Contents

Introduction .................................................. 4
A Word from the Chief Technology Officer for IT ..... 5
Agency Chief Technology Officer for IT: Deborah Diaz 5
Report Organization ........................................... 6
IT Labs: How it all began ..................................... 7
Evolution ....................................................... 7
Personnel ....................................................... 7
Contact Us ..................................................... 8
Partnerships and Collaboration ......................... 8
Process ......................................................... 8
Awards & Recognition ....................................... 14
American Council for Technology (ACT) and Industry Advisory Council (IAC) . 14
Computerworld .............................................. 14
FedScoop ..................................................... 14
Management Innovation eXchange .................... 14
Nextgov Bold Awards ...................................... 14
Press ............................................................ 15
NASA ............................................................ 15
American Council for Technology (ACT) and Industry Advisory Council (IAC) . 15
A Word from the Program Manager ................... 16
Program Manager: Allison Wolff ....................... 16
IT Labs Success .............................................. 18
Goddard Space Flight Center CTO-IT: Keith Keller 18
Johnson Space Center CTO: James McClellan .... 18
FY13 Project Lead—Persistent Telepresence Portal Network: Jon Welch .... 19
FY13 Project Lead / Contracting Officer—Paperless Contracting Initiative: Zachary Burland 19
Distribution Matrices ........................................ 20
Phase Distribution for IT Labs Funded Projects ........ 20
IT Theme Distribution for FY 2013 IT Labs Funded Projects ........................................... 21
Funding Distribution by Center for IT Labs Funded Projects ........................................... 22
IRM Strategic Goal Distribution for FY 2013 IT Labs Funded Projects ................................... 23
Recent Projects ............................................ 25
Application Level Cyber Security for NASA ................................................................. 25
Public Web Sites and Servers ......................................... 26
Applying Big Data Analysis Tools and Techniques using Cloud Infrastructure ........ 27
Automating the Reporting and Releasing of Technologies (ARRT) ......................... 29
Paperless Contracting Initiative (PCI) ................ 31
Persistent Telepresence Portal (PTP) Network ....... 32
PIV Derived Credential for Strong Mobile Application Authentication .................. 34
SysAdmin.nasa.gov (SNG) .......................... 36
Video Conference (V-Concierge) ....................... 38
Collaboration Wolfram Alpha / NASA Enterprise Search ....... 40
Agency Federated Code Sharing Library ................. 41
Projects in Work ............................................ 43
Cloudbursting – Solving the 3-body problem ........ 44
Mobile BYOD VDI Implementation in the Cloud (VDI vs. DaaS) ......................... 45
Supercomputing Desktops .............................. 46
Cloud based HTML5 Toolkit (CBHT) ............... 47
Visualization Engine for SysML ......................... 48
Investigation of Wearable Technologies for NASA Applications ......................... 49
Human to Computer Input .................................. 50
Technical Data Interoperability ......................... 51
3D Printing for Youth Engagement ..................... 52
Where Are They Now? .................................... 54
Shelby Thompson, Ph.D. .......................... 54
Chatwin Lansdowne ........................................ 54
Jon Welch ..................................................... 75
IT Labs: Keep Innovating .................................. 56
Process ......................................................... 56
Website ......................................................... 56
IT Heroes Showcase ....................................... 57
Federating Innovation—Partnerships .................. 57
IT Labs: Where will we be in 2025 .................... 58
Appendix ...................................................... 60
2011 NASA IRM Strategic Goals and Objectives .................................................. 60
As NASA prepares to send astronauts beyond low-Earth orbit, the NASA Administrator, Charlie Bolden, sent an Agency-wide message to all employees that emphasized technology driving exploration.

“NASA’s missions of the future are going to depend on new technologies that will be evolvable and applicable across a broad range of missions. We are dedicated to extending human presence into the solar system and to the surface of Mars, and new technologies and advanced capabilities are essential to safely taking us from Earth-reliant to Earth-independent missions, and the surest path to an eventual crewed landing on Mars.”

By leveraging a proven approach to Information Technology (IT) and IT process development, IT Labs supports phased research and development with concrete deliverables and leverages internal NASA expertise to learn fast and affordably. Using the method of intrapreneurship to incubate solutions to fruition or failure, either outcome is a win for NASA that engages employees and creates a larger knowledge base, optimally resulting in new technologies and products to benefit the Agency.

IT Labs solicits proposals NASA-wide for proposed Enterprise IT solutions. Applications include the concepts, high-level budgets, and an elevator pitch video describing the proposed activity. A comprehensive review team comprised of the Agency's Chief Technology Officers (CTOs) from each Field Center, Service Executives, and several Mission Directorate representatives provide individual review and ranking of the submissions. The extensive IT Labs Review Process provides a degree of credibility to highly-ranked projects and ensures support of NASA’s Mission Directorates. If selected, proposals receive funding and IT Labs works with Project Champions, executives who help foster the project’s success and other subject-matter experts to ensure the work is appropriately collaborated and in alignment with Enterprise goals.

Projects chosen for funding are contained to one of three possible phases for a time period not to exceed 90 days per phase. The Idea/Issue phase explores an area of IT in the first step of development. This initial research phase is followed by the Proof-of-Concept phase and then, the Prototype phase. Each of these phases can be an entry point to the IT Labs program and with proven technology and deliverable completion, can proceed to the following phase culminating at the Pilot phase where Enterprise Services adopts the project for potential Agency-wide deployment. This incremental approach is adaptable and lightweight, avoiding the pitfalls of full project funding from conception to delivery. Ever tenacious, the IT Labs Team works with representatives across NASA to explore new opportunities for high-impact ideas.

Although budget in the federal government is tight, the IT Labs Program Manager and the Agency CTO procured resources and negotiated with project proposers to fund nine new projects out of the 42 received applications. This is in comparison to the 10 projects funded in FY 2013 and 21 projects funded in FY 2012. The projects of FY 2013 as well as the projects receiving funding for FY 2014 are summarized in this document.

Through the understanding of IT Labs’ work, methodology, and review of the portfolio documented in this report, it is vividly clear that IT Labs is answeringAdministrator Bolden’s call and is blazing a trail to be watched and followed.
Deborah Diaz,
Agency Chief Technology Officer for IT

The mission of NASA IT Labs is to engage and empower NASA’s IT innovators to develop capabilities that support NASA’s needs in a rapidly changing world. As one of NASA’s representatives for change and innovation, this mission provokes the right questions for the Office of the Technology & Innovation Division. While looking internally towards our NASA community, we become capable to infuse new technology into NASA’s mission. IT Labs lets us inexpensively invest in innovation and technology here at NASA.

The large and respected reviewer panel that IT Labs wields ensures the right technology project proposals receive funding. This validates the necessity of the work and creates exposure for the new technology or improvement in an agile and cost effective manner.

IT Labs had a huge win this year in confirming its innovation process methodology, by being a finalist for the 2014 American Council for Technology (ACT)—Industry Advisory Council (IAC) Excellence.gov Award for Excellence in Enterprise Efficiency. Being a finalist proves IT Labs confines risk and produces results in a fast and effective manner. IT Labs is a responsible Office of the Chief Information Officer (OCIO) program that engages and empowers the NASA workforce providing examples and prototypes of high technological yields.

In upcoming years as NASA’s CTO, I will ensure IT Labs will be the vehicle for innovation and new technology adoption for NASA. As NASA continues to strive to take humans to where they have never been, we must be responsible and diligent in providing the most effective IT tools available. I see no better path to accomplish this effort than the IT Labs platform. IT Labs will continue to streamline NASA IT development by cultivating great ideas inexpensively for huge returns.
This report includes: an introduction to IT Labs, descriptions of the IT Labs process and phases, NASA IT stakeholder commentary on the program, detailed descriptions of recent projects, brief synopses of upcoming projects, brief updates on some past projects and information pertaining to future development of the program.

The first section describes the program’s inception, its role in NASA’s innovation framework and its development as a valued program. This is followed by recent awards, press coverage, a message from the IT Labs Program Manager, and the observations of a NASA Chief Technology Officer for Information Technology (CTO-IT) and IT Labs Project Leads regarding IT Labs’ value.

Data graphics are presented with the distribution of projects according to phase, themes, centers, and the latest NASA Information Resources Management (IRM) Strategic Plan goals and objectives. Descriptions of recent projects are detailed accounts with project lead and project team quotes regarding the collaboration and support of IT Labs through the course of their work. IT Labs’ identified relevant themes are also noted for each project as well as the targeted goals and objectives from NASA’s IRM 2011 Strategic Plan. (See [http://www.nasa.gov/offices/ocio/IRM_Plan.html](http://www.nasa.gov/offices/ocio/IRM_Plan.html) and/or the objectives as presented in the appendix of this document.)

Synopses of upcoming projects describe newly funded projects and their goals.

Information pertaining to the future development of the program concludes the report with a road map to future plans and collaborative opportunities.
The NASA Chief Information Officer’s portfolio includes a wide range of infrastructure support services. Some of these solutions are outdated and expensive to maintain. Resource restrictions, production continuity, and cultural consideration challenge NASA’s ability to make the necessary updates to these essential capabilities. In order to evaluate alternative solutions for existing business needs, NASA requires the ability to evaluate, adopt and adapt emerging information technologies—quickly and cheaply. A lightweight innovation framework will also help NASA keep pace with the accelerating dynamics of technological advances and maintain its status as a global technology leader.

The IT Labs program was established under the Office of the Chief Technology Officer in May 2011. Its purpose is to provide a streamlined approach for evaluating new information technologies and processes for Agency integration in support of the OCIO and the IRM Strategic Plan.

The Vision: Engage the brightest minds across the Agency to guide NASA’s IT strategy and investment decisions, and identify IT capabilities that can best support NASA’s needs in a rapidly changing world.

The Mission: Adapt to keep pace with constantly evolving technology by leveraging a lightweight and efficient process to explore innovative ideas.

IT Labs represents a significant shift from how NASA traditionally evaluates new technologies. To reduce risk, large scale IT projects at NASA are governed by directives, which require multiple layers of documentation, evaluation, and approvals. As a result, employees with access to funding at sub-Enterprise levels face a powerful temptation to conduct quick, low-cost evaluations of innovative technology on their own—a temptation to which they often give in. This results in duplicative efforts and spending, even as NASA struggles to maintain essential services with a decreasing IT budget.

