longer term, NASA intends to leverage the disruption of planned lifecycle infrastructure upgrades and modifications as opportunities to move systems, applications and services into more consolidated data center environments. This means that it may take longer to implement some consolidations (as we wait for the timing of the planned lifecycle investments), but it also means that significantly less investment will be required expressly for the purpose of data center consolidation.

5.2 Risk Management and Mitigation

Risks will be tracked at three levels: project, component /system and data center. Project level risks and any critical component and system level risks will be reported to IT management. Risk management plans will be developed and risks and tracked using standard reporting templates.

NASA has a mature competency in risk management, documented in NASA Procedural Requirements (NPR) 8000.4A entitled "Agency Risk Management Procedural Requirements". A risk management plan will be developed for the data center consolidation area overall and risks will be tracked at the appropriate levels for the overall Agency activity as well as individual data center consolidation activities.

Risks will be presented to management through NASA's Information Technology and Institutional Infrastructure Program and Project Management process in a standard 5x5 matrix, identifying severity, likelihood and consequences. Project risks will be reviewed and updated on a regular basis throughout the consolidation process.

5.3 Acquisition Management

NASA currently manages its data centers through various support contracts executed at the Center level. These efforts are executed through either one of the Center CIO managed institutional IT services contracts or through one of the many mission support contracts at NASA. NASA owns all the facilities which house NASA data centers. Data center services are typically non-severable components of a much larger IT service or mission contract that includes other scope such as: software/application design, IT security, network & communications and end user services, etc.

Throughout CY12-15 NASA will be consolidating at the Center level closing and vacating less efficient data center facilities and server rooms and consolidating services into a fewer number of objective data centers, to yield increased server and rack densities and higher PUE.

In addition NASA will implement procurement policy to preclude data center services from materializing in future unsanctioned contract vehicles. During this same time NASA will be investigating and implementing mechanisms to obtain and deliver Cloud services to Agency customers to reduce the quantity of managed IT infrastructure and to satisfy the need for rapid provisioning and elastic computing capabilities.

NASA typically leverages the Government-Wide Acquisition Contract (GWAC) Scientific and Engineering Workstation Procurement (SEWP) for acquisition of hardware, software and other services. Presently we are using the SEWP contract for acquisition of power monitoring services and power meters. All types of cloud services are also within scope of SEWP.

Other common acquisition methods at NASA include procuring via existing task order contracts and using the GSA contract vehicles.

There is currently no data center consolidation specific acquisitions planned. All consolidation work will be performed within the scope of existing support contracts.

5.4 Communications Strategy

NASA uses a fairly standard communication strategy that is consistently applied to large Agency-wide IT projects.

The NASA Deputy Administrator has widely distributed a letter to all NASA Center Directors and Officials In Charge of Headquarters Offices announcing that the NASA CIO is responsible for executing the Federal Data Center Consolidation Initiative and directs support for CIO staff who are working

consolidation issues at each center, including the initiative for data center power monitoring and reduction of energy consumption.

The NASA CIO has assigned a Service Executive to oversee all data center related activities, and a project management office has been established and staffed at Kennedy Space Center to lead the Agency work.

Each NASA Center CIO has assigned a Data Center POC (DCPOC) to represent their NASA Center in all Agency data center related activities, and also to coordinate inside their NASA Center with all of the data center owners and related stakeholders. The Agency Data Center Project Management team conducts a weekly telecon with all of the DCPOCs.

At the Agency level, the NASA the Data Center Service Executive communicates data center activities through briefings to NASA management in various forums, the CIOs and to the functional offices. At the Center level, the DCPOCs conduct outreach to the stakeholders within their Center, and forge relationships with facilities and energy management personnel and data center owners to promote program objectives.

This current approach to communication has worked successfully for the deployment of the Agency-wide asset inventory discovery and application mapping tool and the data center power monitoring initiative. Participation in these endeavors has been quite broad, an indicator that the communication is reaching the affected community.

Additional outreach and communication activities will be initiated as deemed appropriate over time.

6 Progress

6.1 FDCCI Consolidation Progress

For CY11 NASA set out to implement consolidation "quick wins" and worked with each local Center to identify activities that could be executed in two six month periods, (Sep 2010 –March 2011) and (April 2011 – Sep 2011).

During the first six month period of FY2011 NASA reduced its number of data centers from 79 down to 54. 13 of these facilities were closed resulting in 12,368 sq ft of floor space returned to the local institutions, to be re-purposed for other than data center use. 12 facilities were eliminated from the count because they did not qualify as data centers.

During this same timeframe 19 server rooms were eliminated, returning an additional 9,921 sq ft of floor space to the institutions, while 208 servers were virtualized and another 173 were relocated to proper data centers.

For the second period (April 2011 – Sep 2011) NASA expects to yield the following:

- Eliminate 46 server rooms (relinquishing 15,280 sq ft of facility space)
- Virtualize 7 applications
- Virtualize 116 servers
- Consolidate 228 servers into other data centers
- Excess 159 unneeded servers
- Close one additional data center (for a total of 14 closed to date)

6.2 Cost Savings

For the first period of FY2011 (Sep 2010 –March 2011) NASA has calculated a $212,000 reduction in energy costs from closing data centers and another $125,000 reduction resulting from closing server rooms for a total cost savings of $337,000.