IT Labs was created to help make strategic investments in innovation. It is an innovation incubator, soliciting ideas from the greater NASA community and enabling their development as part of a rapid, low-cost, low-risk process. The program provides a central collection point for innovative ideas, as well as a lightweight, low-cost methodology for research, proofs-of-concept and prototypes. The IT Labs process for project evaluation allows for a project to be quickly and effectively evaluated based on essential criteria identified by the program, at defined points in the project’s life cycle. This evaluation of quality and potential viability mitigates risk factors of both time and cost, effectively providing a better chance for more projects to be realized and reach production.

IT Labs shares project results with all of NASA, enabling others to apply lessons learned to their own projects or collaborate on new efforts inspired by project results. In addition, IT Labs works diligently to build partnerships within the Agency—Mission Directorates, Centers and facilities—to pool resources in the pursuit of meaningful, cutting-edge technology solutions that can better meet NASA’s needs.

The program strives to keep the amount of paperwork and oversight to the necessary minimum, removing institutional inhibitors to innovation and enabling the speedy evaluation of technologies that can help government agencies meet both their Enterprise requirements and their strategic goals.

Evolution

As IT Labs matures, it has tailored elements of the program to better meet the OCIO’s requirements for a collaborative innovation framework. It has established and leveraged partnerships, constructed a platform for communication and collaboration, and also developed processes to facilitate the innovation-to-operation goals.

Personnel

With the primary focus on innovative projects, IT Labs consists of a small, integrated team with low administrative overhead. This provides the program with better opportunities to fund more projects. This team is well-networked within the NASA IT community; therefore, the team members are able to leverage their knowledge and expertise cohesively to benefit NASA and IT Labs.

Allison Wolff, Program Manager
Chris Gerty, Project Coordinator
Jeffrey Doi, Communications & Partnerships
Judith Peace, Web Developer Team Lead
Jeffrey Brief, Web Developer
Kevin Reister, Web Developer
**Contact Us**

IT Labs is always looking for opportunities to collaborate inside NASA and with external partners in Academia, Industry, and the Federal Government. To contact our team, email us at HQ-NASA-IT-Labs@mail.nasa.gov. Within the NASA firewall, employees can view our activities at https://labs.nasa.gov. We have also established a YouTube page to highlight our project videos which can be found at https://www.youtube.com/user/NASAITLabs.

**Partnerships and Collaboration**

As the great Michelangelo once said, “I am still learning.” IT Labs continues to grow and learn as we develop new projects, processes, and relationships. We believe the best way to learn is through sharing and gathering insights from a diverse collaboration network.

The cornerstone of IT Labs’ success is its cross-functional and cross-Center collaboration. By branching out and creating a network of IT innovators, IT Labs is able to identify otherwise stove-piped advancements and initiatives and connect them with similar efforts across the Agency. In doing this, the program is able to reduce duplication of effort and identify shared requirements for processes, systems, or applications that can be expanded to fit Enterprise needs.

In addition, IT Labs proudly partners with other Federal Agencies and continues to cultivate those relationships in support of the NASA mission. We have worked with several other Agencies to benchmark and share successes, such as the General Services Administration (GSA), Department of Defense (DoD), and Human Health and Services (HHS).

Along with Federal Agencies, the program has also collaborated with industry partners such as Google, Microsoft, Verizon, Apple, and Wolfram Alpha—just to name a few. IT Labs values the insight of its industry partners and works with them to learn about new and cutting edge technology. IT Labs also values partnerships in academia, and has engaged in a formal sponsorship with the Massachusetts Institute of Technology (MIT) Center for Information Systems Research (CISR).

**Process**

IT Labs has a lightweight process in place for projects funded by the Program. The team has built on its experience with the first two rounds of funded projects and crafted a process that maintains a lightweight approach, but also keeps project leads accountable for milestone deliverables with pre-defined points of review and templates. These templates include documents such as position papers, white papers, and business cases—each including a standardized format and commentary that defines what information is required for the project to be evaluated.

IT Labs identifies four distinct phases that a project progresses through to become an Enterprise service. Successive phases build on the deliverables generated in previous phases to ensure efficient utilization of resources. The four identified and defined phases are as follows:

- **Idea/Issue** – Identify an Agency need and evaluate processes or technologies that can accommodate that need
- **Proof-of-Concept** – An agreement to quickly show whether a thesis for using the targeted capability or technology would work in the proposed environment
- **Prototype** – An agreed-upon limited-scope trial aimed at solving a specific business problem that is representative of the eventual larger solution
- **Pilot** – A small-scale implementation of the solution that includes a representative subset of customers and other impacted stakeholders

In addition to the four project phases, IT Labs has also defined processes for projects to move from one phase to the next. Refer to the following process diagrams for a visual flow of the process.
IT Labs has defined processes for projects to move from one phase to the next. The goal of each phase is to progress to the next one resulting in an Enterprise Service. The figure above shows the overall process a project typically goes through starting from the Idea phase until it becomes an approved Enterprise Service.
Progression from an Idea/Issue to a Proof-of-Concept

Project Reviewers include Chief Technology Officer Working Group (CTOWG) members and solicited representatives from the OCIO.

The Idea/Issue phase is the first phase of the IT Labs research and development profile. It is the initial look into a capability or technology that has potentially significant value to NASA. Project teams conducting a project in this phase deliver a technical position paper and a presentation to the CTO-ITs at the completion of the phase. The FY 2013 projects conducted in this phase are listed below.

FY 2013 Idea/Issue Phase Projects

+ Automating the Reporting and Releasing of Technologies (ARRT)
Progression from a Proof-of-Concept to a Prototype

The second phase of the IT Labs profile is the Proof-of-Concept phase. In this phase, an agreement is made to quickly show if a thesis for using a targeted capability will work in the proposed environment. As in the Idea/Issue phase, a final presentation to the CTO-ITs is made. Deliverables also include a white paper and observable demonstration. The Proof-of-Concept projects from FY 2013 are presented below.

FY 2013 Proof-of-Concept Phase Projects

- Applying Big Data Analysis Tools and Techniques using Cloud Infrastructure
- Paperless Contracting Initiative (PCI)
- Persistent Telepresence Portal (PTP) Network
- Video Conference (V-Concierge)
IT Labs’ third phase is the Prototype phase. An IT Labs Prototype is an agreed-upon limited-scope trial aimed at solving a specific business problem that is representative of the eventual larger solution. In this phase, the project team must deliver a detailed business case, demonstrable prototype, and a final results presentation. Below are the FY 2013 projects conducted as prototypes.

**FY 2013 Proof-of-Concept Phase Projects**

+ Application Level Cyber Security for NASA Public Web Sites and Servers
+ Personal Identification Verification (PIV) Derived Credential for Strong Mobile Application Authentication
+ **SysAdmin.nasa.gov (SNG) — Knowledge Sharing for Improved Operations**
Pilots are the final phase of the IT Labs project flow and are the handoff to Enterprise Services to execute and put into operations. They are a small scale implementation of the solution that includes a representative subset of the customers and other impacted stakeholders with an operational readiness review and final presentation at the end of the pilot. The FY 2011 IT Labs portfolio included a single pilot, Google Apps, for Enterprise. In the Pilot Phase the appropriate service office has the primary responsibility for the project with IT Labs playing a support role. For tracking, Google Apps was included in our graphic for project phases. The IT Labs pipeline of projects did not include any other pilots in the FY 2013 portfolio.
IT Labs is thrilled to be recognized so early in the program’s development by the following organizations:

**American Council for Technology (ACT) and Industry Advisory Council (IAC)**

**Finalist Program Descriptions for the 2014 ACT-IAC Excellence.Gov Awards**
— ACT-IAC, Events (24 March 2014)
Link: https://actiac.org/custom-links/10055/65076/65233
ACT-IAC named IT Labs in the top five for Excellence in Enterprise Efficiency.

**Computerworld**

**Recognized 2013 Computerworld Honors Laureate**
— Computerworld, Honors Laureate Program (19 March 2013)
Link: http://www.eiseverywhere.com/ehome/49069/33917/
Computerworld recognized IT Labs as an Honors Laureate in Innovation.

**FedScoop**

**FedScoop 50 Awards honor top government, industry leaders and innovators**
— FedScoop, Events (29 November 2012)
IT Labs received the FedScoop50 award for 2012 Federal IT Program of the Year.

**Management Innovation eXchange**

We are proud to announce the eighteen finalists of the **Leaders Everywhere Challenge**, the second leg of the Harvard Business Review/McKinsey M-Prize for Management Innovation—a robust collection of real-world case studies and courageous experiments in rethinking the work of leadership, redistributing power, and unleashing 21st century leadership skills.
— Management Innovation eXchange, M-Prize (30 July 2013)
Link: http://www.mixprize.org/m-prize/leaders-everywhere-challenge
IT Labs is a finalist for the M-Prize Leaders Everywhere Challenge.

**Nextgov Bold Awards**

The **Nextgov** editorial staff has selected 19 finalists for Bold Awards from more than 180 nominations. The honors recognize federal employees who have taken risks to implement innovative programs that make government more effective.
— Nextgov, Bold Awards (30 July 2013)
Program Manager, Allison Wolff, is a finalist in the Bold Award for Tech Innovation.
As a demonstration of the proven value that IT Labs holds, detailed below are several articles pertaining to the program across various web media outlets.

**NASA**

FY’14 IT Labs Project Awardee Announcement  
— Internal NASA OCIO, CIO News (13 May 2014)  
Link: [http://inside.nasa.gov/ocio/content/nasa-it-labs-fy2014-project-awardees-announcement](http://inside.nasa.gov/ocio/content/nasa-it-labs-fy2014-project-awardees-announcement) (Internal NASA web site)  
Announcement of the nine selected projects for funding in FY 2014 chosen from the FY 14 Project Call.

FY’14 IT Labs Project Awardee Announcement  
— IT Talk (Volume 4, Issue 2; April – June 2014)  
Announcing the nine selected projects from the FY 14 IT Labs Project Call.

NASA IT Labs: Behind-the-Scenes Contributions to a Star-Studded Stage  
— IT Talk (Volume 4, Issue 1; January – March 2014)  
Discusses two IT Labs sponsored projects that have impacted NASA IT services: Large File Transfer (LFT) and PIV-Derived Credentials for Strong Mobile Application Authentication.

IT Labs Update  
— IT Talk (Volume 3, Issue 4; October – December 2013)  
Gives a brief program update and announces the start of the IT Heroes Showcase which is a streaming presentation that demonstrates the work supported by IT Labs.

IT Labs @ Langley Research Center  
— IT Talk (Volume 2, Issue 4; October – December 2012)  
Link: [http://www.nasa.gov/pdf/693023main_ITTalk_OCT2012_Final.pdf](http://www.nasa.gov/pdf/693023main_ITTalk_OCT2012_Final.pdf) (PDF, 3.6 MB)  
Langley Research Center had several projects that were funded by IT Labs in FY 2012 and benefitted Langley with summaries in this article.

**American Council for Technology (ACT) and Industry Advisory Council (IAC)**

Finalist Announcement for the 2014 ACT-IAC Excellence.Gov Awards  
— ACT-IAC (24 March 2014)  
Link: [https://actiac.org/custom-links/10055/65076/65233](https://actiac.org/custom-links/10055/65076/65233)  
The 2014 ACT-IAC announcement naming IT Labs in the top 5 for Excellence in Enterprise Efficiency.
Allison Wolff,  
IT Labs Program Manager

IT Labs was designed with one specific goal: empowerment. It is about empowering NASA to make smarter IT investment decisions and empowering NASA employees to develop their ideas making Enterprise IT better. We have done this by leveraging NASA's highly-skilled workforce to identify and develop approaches and technologies that improve the way we do business. In an environment with waning budgets and a tendency to focus funds on operations rather than new innovations, the challenges to this empowerment model can at times be overwhelming. We identified the challenge areas up front: technology, policy, and culture, and have spent the last few years systematically attempting to deconstruct barriers and ensure progressive synchronicity within these areas. During this time we have our share of successes and failures, joy and frustration, but the one thing that has kept us going was the steady beckoning promise of a better way forward.

Technology

In many ways the technological barriers are the easiest to overcome. There are set requirements, definite capabilities, when changes need to occur there is often a fairly clear path forward, and when it is all said and done, either it works or it does not. However, some solutions work better for some than others, and finding best fit solutions that meet the justifiably high standards of the NASA workforce can prove challenging. Complications can also arise when there are multiple solutions or approaches, at which point one must evaluate options and determine best fit solutions. IT Labs has helped ameliorate these issues by tapping into the desirable technologies as brought forward by our capable workforce. Furthermore, by taking a lightweight, low-cost approach to technology development, the efficacy and feasibility of a potential solution can be determined quickly and with very low overhead cost.

Policy

NASA, like all Federal Agencies, is governed by numerous policies designed to ensure accountability and provide guidance. Many of the policies surrounding NASA IT have grown more rigorous over the years, and reasonably so. Policies are developed over time as a result of lessons learned, and additional rigor is imposed to ensure success, security, and accountability. With this additional rigor comes additional overhead, extended time to market, and in some cases, as a result of the rapid advancements in technology, the most viable solution becomes obsolete in the time it takes to run through the more stringent processes, resulting in a need to start over before an identified solution can be delivered.

IT Labs had an opportunity to help influence policy in 2012 by working with NASA's Identity, Credential and Access Management (ICAM) group to help redefine the Federal ICAM policy making external cloud-based services more accessible to Federal Agencies. This year, with the ever-increasing adoption of agile project management, IT Labs has had an opportunity to help build a case for a more lightweight approach to IT service delivery by participating in a team aimed at streamlining NASA IT project management and delivery processes. By embracing this approach, NASA IT has an opportunity to save millions in development and resource costs and ensure a quicker delivery of secure solutions to the Agency.

Culture

Culture develops over time, and often approaches and rules are instilled and repeated without a true understanding of the original intention or sometimes the original intention is no longer valid due to the changing environment. However, updates to the rules may not occur on a timely basis and we keep doing it the same way because “that is the way we do it.” To follow these norms means to be accepted into the corporate culture. Like any organization, NASA has its share of these scenarios. Our highly technical, solutions-driven workforce often suffers from the 'not invented here'
syndrome, meaning if we did not come up with the solution, it probably is not the right one. The resulting behavior is then, “Here, let me show you a solution that does work.” With the pervasive propagation of this approach comes multiple technologies performing duplicative functions. In some cases, the technology itself is a duplication, resulting in multiple investments in the same product, and a failure to exhibit adequate trust or a collaborative spirit to consolidate or federate products and services.

To NASA’s credit, the people that make up the Agency’s civil servant and contractor population are highly motivated, incredibly intelligent, and driven to make NASA’s mission a success. So, while overcoming cultural barriers proves the most challenging obstacle of all, empowering NASA’s employees, or as we call them, our IT Heroes, to be agents of that change has been inspiringly successful.

**The Future of IT Labs**

We have learned so much these past few years, and have had the opportunity to work with a cadre of IT innovators from numerous NASA organizations and disciplines. Our focus in the coming years will be ensuring a more effective transition to service for the most viable IT Labs projects, continuing our model of empowerment, and enhancing the means for NASA IT Heroes to collaborate both virtually and face-to-face. These future efforts are sure to be successful as we are seeing increased awareness and engagement from management on the merits of our approach and the exploration of additional ways we can make NASA IT better.
Keith Keller,
GSFC CTO-IT

IT Labs has given us a method to explore and adapt to the ever-changing IT landscape. We can reward and encourage employees to see where we, NASA, can become more efficient and effective when new technologies and ideas come to light. IT Labs projects provide an inexpensive quick view of possible solutions for a known issue or concern. These solutions can then be used to assess and determine the best possible solution in terms of both operations and cost-effectiveness. IT Labs provides an invaluable service by facilitating concept ideation and providing information on possible solutions that can be utilized by any NASA project or organization.

James McClellan,
JSC CTO

The future FY12 Project Lead, Chatwin Lansdowne, appeared in my office out of the blue one day a couple of years ago and began relating how antiquated were the methods for capturing the engineering test results. They were barely off a paper form and although spending millions on research, they were capturing test results in Word documents! He proposed an idea to develop Automatic Test Markup Language (ATML) to help automate the configuration of tests to automatically capture the results. I was interested and had him propose it to Allison Wolff, the IT Labs Program Manager. Allison and I recognized the value to the customer community, and the project was funded. Engineering was surprised, and it got their attention. The project received additional funds from them. Out of that Phase 1 project, Chatwin Lansdowne and Engineering Management published papers and presented at Institute of Electrical and Electronics Engineers (IEEE). The IEEE was so impressed they created a new standards group around ATML and Mr. Lansdowne was appointed to lead it. Allison also funded a Phase 2 project the following year. Ultimately, without IT Labs, none of it would have happened!

IT Labs Success
Jon Welch,
FY13 Project Lead
Project: Persistent Telepresence Portal (PTP) Network

The most helpful support that the IT Labs program provided for the PTP project was endorsement and visibility. Being able to describe the PTP project as a ‘NASA IT Labs supported effort’ was instrumental in getting approval for the installation of the required network connections, videoconferencing equipment, and authorization to use the N232 lobby, and the endorsement of IT Labs as an official agency-wide program gave the PTP project’s ‘local support team’ (Ray Gilstrap, Krisstina Wilmoth, and Estelle Dodson) a vehicle for providing their time and resources.

The funding was also quite important, as that enabled us to do the required research for the technical aspects of the project, coordinate the project activities, and purchase the equipment needed for the proof-of-concept installation.

Finally, I think that offering ‘participation in a NASA IT Labs supported initiative’ will be helpful as we recruit new sites into our network: we have been contacted by several NASA groups that have interest in creating their own portals, and they will need to get management buy-in to proceed with implementation.

Zachary Burkland,
FY13 Project Lead / Contracting Officer
Project: Paperless Contracting Initiative (PCI)

IT Labs helped the PCI gain NASA wide visibility and credibility by legitimizing the grass roots effort as an official project with a budget, a timeline for deliverables, and by providing Agency-wide publicity and recognition. As soon as the announcement went out that described the project, the team reported getting phone calls from interested parties inquiring about the initiative and asking about how they could get involved in the movement. The credibility that IT Labs lent to the PCI allowed for discussions with the highest levels of NASA leadership who have the authority and influence to make this an Agency-wide initiative. IT Labs has also provided an invaluable opportunity to publicize the successes of the project and encourage others to take on similar efforts. As of now, over 1,000 electronic contract files have been created. This has prevented tens of thousands of pieces of paper from being wasted, which has in turn reduced transaction costs and cycle time. The Agency will reap the benefits of the PCI’s accomplishments for decades to come.
IT Labs aims to align with NASA IT strategic goals while maintaining a diverse and balanced portfolio of projects that includes a mix of near-term and long-term solutions spanning multiple phases of development and IT focus areas while engaging and uniting a geographically distributed workforce. Below are matrices and graphs displaying this data for ease of review. Applications were submitted from nearly every Field Center for the FY 2014 Project Call.

**Phase Distribution for IT Labs Funded Projects**
**IT Theme Distribution for FY 2013 IT Labs Funded Projects**

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Access Management</th>
<th>Big Data</th>
<th>Cloud Computing</th>
<th>Collaboration</th>
<th>Cyber Security</th>
<th>Data Center Consolidation</th>
<th>Data Visualization</th>
<th>End User Experience</th>
<th>Enterprise Applications</th>
<th>Gaming &amp; Tech</th>
<th>Green IT</th>
<th>Information Management</th>
<th>Interoperability</th>
<th>IT Security</th>
<th>Knowledge Management</th>
<th>Mission IT</th>
<th>Mobility</th>
<th>Networks</th>
<th>Search</th>
<th>Simulation and Modeling</th>
<th>Social Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Level Cyber Security for NASA Public Web Sites and Servers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applying Big Data Analysis Tools and Techniques using Cloud Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automating the Reporting and Releasing of Technologies (ARRT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paperless Contracting Initiative (PCI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent Telepresence Portal (PTP) Network</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIV Derived Credential for Strong Mobile Application Authentication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SysAdmin.nasa.gov (SNG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video Conference (V-Concierge)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration Search Portal / NASA Enterprise Search</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency Federated Code Sharing Library</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Relevant themes were selected based upon the 2011 NASA IRM Strategic Plan and help illustrate the diversity of the IT Labs portfolio. Choosing themes for each project also facilitates identification of potential collaborations inside and external to NASA.
Funding Distribution by Center for IT Labs Funded Projects

IT Labs strives to maintain a rich and diverse portfolio. In addition to having a variety of technical solutions in our portfolio, we also encourage and appreciate the geographic and cultural diversity of each NASA center, and consider multi-Center participation a key program success indicator. The graph above shows the funding distribution per Center.
**IRM Strategic Goal Distribution for FY 2013 IT Labs Funded Projects**

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Goal 1</th>
<th>Goal 2</th>
<th>Goal 3</th>
<th>Goal 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Application Level Cyber Security for NASA Public</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Web Sites and Servers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applying Big Data Analysis Tools and Techniques</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using Cloud Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automating the Reporting and Releasing of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technologies (ARRT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paperless Contracting Initiative (PCI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent Telepresence Portal (PTP) Network</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIV Derived Credential for Strong Mobile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application Authentication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SysAdmin.nasa.gov (SNG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video Conference (V-Concierge)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration Search Portal / NASA Enterprise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency Federated Code Sharing Library</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NASA's IRM Strategic Plan from June 2011 identifies the four IT goals and their underlying strategic objectives to be accomplished over the following three to five years in support of advancing our Agency’s mission and vision. Together, these goals define a common future ideal, such as providing affordable IT and enhanced IT security for our IT workforce to collaboratively focus on accomplishing the IT strategy – within the constraints of the forecasted IT budget environment.

Each of the IT Labs projects meets one or more of these goals as illustrated in the matrix above and indicated in the header of each project summary. Refer to the full list of strategic goals in the Appendix of this document or navigate your browser to the website [http://www.nasa.gov/offices/ocio/IRM_Plan.html](http://www.nasa.gov/offices/ocio/IRM_Plan.html) for the entire 2011 NASA IRM Strategic Plan.
Recent Projects

Detailed in the following pages are projects funded by IT Labs in the FY 2013 project cycle. Each project is described by the project leads or champions regarding the successes and lessons learned. The projects denote the engaged NASA Field Centers, project champions, leads, teams, applicable IT Labs process phases, relevant themes, and 2011 NASA IRM Strategic Goals and Objectives.
NASA's Life Sciences Data Archive (LSDA) is an active archive that provides information and data from 1961 (Mercury Project) through current flight and flight analog studies (International Space Station, Shuttle, bed rest studies, etc.) involving human, plant, and animal subjects. Much of the information and data we manage is hosted on a public-facing website hosted at Johnson Space Center (JSC). With this comes the daunting task of maintaining security from the tenacious hacking community. JSC’s Information Resources Directorate (IRD) has infrastructure in place to detect threats at the firewall, network, and systems levels. Our LSDA team has developed Cyber Threat Detector, an application-level threat detection software specific to Windows-based web servers. We have been using it as a cyber-threat detection software application to monitor suspicious web activities on our lsda.jsc.nasa.gov site. On November 22nd, 2011, LSDA's Cyber Threat Detector software detected an attack on our public website. This early notification allowed LSDA personnel to neutralize the security threat long before the JSC security team notified us of the event. IRD was very impressed and requested a copy of the software to implement on other web applications. Lynn Buquo, the Human Health & Performance (HH&P) Directorate Information Architecture Lead, highlighted the Cyber Threat Detector software at the December 2011 Space Life Science Directorate (SLSD) (now known as the HH&P Directorate) All-Hands Meeting as a best practice.

Over the years, our team has systematically monitored and evaluated these attempts to breach the security of our public system, noting trends and methods used to gain access to LSDA systems. This knowledge led to our development of this software, which has been invaluable to the LSDA project and NASA as a whole.

This software, currently deployed in our LSDA infrastructure, was significantly updated in February 2013. Our team proposed conducting a Feasibility Assessment (FA) to determine if the software could be deployed across other websites in the NASA community.

After discussions with NASA IT personnel, commercial solutions were identified that might meet the same needs instead of the custom solution. The project was redirected to focus on software requirements and perform a market survey. The LSDA project will likely adopt a commercial solution as it will provide protection at a cheaper overall cost and provide higher functionality.

A key recommendation from our work is that NASA information technology security should provide a valuable service to the NASA community by maintaining a list of web application firewall solutions that work well with NASA network infrastructure and negotiated volume licensing agreements as these commercial solutions can meet the community's needs at lower costs than custom solutions. The next phase of this project could engage with a larger group of application owners, generate further requirements, conduct a more complete market survey with NASA IT infrastructure practices taken into account, and identify leading solution(s).

Software Requirements

1. Detect and protect against the following:
   a. SQL injection
   b. Cross Site Scripting
   c. Denial of Service (DoS)
   d. Malicious Code Entry
   e. Suspicious IP addresses
2. Provide automatic update to web application firewall security rule on a daily/weekly/monthly basis
3. Allow user to create security rules and distribute to other users or to central node
4. Minimize false positive in the report results
5. Provide an intuitive user interface
6. Provide alerting services
7. Provide log analysis tools
8. Export log information in multiple formats to generate report (e.g., .csv, .xml, .html, .docx)
9. Protect multiple servers
Applying Big Data Analysis Tools and Techniques using Cloud Infrastructure

Project Lead: Joshua Krage
Project Team: Jasaun Neff, Lucas Yamanishi, David Obler, Thomas Gaeng, Michael Greason, R. Tom Northcutt
Project Champion: Jaya Bajpayee
Center: GSFC
IRM Strategic Goals: 1.2, 1.5
Phase: Proof-of-Concept
Themes: Big Data, Cloud Computing

All network connected devices from the servers in the data centers to the desktops and laptops, printers, and even bring your own device (BYOD) generate a continual stream of log data. This data streams with great velocity, volume, and variety. Ultimately, this data is distributed across many organizations. This scattershot approach makes it impossible to examine the logs in aggregate; thus, log analysis techniques are not consistently applied across NASA. Splunk is one commercial tool well suited to the job, but the cost of Splunk rises as a function of the volume of data that it is pointed to. We sought to:

- Employ big data backends like Storm, MongoDB, and SciDB to collect and consolidate log data
- Select a suite of open source tools such as Graylog, Logstash, and Cubrid for log analysis
- Leverage the infrastructure as a service in the Code 700 trailer

The primary purpose of the project is to determine whether big-data oriented solutions can address the challenge of collecting, aggregating, and analyzing system log data effectively (as compared to current practices). This in turn will increase NASA’s experience with big data systems, application to a targeted solution (system log data), and offer alternatives for future investments in these areas. Aggregation of data in correlatable form has the opportunity to better inform decision-making around system use and performance. Aggregated data enables security analysis to become more proactive, by identifying ongoing activity in sufficient time to mitigate identified threats. Easy access to correlated information enables system administrators (SAs) to spend less time searching for essential troubleshooting information, and more effective time managing their systems. The results of this project provided a path to alternatives in the log aggregation and analysis areas. Ideally, the capabilities demonstrated will become an internal service. The service would provide groups a cost-effective way to store and analyze their log data. In addition, this will enable system performance analysis and trending to be performed across a larger scale, leading to potential future efficiency gains. The NASA Security Operations Center can leverage these capabilities to further inform and protect NASA’s IT infrastructure. Ultimately, we improve the efficiency of our systems management teams by enabling them to focus more time on supporting mission activities.
The team set out to implement a proof-of-concept log management and analysis environment out of open source components, and after some experimentation, decided to use Logstash for log ingestion and normalization, Elasticsearch for indexing log messages, and Graylog2 for log analysis.

In this approach, there were two main setbacks; the unavailability of log data and the unavailability of the GSFC cloud environment. The tools were not tested on log data from a variety of sources at large volumes streamed from outside the cloud environment. This was due to only one center division providing a single bulk set of fairly homogeneous system log data. The last setback was the instability of the cloud environment which resulted in loss of work and frequent network disconnects.

The open source software proved to be mature and sufficiently capable for the small-scale tests performed. Improvements on the current configuration and testing with larger volumes could lead to a production-ready solution.
The acquisition, development, and maintenance of new technology is critical to NASA's success. Civil servants and contractors across NASA report newly developed and re-engineered software systems and technologies via NASA's form NF-1679, which is then released through the Software Release (SWR) process as defined by NASA Procedural Requirements 2210.1C. The SWR process is an effective solution, ensuring that NASA remains aware of its software assets and continually searches for opportunities to benefit agency and society. However, the SWR program is limited in that it does not provide an effective infrastructure to support the day-to-day needs of project managers, software developers, and testers on NASA missions.

This effort initially aimed to utilize and expand upon the existing SWR system to provide a more effective means for NASA employees to search and attain software technologies that may benefit their individual projects and/or missions. This capability would provide a means to increase software reusability and help ensure software technologies from previous efforts are evaluated and considered in support of new projects and/or missions. The primary objective was to mature and identify recommendations to automate the SWR processes and system to provide a means for NASA employees to search for and identify previously developed and
available software technologies, thereby reducing the level of effort to report and release software products developed by NASA innovators.

The team had an interesting observation while researching and investigating this issue. There are many existing systems that house and disseminate information on NASA technologies but no system currently exists that can solve the problem.

The team gathered information via interviews with NASA Center Release Authorities and supporting systems, reviewed applicable NASA documentation, and documented a set of observations and recommendations in a final report. The team developed a proof-of-concept system based on the information gathered to highlight high-value-use cases and provide a means to solicit customer and stakeholder feedback.

Moving forward, this effort should be synchronized with on-going efforts such as the NASA Software Catalog and supporting efforts. In addition, the effort should continue to capture what is required to interface with existing systems (technical and non-technical requirements) and to define and implement another iteration of system use cases.
This was a joint proposal between the ARC and the LaRC to develop an electronic, paperless system for processing and storing NASA procurements which could be used across the Agency by every NASA procurement office. Our findings were used to help develop NASA Headquarters’ position on paperless contracting and catalyzed the creation of the Acquisition Investment Board. The board has been tasked with determining the Agency’s paperless contract strategy in response to the Managing Government Records Directive, which was due December 31, 2013. The Directive requires full implementation of a paperless system by December 31, 2019.

The near term success for this project is that the electronic system the team created is being used to create, maintain, store, route, organize, secure, and manage multiple electronic contract files. At IT Labs phase completion, over 1,000 electronic contract files have been processed.

As a direct result of the success of the PCI work in the proof-of-concept phase, the Agency is now investigating how to include all contract files including larger dollar value and complex contracts with sensitive information. Conversations are being held at the highest levels about how to best move procurement beyond the use of paper files, and through the extensive due diligence of the team, they are now more knowledgeable about the topic. Other areas to be explored once electronic contract files are implemented could include reporting tools and their capabilities for providing procurement statistics that are more subtle and specific than what is currently possible (e.g., the identification of sole source procurements, Buy American Act Determinations, etc.) and an electronic document submission system for contractors to use as opposed to providing paper submissions.
The project proposed to create a network of ‘persistent telepresence portals’ that will create virtual bridges between spaces at two or more NASA centers. These portals would be available to all NASA staff for work and social use. Each node would provide a high-resolution ‘window’ (e.g., large tiled display system or hyperwall) into the remote locations in the network, and would allow high-fidelity audio conversations between those present. The first three nodes of this telepresence network would be at ARC, JSC, and JPL: possible locations include cafeterias, reception areas, and other general access locations that have a high volume of foot traffic. The locations would all have the same degree of ‘public-ness’ to prevent confusion about the privacy of conversations.

This proof-of-concept project had the following goals:

1. Conduct research on the innovation benefits of serendipitous communications within institutions, and describe these potential benefits in the context of NASA’s organizational structure

2. Design a low-cost system for providing telepresence between at least three general access locations at NASA centers

3. Implement the proposed system

4. Collect information on system use patterns and user feedback

5. Assess the feasibility of a longer term prototype that would add NASA centers into the PTP network and extend the set of system features

These goals were in large part achieved: we have functioning portals at ARC, JSC, and JPL, and the research and user feedback collected has been published. With the application of ‘in-kind’ contributions from all participating centers, including the use of second-hand computers and displays, and the support of local staff, we were able to extend the project funds provided by IT Labs. However, there were significant challenges encountered during implementation that limited the accessibility of the portal network.

One of the requirements for the portal locations, as originally planned by the PTP project, was ‘a high foot traffic...
general access location’. This would provide good visibility for the portals, and would make users more comfortable in approaching ‘strangers’ on the other side of the portal. However, when the Ames Megabites cafeteria was proposed as a location for the ARC portal, privacy concerns were raised. It was felt by the cafeteria management that this system would be too intrusive. An alternate location was secured (building N232 lobby), but this location has a much lower volume of foot traffic, and therefore the visibility of the portal at Ames was lower than planned.

Another issue related to deploying in a high visibility area was the relative risk of system downtime. Keeping a ‘24 by 7’ videoconference running smoothly among three sites is not a simple process, especially when no staff resources are available to continuously monitor and fix the system if any problems occurred: network disconnection, videoconferencing server downtime, software patching, etc. This led to a concern among the participating centers that having a non-operational portal in a high visibility area was an unacceptable risk until a later stage of testing and readiness, and therefore the JSC and JPL portals were kept in lower visibility ‘makerspace’ locations, rather than the higher visibility cafeteria and library locations originally planned. This also limited the exposure of the portals and led to a lower than anticipated level of use.

Finally, the willingness of ‘NASA strangers’ (without an existing work or social relationship) to interact with each other through the portals was overestimated. For future portal work, perhaps a lower-level challenge should be tackled first: establishing consistent portal use among the distributed team members of a NASA project. Once that is in place, and the ‘cultural aspects’ of telepresence portals begin to take root, a more general portal capability can be explored.

For future work, the following areas are recommended:

- Recruit distributed NASA project teams that can directly benefit from the social cohesion that 24/7 portals can enable, and assist them with portal setup and participation
- Add media sharing and collaboration features to the portal network
- Install higher quality videoconferencing elements (software, microphones, speakers, and displays) to increase the sense of presence between portal users
- Install a portal connection between two or more ‘NASA Lobby’ spaces that are frequented by center visitors. This would require an adequate maintenance budget to ensure high system uptime
- Discussion and collaboration on persistent telepresence research and project between NASA, other federal agencies, and academic institutions
In today's world, a NASA user is able to access a multitude of applications via their mobile device without ever stopping to consider the security ramifications of what would happen if that device was misplaced or stolen. This is a growing concern, and one that must not only be acknowledged but also resolved. Federal policies require all moderate applications to be Level of Assurance 3 (LOA-3) compliant. The category, or rather the level of assurance, defines the Agency's degree of confidence in two areas; the vetting process of the identity and the person presenting the identity. In other words, the user accessing the application is in fact the person they claim, and they were provided this identity via a fully vetted process. With the majority of NASA's business applications falling into a LOA-3, including the extension of mobile applications, we are forced to seek new ways of meeting LOA-3 – ways which not only meet the requirements but also do not degrade the user experience.

The Center for Internal Mobile Applications (CIMA) has been working with the Identity, Credential, and Access Management (ICAM) Community to leverage existing ICAM services to meet this requirement and make it feasible to implement on a mobile device without causing the user undue aggravation. After months of collaboration and design, CIMA has prototyped the use of the NASA derived credential, which is issued based on proof of possession, control, and ownership of a valid NASA issued PIV credential. The derived credential leverages both the ICAM and CIMA services, specifically the ICAM certificate services, including the certificate lifecycle and all required authentication and authorization services and the CIMA Secure Mobile Access Point (S-MAP).
The objective of the NASA derived credential effort is to provide an enterprise solution for the implementation, utilization, and management of derived credentials for mobile services utilizing Agency approved ICAM infrastructure and services. The pilot focused on PIV-derived authentication for CIMA enabled iPhone Operating System (iOS) mobile applications.

The benefits of the NASA derived credential are:

1. More secure access to NASA services (applications/data): The NASA derived credential will allow users to access multiple NASA services, including CIMA mobile applications, on their mobile device with LOA-3 authentication.

2. No PIV card reader required for mobile devices: The NASA derived credential approach frees the user from having to carry and utilize additional components for securely accessing and utilizing NASA services on their mobile device(s) by utilizing the device as the container for the NASA derived credential.

IT Labs provided the ‘seed money’ to prototype the connection between the CIMA S-MAP and the ICAM Simple Certificate Enrollment Protocol (SCEP) service. CIMA completed the IT Labs prototype project in September 2013. CIMA was able to ‘cobble’ together sufficient funding to support the complete development of the derived credential for iOS devices and to begin the iOS pilot deployment and testing.

The pilot will be done in phases with the initial phase beginning in the late April 2014 timeframe (once the development effort is complete). The iOS pilot will begin with a small group of users and the number of users will be expanded in each subsequent phase.

The iOS pilot is planned to be completed by the end of August 2014 with production deployment tentatively targeted for September 2014. With the implementation and expansion of derived credentials to additional use cases beyond just iOS devices, the Agency can realize multiple benefits including a secure authentication for mobile services, the ability to encrypt and sign email on mobile devices, provide a consolidated strong authentication solution for the Agency’s Virtual Private Network (VPN) needs, as well as providing the ability to securely extend authentication for network services including traditional and mobile devices (e.g., 802.1X authentication).
In the day-to-day operations of SAs maintaining diverse and dependent systems, the expanding base of technology, and keeping production systems available and secure, there are a plethora of methods and solutions developed concerning information systems which are committed to memory, and various local file repositories or local ticket systems. The limited contact within the system administration community creates the situation where this information is either ‘stove piped,’ passed down from senior SAs to junior SAs, shared among known colleagues, or lost through attrition. This means that many administrators are addressing the same or similar issues, repeating work, and as a community, hemorrhaging knowledge.

This proposal is a grassroots endeavor developed by a large team of SAs and IT security professionals around the Agency, for the internal hosting of a community-supported centralized set of services. These services will be made available to all NASA personnel. The community develops and organizes information and provides it to all administrators, enhancing cross-Agency communications and improving operations.

The site uses the open-source Trac system to provide several major services: blogs, documentation wiki, issue tracking, and code repository management. The features are integrated and allow easy linking of relevant information across the system. The blogging area allows current issues to be discussed and posted. The wiki creates a common body of knowledge which can be used by anyone to post tips, tricks-of-the-trade, and links to other information. The code repository uses subversion, which hosts tools developed and used by NASA administrators. Issue tracking is used to allow site and tool managers a unified way to organize issues, defects, or enhancements to their toolset. Service access and authorization uses NASA central authorization services. A volunteer team of SAs from across the Agency, with members from both system administration and IT security, provide oversight and organization of content.

Site content may be created, edited, and reviewed by all users. Wiki page changes are sent to the original author and there is also a comment/rating system available to provide feedback. Tools are provided a home for documentation and use. Tools are developed, managed, and made available through software repositories. Tool management can be simple or complex (including enhancement and issue tracking, etc.) Team members solicit and create blog entries, publish tools, organize information, and provide feedback to authors.
Through implementation of this site, we have found several challenges. Users enjoy having Center specific, as well as Agency wide, information repositories; however, center-specific sites atrophy quickly and need sponsors. Contributors can be hesitant to expose their work but the work that has been contributed to date has been of high quality. The site has received very favorable feedback on concept and implementation. Promotion and content creation is a time-consuming process that requires direct resource allocation; however, there is a direct correlation between promotion and usage.

Using the vision of IT Labs, sysadmin.nasa.gov (SNG) has proven its capability. The site has been established and has growing use by SAs and IT Security for collaboration and communication. Combined with the chat and mailing list, SNG is fostering a sense of community between administrators and security associates across disciplines, branches, contracts, and centers. Individuals and groups are beginning to use the facilities to store documentation, code, and other information in support of their local services.

This project has integrated the OpsSchool training system directly into the site, providing community best-practices and stronger training for junior and senior SAs. With the additional IT Labs funding, the independent survey of the effectiveness of the site was successfully completed. This initiative was worked in collaboration with Utah State University.

The survey had several key determinations:

- Messaging and support from management and supervisors about the use of SNG reinforces the importance of organizational rewards that come from SNG use
- While feeling time pressure from the overall work environment reduces the use of SNG, SAs are still willing to spend the time to share their knowledge with the system
- Personal satisfaction with sharing knowledge contributes to the use of SNG, so messaging about the importance and use of SNG as a key aspect of being a SA at NASA will increase SNG use
- SAs perceive efficiency and effectiveness gains from SNG use
- Colleagues are seen as a complementary knowledge source, and not a competing knowledge source, to SNG

SNG is ready to migrate to a Production Service. There is already a strong community that is awaiting this service. With promotion by NASA Management, NASA can improve the culture of system administration to meet goals and increase content submission. The project also identified the following areas of improvement should the project be moved to production:

- Direct integration with the common code repository being investigated
- Expansion of search capability to target resources around the agency
- Direct integration of other relevant agency ‘blogs’
- Centralized OpenSource repository mirror(s) to lighten the load of NASA Integrated Services Network (NISN)
- Better reporting of system use and tracking (by center, group, etc.)
NASA has made many investments in its teleconferencing and videoconferencing capabilities; however, for a variety of reasons, NASA’s videoconferencing capabilities are underutilized, especially by the cross-Agency program and project personnel that videoconferencing was designed to enable. With the current budget pressures on travel, videoconferencing at NASA has never been more critical.

The initial proof-of-concept phase began with the idea that NASA may be missing just two ingredients to fully exploit the videoconferencing infrastructure: a ‘bridge’ for the variety of devices and facilities available to NASA personnel and case-specific instructions that enable a broad cross-section of NASA personnel to easily set up videoconferences. This multi-phase proof-of-concept/prototype provided the analysis that supports a way forward for greater utilization of videoconferencing by NASA programs and projects.

The initial phase provided an analysis of the variety of conferencing capabilities currently available and under evaluation. The resultant white paper provides functional architecture inputs that facilitate the NASA ‘as-is’ architecture and assist in the ‘to-be’ architecture for conferencing and collaboration. Integral to this initial phase is an evaluation of ‘integrators’, including the variety of software or hardware based multi-point conferencing units (MCUs) available, and how they match up to the requirements and use cases that are representative of NASA videoconferencing needs. Supporting the analysis is a model or mockup of a v-concierge, the future online wizard for identifying the type of videoconferencing the user requires, recommending the instructions/best practice for planning and setting up the videoconference.

Conceptually, video conference concierge provides an exciting opportunity to explore two emerging technologies that have the potential to radically enable how NASA engages IT services and other centers. Further, it builds on existing NASA services (Video Teleconferencing (ViTS)) and emerging NASA capabilities (Desktop Video), to provide a satisfying end-to-end experience for multiple types of users at NASA.

IT Labs funded the next phase of this project to build a prototype which entailed designing the user interface using METRO design language and integrating the back end with the service providers. This included an opportunity to work with the various IT providers at NASA (ViTS, Agency Consolidated End-User Services (ACES), Desktop Video) and help further enable their services. It also further explored operational and maintainability issues, including IT security, bandwidth requirements, reliability, and certain unknowns in providing this new concept for engaging users in provisioning IT services.

The prototype can be found here: [http://videoconcierge.jpl.nasa.gov/](http://videoconcierge.jpl.nasa.gov/)
Wolfram Alpha is an engine for computing answers and providing knowledge. It works by using its vast store of expert-level knowledge and algorithms to automatically answer questions, do analysis, and generate reports. Shortly after Stephen Wolfram discussed the capabilities of Wolfram Alpha with JSC, we embarked on a project to investigate the feasibility of integrating the computational search information into the JSC and Agency Search experience.

**Work:**
The first phase of the project used the public Wolfram Alpha application program interface (API) to bring basic query functionality into the search interface. This phase was successfully accomplished.

The interface would attempt to find a computational result, and, if found, would load asynchronously to the top of the search results. If more than one result ‘module’ was available, the additional ones would be available from a ‘load more’ link.

**Lessons Learned:**
Once deployed, we found that sometimes NASA subject matter, while represented, was not the preferred interpretation of some elements – a good example of this was a query we performed looking for information on NASA’s prototype planetary lander, the Morpheus project. We intended to be able to receive information about the project itself, but the query instead returned information on the character “Morpheus” from the movie “The Matrix”.

We also learned several lessons about result prioritization and user interface (UI) space management – with a full complement of ‘enhanced’ search features.

**Future Work:**
The next phase of the project was to bring the proof-of-concept into a pilot phase. This would include adding the new components to the search interface, and implementing whitelisting and blacklisting to steer the results from Wolfram Alpha toward NASA centric interpretations of search queries.

Provided the pilot was successful and well received, we would then investigate the use of either a site account for Wolfram Alpha or possibly obtaining an on premise Alpha appliance so that custom, secure data could be used.
In early 2012, the Agency-wide Autonomous Rendezvous and Docking (AR&D) Community of Practice released a white paper, signed by eight centers and the NASA Engineering and Safety Center (NESC), detailing the number one strategic initiative, by far, that the Agency can take is AR&D. That initiative includes designing a user-friendly software and hardware ‘warehouse’ that enables future projects to re-use AR&D software where it makes sense, and also enables supply-chain hardware development of AR&D sensors, and the resulting safety, reliability, cost, and schedule benefits of both.

Per AR&D Community estimates, such a warehouse can save the Agency up to 60 million dollars and 2 years development time, per vehicle that requires AR&D, which encompasses nearly all foreseeable NASA exploration missions. This concept has been endorsed by the Agency's Flight Sciences Steering Committee, the Agency Chief Engineer, the Guidance, Navigation, and Control (GN&C) Technical Discipline Team, and the NESC Review Board. Also, the Office of Chief Technologist (OCT) has incorporated most of the aforementioned white paper into its roadmap for AR&D.
Currently, there are various code repositories across NASA with limited opportunities for collaboration and reuse. There is also an inability to implement or enforce standards at project and community levels. Additionally, software reporting and release processes are confusing and tedious. This project completed the following in a previous project cycle: requirements gathering, tools analysis, trade studies, identifying stakeholders, and an initial lab prototype based on open source GitLabs software.

IT Labs is proud to report that this project received follow on funding and has transitioned to the OCIO Open Innovation team. They are now maintaining and managing this work as part of the public code repository at [http://code.nasa.gov](http://code.nasa.gov). The team deployed the GitLabs prototype into the Integrated Power Avionics and Software (iPAS) Lab, and a Warehouse prototype was built and demonstrated to AR&D in anticipation of additional funding. Should additional funding be awarded, the team has identified the following two forward options:

1. A hosted service for NASA employees to share software configuration management

or

2. A federated software versioning application
With the successful run of projects that IT Labs experienced previously, the program sent out another call this year to solicit proposals for ideas and proofs-of-concept.

Approximately forty (40) proposals were submitted from nearly every Center across NASA. The following pages detail the awarded projects and a synopsis of what each project intends to accomplish in FY 2014.
Many science projects in the future will be accomplished through collaboration among two or more NASA centers along with, potentially, external scientists. Science teams will be composed of more geographically dispersed individuals and groups; however, the current computing environment does not make this easy and seamless.

Center resources are ‘stove-piped’, currently shared in a limited and conventional way and the remote user must access them via VPN; this presents usability, latency, and bandwidth issues. Users often find when they are remote from resources, support and troubleshooting are hard to obtain. Experience indicates that many tools available for local collaboration do not work or perform poorly via VPN.

Many data reduction or analysis processes involve multiple steps in which co-located users examine each other’s work, make suggestions, and contribute code and ideas; for example, it is not uncommon for two individuals to agree on a computation, watch the processing and look at the output together when they are in the same office or down the hall. However, remotely, the logistics of this is quite burdensome, often requiring file transfer, configuration control, etc.

Remote collaboration through telecoms and WebEx is a step towards breaking down these barriers to sharing of ideas, data and to the process of developing and discussing results effectively, but the sharing of processing, code and intermediate data would greatly enhance the intimacy and effectiveness of these collaborations.

JPL has led the way in conducting collaborative science on planetary missions, such as Curiosity and Lunar Reconnaissance Orbiter (LRO) using Cloud Computing on Amazon Web Services. Their experience has provided considerable lessons learned for others in the science community. The science communities at LaRC and JPL are interested in more extensive collaboration, but the difficulties in sharing data which has not yet been released but should be shared among multi-site science teams prevents this from happening smoothly. Experience indicates that remote users must put a lot of energy into the logistics of the collaboration with the team local to the data.

The team will investigate if a shared computational resource will reduce burdens, enhance team experience in working together, and result in moving a project forward more quickly.
Mobile BYOD VDI Implementation in the Cloud
(VDI vs. DaaS)

Project Lead: Richard Schneider
Project Champion: Keith Keller, James McClellan, John Sprague
Center: GSFC
IRM Strategic Goals: 1.1, 1.3, 3.3

Phase: Proof-of-Concept
Themes: Cloud Computing, End User Experience, Mobility

The office environment is changing. The government workforce is no longer tied to a specific desk or office. Emergencies (e.g., weather related), teleworking and government hoteling initiatives mean that government employees are in need of access to a secure, robust network anytime, anywhere, with any device. From remote offices to the home office, there is an ever-increasing demand of wireless network access through mobile devices and laptops. Additionally, an increasing number of employees prefer to use their personal devices for work, versus carrying multiple devices for both work and personal use. NASA also has a need to efficiently support summer intern students and collaborators outside the Agency. Many of these individuals use their own equipment to connect with the network resulting in a BYOD environment, which has associated security issues.

Whether on a laptop, iPhone, Android, Windows Mobile or the latest platform to emerge, embracing BYOD means users can use their personal devices to check calendars, access notes, and send and receive email securely without exposing the enterprise to additional risk. When the user requires access to legacy applications, they simply log into their Virtual Desktop Implementation (VDI) desktop from their device. Important data stays in the Center, but end users have the flexibility of accessing line-of-business applications and securely collaborating while on the go.

However, as many enterprises have experienced, in-house VDI implementation requires considerable hardware and software to buy, install, manage, and operate. As a result, VDI has lost some of its appeal over the years. However, the evolution of Mobile BYOD and the increased desire to eliminate end-point data storage have brought VDI to the forefront once again.

Public cloud services offering Desktop as a Service (DaaS) specifically addressing VDI have further spurred the VDI revival. Moving the VDI infrastructure of the cloud provides a large reduction in enterprise capital expenditures and an increase in resource elasticity and projected lower cost. Thus, the cloud brokerage model emerges.

This effort will investigate the advantages of cloud DaaS over an on-premise VDI for the implementation of a Mobile BYOD, and will employ a cloud broker over dealing with the cloud provider directly in the cloud selection and life cycle operations/reporting of the selected cloud DaaS service.

Selecting the proper DaaS cloud vendor that is Federal Risk and Authorization Management Program (FEDRAMP) certified and especially tailored for government use and security will facilitate the removal of many of the acquisition capital expenditures, installation, maintenance, and operational problems associated with a VDI infrastructure.

Cloud selection and setup requires a significant effort which cloud brokerage services can mitigate. The proper cloud broker can bridge functions between the customer agency and the cloud vendor and can manage the procurement, use, performance, and delivery of cloud services, and negotiate relationships between the cloud provider and the cloud consumer thereby creating both cost and executional efficiencies.
Recently high performance computing (HPC) has been extended to include hardware accelerators into the full range of architectures, from leadership class machines (e.g., Oak Ridge National Laboratory Titan), to large scale clusters, to specialized desktops. These specialized desktops offer innovative opportunities of infusing HPC resources – hardware accelerators that can perform computations in a massively parallel manner directly on the chip – to address portable scientific problems. Two main contexts for execution of these highly parallel architectures have emerged, Graphics Processing Units (GPUs) and Intel’s Many Integrated Core (MIC). Both of these seek to provide teraflop performance from a desktop computer. This is advantageous to NASA for several reasons including power consumption, applications where access to a large cluster or cloud computer is not possible (i.e., Flight Conditions) and instrumentation measurement science where uploading hundreds of gigabytes of collected data per test is prohibitive.

We seek to gain knowledge in several areas of computation performance including, but not limited to, Signal Processing, Image Processing, Fourier Transforms, and Statistics. In addition, we would also like to explore how these two processors might interact with each other to perform efficient computation in both a desktop and small cluster context. Several applications and programs could take immediate advantage of progress in the integration of these processors including, but not limited to, Finite Element Modeling (FEM), Finite Difference Modeling (FDM) and Real-time flow visualization using Background Oriented Schlieren. We hope to make progress in implementing the GPU or Phi into one of these areas.
The CBHT is a toolkit that will enable front-end, user-experience designers, content publishers, and application developers to build mobile and web applications in HTML5. When prototyping web applications with the CBHT, the CBHT automatically builds a clean rendition of the HTML document of the project in the background. This will give end users the ability to stay focused on creating a visually attractive application interface and content, without sacrificing complexity. The CBHT can be an excellent tool to create ‘finished-looking’ mock-ups that empower designers to focus on user experience concepts, features, and interface objectives needed to create a great web application.

**No Coding Needed**

It is not at all necessary that the user know how to code in order to use the CBHT. We envision people of varying degrees of technical ability will be able to use the toolkit. When and if a user exports a project’s HTML5 file, it is up to the user to decide the end result. Publishers and content providers who begin development of a prototype in the CBHT can then give projects to programmers and application developers who can add more functionality, or use it as a model for other projects.

**Integrating NASA Data**

The CBHT will integrate NASA data sources from its vast array of data stores. This will unify data sources, and provide direct access for publishers to include data in their apps.

**Standardized Coding**

The CBHT will be designed to generate cross-platform code updated to industry standards and best practices by generating valid HTML5 code for mobile and web applications. The CBHT will allow users to create code that can be easily evaluated, shared, and built upon by others and will facilitate development by creating HTML5 code that works on any browser, platform, or device where the CBHT web site or web application will be deployed. Standardized code generation minimizes security vulnerabilities by providing code that can be easily examined and patched in relatively quick order.

**New Cloud Service**

Users from all NASA centers will be able to develop prototypes with an intuitive and easy-to-use service that is available from any location. Remote collaboration work can be completed with other users in the cloud, supplemented with the ability to see and interactively test actual working prototypes. Leveraging HTML5 is key, and the tool itself will be created with the idea all that is needed is a browser.
Project Lead: Kathryn Trase  
Project Team: Richard Rinehart, Tad Kollar, Herbert Schilling, Christopher Steffen, Calvin Robinson  
Project Champion: Les Farkas  
Center: GRC  
IRM Strategic Goals: 1.5, 3.3

**Phase: Proof-of-Concept**  
**Themes: Data Visualization, Mission IT, Simulation and Modeling**

The project seeks to provide system engineering (SE) and stakeholders the ability to define and generate interactive visualizations, or ‘dashboards,’ of models built in the Systems Modeling Language (SysML). This proposal will expand the Interactive Visualization Engine for SysML Tools (InVEST), which previously demonstrated the ability to create rudimentary ‘dashboards,’ to now provide the user with a tool to create custom ‘dashboards.’ The application of data visualization techniques to SysML models will help overcome the challenges to Model Based Systems Engineering adoption:

- SEs can compare visualizations of models from other projects and uncover previously hidden modeling trends. These new insights into what constitutes successful modeling will help SEs more quickly formalize modeling best practices.
- Visualizations can remove some of the SysML notation, or present it more efficiently, making it easier for stakeholders to assess and understand the system design.
- User-defined, interactive visualizations will efficiently direct users to the information they need to make decisions.

Project objectives:

- Identify at least three types of visualizations and their features that are relevant to system stakeholders and SEs.
- Develop a tool with a Graphical User Interface (GUI) that allows the user to:
  - Define the portions of the SysML model to display on the dashboard
  - Filter dashboard content based on user needs
  - Customize the presentation scheme (color, etc.)
Investigation of Wearable Technologies for NASA Applications

The consumer electronics industry is creating new technologies that could enable NASA users to participate in discovering and inventing future mission applications. Wearable Technologies, Virtual Reality, and Augmented Reality provide new forms of communication and greater levels of understanding. These technologies also act as problem solving devices enabling exploration of various options as a means of finding an answer to a problem. They will also benefit NASA and industry in the areas of training and maintenance support where hands free information and video access are highly desired.

The project will seek to identify use cases for wearable technology such as Google Glass, Pebble, and Fitbit, evaluate potential use and demonstrate this technology at NASA, and provide recommendations for future development. This project is also a collaboration of five different project proposals that were originally submitted to the FY14 IT Labs Project Call.
Human to Computer Input

Project Lead: Francisco Delgado
Project Team: Mai Lee Chang, Jason Kruska, Millard Reschke, William Little, Wyck Hebert, Phillip Michael, Kurt Leucht, Shelby Thompson, Kerry Mcguire
Project Champion: Ben Bryant, James McClellan, Chris Gerty
Center: GSFC
IRM Strategic Goals: 1.1, 1.2, 1.5, 3.3, 4.1, 4.2
Phase: Proof-of-Concept
Themes: Cloud Computing, End User Experience, Mobility

This project will conduct research into alternative Human to Computer Input Technologies that could be beneficial in NASA Applications. This research includes technology development related to augmented reality, gesture recognition, brain computer interface, and visualization technologies. Furthermore, these goals will be met through a collaboration of multiple organizations across NASA centers.

The project team has identified the following specific tasks to accomplish their goals to investigate and develop technologies related to novel computer input technologies and advanced visualization technologies:

1. Conducting research, development, and testing of a multi-Kinect system
2. Conducting research, development, testing, and integration of a cross platform gesture recognition software architecture
3. Brainwaves as computer input devices:
   a. Conducting a literature review to explore all the latest technology developments into using brainwaves as computer input devices
   b. Evaluating the feasibility of using brain-computer interface (BCI) based technology as an alternative computer input device
   c. Conducting human evaluations to assess the ease and comfort of such a system
4. Testing and demonstrating capabilities developed

This project brings together a collaborative team across the Agency to provide a critical evaluation of this technology, lay the groundwork for providing NASA with the appropriate capabilities to complement and investigate alternative Human to Computer Input Technologies for NASA Applications, and provide strategic recommendations for NASA’s future development and implementation of these technologies.
Technical Data Interoperability

Project Lead: Michael Conroy
Project Team: Steve Kennedy, David Ungar, John Ingalls, Joe Jacobs, Tony Zucco, Kjell Bengtsson
Project Champion: Ben Bryant, Paul Gill
Center: GSFC
IRM Strategic Goals: 1.1, 1.2, 1.5, 3.1, 3.2, 4.2

Phase: Proof-of-Concept
Themes: End User Experience, Interoperability

This project seeks to test a proof-of-concept of trending technical data interoperability standards used to optimize Life Cycle Cost (LCC) of vehicles, space stations, payloads, facilities, and equipment. The project will investigate emerging Integrated Product Support (IPS) standards for applicability to NASA space systems:

- Test interoperability, repurposing, format, and processing of NASA product technical data across the life cycle
- Test in relevant operational environments
- Test standards and integrations rarely used or untested
- Carry results forward to the next level for future potential projects, by testing networked integration of this setup, with the eventual goals of adding tests of additional functionality, adding more space products/systems, and adding more lifecycle phase functions for a full integration pilot

Most NASA technical data systems still function with silo tools and methods which are inefficient in themselves or are incompatible between systems or products. Long Term Archiving and Retrieval (LOTAR) strategies are either non-existent or very limited. State-of-the-art IPS interoperability is still developing in industry.

Current/past space industry systems are not designed for efficiency or interoperability between design and Operations & Support (O&S) data, across the whole life cycle, nor for commonality and interoperability between vehicles, space stations, payloads, facilities, and equipment. Until now, truly standardized interoperability was not possible. NASA has expressed a desire for industry standards.

If appropriate choices are not made soon, then incompatible data systems and inefficiently-organized data will be custom-developed and operated independently, and future needs will drive undesirable software and data conversions. The missed opportunities to fix and optimize NASA systems for existing and developing programs will cost more time and money than needed.

The project will investigate trending technical data interoperability standards for applicability to NASA space systems.

- Test Commercial Off-The-Shelf (COTS) software compatible with industry standards for capabilities for standalone and interoperability use
- Use content data from different life cycle phases of NASA vehicles, space stations, payloads, facilities, and/or equipment
- Publish potential applicability for standardization across the global space industry
NASA Space Place, the Science Mission Directorate (SMD) outreach site for school age youth, has been providing youth and their educators with cutting-edge, age appropriate information and learning activities based on SMD missions. The site reaches millions of unique users and has won numerous awards including Webby's on two separate occasion. An emerging area for outreach is the possibility created by Makerbot Academy, a non-profit initiative to put a 3D printer in every educational institution in the US. Consumer-grade 3D Scanning and Printing, such as Makerbot Digitizer and Makerbot Replicators, have created excitement among technology early adopters. JPL has been exploring its application in mechanical design, proposal modeling, and parts engineering; however, NASA could tap into the near rabid excitement of early adopters of 3D printing as a part of its public engagement and outreach. NASA could make the Makerbot Academy even more worthwhile by providing educational activities that use 3D printing of NASA spacecraft and NASA images. The activities and printable models would be shared on Thingiverse to promote public engagement as well as Science, Technology, Engineering, and Mathematics (STEM) education. This project proposes to analyze the feasibility of creating NASA-based educational curriculum using 3D printing. It would address such issues as:

- How to create miniature scale models of NASA spacecraft
- What other NASA images and assets can be transformed into printable models
- What are the limitations of intellectual property and public domain for creating models for the public?
- What are the learning opportunities that this technology could introduce that are not possible with the current approaches used by Space Place?

One of the most important challenges at NASA is to fulfill its Space Authorization Act requirements for education and outreach in an environment of budget constraints. While IT has changed the game with such novel approaches as web-based assets and social media, IT needs to compete with the offerings of industry and to constantly stay relevant as new technologies are introduced. 3D printing is one of the emerging technologies that could potentially change the way organizations interact with the public, especially outreach to youth.

3D printing and 3D scanning are new technologies that may revolutionize the way we approach design, manufacturing, and communications. One critical area that would allow NASA to fulfill a need while evaluating the potential of this new technology is to partner with Makerbot Academy and share printable models based on NASA unique discoveries. We propose extending NASA Space Place's outreach for school age youth with activities that museums and schools could 'print' and use as interactive educational games. The outreach could demonstrate such NASA discoveries as the evolution of our understanding of Saturn’s rings, the texture of Martian surfaces, models of asteroids and moon rocks, and perhaps even provide tangible spacecraft models for the visually impaired.
I have a great passion for innovation and my work with the Kinect (a motion sensing input device). I cannot express enough my gratitude in the fine effort being conducted by IT Labs. In the Usability Testing and Analysis Facility Lab in SF3, we just won a proposal called, ‘the Space Utilization Project’ valued at $300,000 from the NASA Human Research Program. It combines the technology of the Kinect and radio-frequency identification (RFID) to track and capture volumetric information that can be used as metrics for habitation. The Kinect is only a piece of a larger picture that uses several technologies; however, the idea to use the Kinect for this project was helped by my previous work and promotion of the Kinect (including two projects funded by IT Labs). The IT Labs program validated and continued my work with the Kinect, and it helped keep this innovative technology at the forefront of everyone’s mind to believe that it could produce the results needed in this proposal.

Due to the IT Labs exposure, there is interest in pitching our project to the MTConnect Challenge sponsored by the Office of the Secretary of Defense (OSD), the NASA TopCoder resource, and the Oil and Gas Exploration Space Act Agreements (SAAs). Our IT Labs project sought to produce a plug-and-play modular approach to test automation which is developing into Institute of Electrical and Electronics Engineers (IEEE) standard P1877, built on a Navy-sponsored family of international standards for automatic testing. One of the more noteworthy collaborations after our project was a Safety and Mission Assurance (S&MA) convergence of design tools with intelligent Integrated Vehicle Health Management, which has demonstrated the flow of functional models, failure, and risk information from design-phase tools to on-board diagnosis and risk-ranked crew responses. The technology is related to model-based diagnosis during testing, testing against models representing requirements, and feed-back of test results into models and technologies which would re-focus engineering workflow.
I was asked to be a presenter at the 2014 Annual Conference for the Corporation for Education Network Initiatives in California (CENIC). I was able to share the details of our IT Labs proof-of-concept project and how it was a collaboration with ARC, JSC, and JPL. I discussed the social events conducted through the network (trivia contests, seminars, ‘talk to me’ chairs), user feedback, metrics, and future plans. One of the suggestions from the audience was to put a musical instrument (piano, guitar) at each portal, and then invite passers-by to a ‘jam session’ with participants at the other portal locations, as a casual channel for interaction.
IT Labs is forever in search of new and innovative ways of evolving as a program and helping NASA in reaching its strategic goals. As such, it is constantly improving elements of the program and searching for efficient ways to acquire additional funding to garner great ideas.

**Process**

Each iteration of the IT Labs project call brings with it a review of the steps it took leading up to, conducting and completing its projects. Lessons learned are compiled and reviewed to refine the entire process. Looking forward, the process is already becoming more succinct while still adhering to the objectives the program strives to reach. Currently, IT Labs is aligning all project deliverables with NASA’s program management requirements to smooth the transition of each technology from research and development (R&D) into production as an enterprise service and decrease the time for implementation. IT Labs supported an effort to streamline NASA IT project management by mapping technical products and milestones from NPR 7120.7 to agile software development products. Potential changes to IT Labs’ process and products to match the streamlined approach were created and documented in this effort. This work will hopefully bring services to the people it is meant to serve more quickly and efficiently. It is always great to have good ideas but sometimes making them reality is even more difficult. IT Labs is working to clear the path, empower the workforce, and let the power of intrapreneurship drive change, improve morale, and inspire growth in IT.

**Website**

The program tries to stay light on paperwork, but still thrives on effective communication. With this in mind, IT Labs’ internal website ([https://labs.nasa.gov](https://labs.nasa.gov)) is always under review to make communication more effective. This past year the website and proposal application have been updated with simplicity for all the end users in mind. The application has been simplified, and the browse funded and unfunded projects search capability has been drastically restructured allowing users to find projects more easily. These pages will serve as a great place to see what work is being done or could be done and as an opportunity to find collaborations with similar ongoing work.
**IT Heroes Showcase**

The IT Heroes Showcase is a bi-monthly live presentation hosted by IT Labs where we highlight the great work that our IT Heroes (IT Labs Project Leads) have accomplished. This is a live event via Google+ Hangouts On Air where viewers can submit questions to our IT Heroes through the hangout or by email. The series started this past year with the first episode in August 2013, and as of August 2014, we have hosted six showcases ranging from a variety of topics. We also welcome IT Heroes from around NASA to join in on the conversation and have highlighted projects outside IT Labs during particular sessions, so that we can spread the word about their stellar work.

**Federating Innovation—Partnerships**

IT Labs is not the only play in NASA’s playbook. Other programs at other Centers within the Agency are also looking for ways to help NASA reach its goals, including the IT community. The program not only wants to bring awareness to these other programs (e.g., NASA Center of Excellence for Collaborative Innovation (CoECI), NASA@Work, innovate.nasa.gov at JPL, Idea Tank at MSFC, etc.), but also partner with them in the hopes that synergy will present itself and produce even more effective, innovative ways to accelerate NASA’s performance.

In closing, IT Labs is continuing the mission of fostering innovative individuals that seek to provide new technologies and capabilities to the Agency, catalyzing partnerships within and outside NASA, and forming a nexus of communication about innovations in IT. While on this path, the program will take the following steps:

- The continuation of our objectives and the development of innovative partnerships and relationships
- Improving the website for more effective communication between the program and its projects
- Further refining the IT Labs process
- Working on integrating innovations into operational capabilities and valuable Enterprise deployments
- Leveraging the knowledge of each project and input from users across the Agency

The first screenshot shows Zachary Burkland discussing his IT Labs Project, Paperless Contracting Initiative, on a live broadcast on March 20, 2014. The last screenshot is of David “Scotty” Scott recounting his journey as an IT Hero in working his project: Communications Dashboard.
By 2025, NASA seeks to return to the Moon, land on an asteroid, and be one step closer to sending humans to Mars. It’s advancements like this we plan for and execute every day. NASA and our many partners create this vision of the future and make it a reality. With such a vision, the next question is always, ‘How?’ How will we interface with the data, how will we discover the answers, how will we build the spacecraft, how will we know what to do about an asteroid headed to Earth, how will we live on Mars, and how will we make responsible use of the world’s (including our taxpayers’) resources?

For NASA, creating the future of our Agency, while knowing that the future of information technology will advance beyond our wildest dreams is a call to action for everyone in the field of computing. We hope that everyone who takes interest in NASA’s information technology advancements, both inside and outside the Agency, shares the empowering sense of opportunity and responsibility that knowing and creating the future presents itself to us every day.

IT Labs is currently exploring a number of information technology innovations that will address the opportunity of today to help shape the technology of tomorrow. Current investments in Alternative Human-Computer Inputs are paving the way for a workplace where NASA engineers can create and manipulate spacecraft models using gestures. This simple capability that entered households via the gaming industry (Microsoft Kinect®) when coupled with emerging haptic and projection technologies will provide a multi-sensory design and development experience. The IT Labs Technical Data Operability Pathfinder and SySML Visualization Engine projects will ensure this design data is organized, transferrable, and centrally displayed on an intuitive dashboard, ensuring a seamless transition across projects and systems. Furthermore, IT Labs is playing a part in taking NASA High Performance Computing to the next level. Whether leveraging a hybrid model similar to the current IT Labs Cloudbursting project or enhancing capabilities locally, like the current Supercomputing Desktop project, IT Labs will help ensure a NASA culture that seeks opportunities to advance information technology in a responsible manner that provides a progressive end-to-end experience in support of the NASA mission.
2011 NASA Information Resources Management (IRM) Strategic Goals and Objectives

The following is an excerpt of the 2011 NASA IRM Strategic Plan for reference and guidance to evaluate the IT Labs project portfolio. These goals and objectives were identified as key focal points for NASA IT as a whole and thus, guide the IT Labs program for project selection.

A complete electronic version of the 2011 NASA IRM Strategic Plan may be found at [http://www.nasa.gov/offices/ocio/IRM_Plan.html](http://www.nasa.gov/offices/ocio/IRM_Plan.html).

**Strategic Goal 1**
Transform NASA's IT infrastructure and application services to better meet evolving stakeholder needs and support mission success.

**3-5 Year Objectives**
- Ensure a positive end-to-end computing experience for stakeholders.
- Achieve efficiencies in providing IT services, e.g., Data Center Consolidation and Enterprise Service Desk (ESD).
- Empower the mobile workforce (anytime, anywhere, securely).
- Provide enterprise applications that support the Agency’s business and information needs, with new initiatives and enhancements focused on improving business & management practices.
- Enhance mission success by providing efficient and effective access to enterprise information and collaborative functionality.

**Strategic Goal 2**
Enhance and strengthen IT Security and Cyber security to ensure the integrity, availability, and confidentiality of NASA’s critical data and IT assets.

**3-5 Year Objectives**
- Improve NASA’s capability to prevent, or to quickly and effectively respond to, any potential IT security incidents and centrally manage outcomes and the Agency’s response.
- Achieve a risk-based balance between security, system operability, and the user’s experience.
- Nurture a culture of security awareness that improves the accountability of IT resources and ‘bakes’ security into IT solutions and everyday work habits.
- Achieve an integrated and adaptive enterprise security posture by increasing interoperability, visibility, and innovation across NASA’s enterprise security architecture.

**Strategic Goal 3**
Identify, test, and adopt new information technology that will make NASA’s missions more capable and affordable.

**3-5 Year Objectives**
- Develop effective architectural roadmaps for each NASA domain that reflect future mission requirements and provide an effective management tool for identifying and selecting new information technology.
- Expand partnerships with other Government Agencies and commercial partners to identify best practices in the acquisition, development, and maintenance of new IT, particularly in light of the proposed commercialization of space travel.
- Identify innovative information technologies and create active participation opportunities for NASA scientists and engineers to collaborate on missions.

**Strategic Goal 4**
Provide enterprise resources and processes that foster mission success and allow NASA to attract and retain a highly performing IT workforce.

**3-5 Year Objectives**
- Align NASA IT workforce competencies with desired competency levels, and provide career enhancing opportunities and training to all IT employees.
- Utilize innovative methods, including social media, to attract a productive IT workforce focused on efficiently achieving NASA’s IT mission.
- Develop and improve enterprise best practices for governance, shared services, capital planning, IT project management, and performance management.
- Improve two-way communications with our internal and external customers regarding the IT services we provide.