Information Technology Infrastructure Committee (ITIC)

Report to the NAC

November 29, 2012

Larry Smarr
Chair ITIC
ITIC Committee Members

Membership

 Dr. Larry Smarr (Chair), Director- California Institute of Telecommunications and Information Technology, UC San Diego
 Dr. Charles Holmes (Vice-Chair), Retired- NASA HQ Heliophysics Program
 Mr. Alan Paller, Research Director- SANS Institute
 Dr. Robert Grossman, Professor- University of Chicago
 Dr. Alexander Szalay, Professor- Johns Hopkins University

New Members

 Dr. Mark Boster; President-ImpaQ Solutions, LLC
 Hon. Mark Forman, former associate director of IT and e-government, OMB
 Mr. Joel Mambretti, Director, Intl. Center for Advanced Internet Research, NW Univ.
 Dr. Ed Lazowska, Gates Professor & Chair , Dept of Computer Science, UWash
 Dr. Pete Beckman, Dir., Exascale Technology and Computing Institute, Argonne NL
 Mr. John Muratore, former NASA engineer & Program Manager, now with Space X

 Mr. Jason Gillis (Exec Sec), Special Assist. to CIO, NASA
Welcome and Introduction to MSFC
- Patrick Scheuermann; Center Director
- Jonathan Pettus; MSFC CIO
- Sharon Cobb; SLS

Chandra Astronomy Mission
- Martin Weisskopf

SPoRT
- Gary Jedlovec

MSFC Office of the CIO
- Jonathan Pettus - Overview
- Carol Bryant - High Performance Networking
- Jane Maples – Mobile Applications

Human Space Flight Operations At MSFC
- Jay Onken
To enable new scientific discoveries, in a fiscally constrained environment, NASA must develop more productive IT infrastructure through “frugal innovation” and “agile development”

- Easy to use as “flickr”
- Elastic to demand
- Continuous improvement
- More capacity for fixed investment
- Adaptable to changing requirements of multiple missions
- Built-in security that doesn’t hinder deployment

Two Good Examples
From NAC ITIC Fact-Finding Trip to Marshall Space Flight Center

Presented to NAC March 2012
Web Services to Support Disaster Applications

**Short-term Prediction Research and Transition Center**

Need for access to data and products supporting disaster applications “anytime and from any place”

**SPoRT Web Services**

- tiled imagery for a “Google Earth” roam and zoom
- web-based applications - [tiled web service link](#)
- Android and IPhone “apps”

Tiled web service for Hurricane Sandy

[SPoRT](#) transitioning research data to the operational weather community
VIIRS DNB Detects Power Outages

City Lights – 8-31-2012
City Lights – 11-04-2012

RGB composite image indicating extent of area affected by power outage (yellow)

U.S. Army North Command uses SPoRT products to monitor power recovery
SPoRT Success Due (In Part) to Access to Advanced Information Technology

External high performance computer systems allow for model development, benchmarking, and case study analysis and frees up local resources.

Local high performance systems allow special configurations of regional models to be provided in a timely fashion to end users.

Web services support dissemination of data to a broad user community.

Cloud computing resources provide configurable assets for regular or infrequent applications.

Hyperwall capabilities allow for advanced product training and real-time disaster support.
SPoRT uses “cloud” computing resources to support ongoing and specific partnering projects.

- configurable “images” in NASA Code I Private Cloud and at Amazon
- regular execution of pre-configured weather model runs requiring unique resources - SERVIR Mesoamerica forecasts
- pre-configurations for infrequent applications in support of disaster applications - used during MSFC 10 day power outage from April 27, 2011 tornado outbreak [ASTER link](#)
SPoRT Visualization and Collaboration Lab

Lab under development, will host a large hyperwall display

- visualization for demonstrations showing scientific results
- scientific discovery through interactive analysis and display
- end user training and development workshops
- disaster response and support

Hyperwall display at NASA Center for Climate Simulation (NCCS)
A NASA-Wide Mobile Apps Project
apps.nasa.gov

apps@NASA is…
A website where NASA employees & contractors can download mobile apps that access NASA systems. These apps enable users to perform critical job functions at any time from anywhere, via Personal AND NASA mobile devices.

Jane Maples
Contact us at: msfc-cima@mail.nasa.gov
Mobile Dev Center at apps@NASA

♦ Software Library
  • Framework Libraries
  • Example applications

♦ Documentation Library
  • Getting started documents
  • Development standards
  • Technical instructions
  • Coding How-To’s

♦ Instruction Videos
  • Getting started videos

♦ Development Forums
  • Development discussions

Downloads

iOS Framework 1.0
Developer library for iOS devices. It enables apps to use CIMA hosting, monitoring and deployment solutions.

Android Framework 1.0
Developer library and an example application for Android devices. It enables apps to use CIMA hosting, monitoring and deployment solutions.

iOS Example Application
iOS application showing how to use CIMA services.

Hybrid Plugin Example Application
Hybrid plugin example application description goes here.

Hybrid Pulse Example Application
Hybrid pulse example application description goes here.

Hybrid Example Application
Hybrid example application description goes here.

Jane Maples
Contact us at: msfc-cima@mail.nasa.gov
Critical AppStore success factors

♦ Executive Sponsorship
♦ Clearly Defined AppStore Scope
  • What apps are to be hosted (internal, external, COTS, GOTS)?
  • Who are the users (govt employees, contractors, public)?
  • What are the Rules of Engagement for hosting?
♦ Coordination with IT Security and Identity, Credential, and Access Management teams
♦ Scalable Infrastructure
♦ Agile architecture to quickly support existing and emerging mobile platforms (i.e., iOS, BlackBerry, Android, MS, etc.)
♦ Marketing and Communication Strategy
♦ Dedicated team (manager, developers, customer relationship manager, graphics designer)
♦ Pilot group of mobile users for initial rollout and future enhancements

Jane Maples
Contact us at: msfc-cima@mail.nasa.gov
NASA OCIO Support for High Performance Networking

November 28, 2012 Briefing for the NASA Advisory Council (NAC) Information Technology Infrastructure Committee (ITIC)
Regional Sites:
Dual, diverse connectivity to:
• Core NASA Center and
• Carrier hotel

50 ms failover:
Fast ReRoute (FRR) vs. SONET

Core Sites:
• 4 NASA Centers
• 5 carrier hotels

GigE in dev't

10 Gbps lambda
2.5 Gbps lambda
SONET OC12 (622 Mbps)
SONET OC3 (155 Mbps)
Example: Accelerated Implementation of Requirements

LaRC ACES desktop backup data replication to MSFC NDC

- 1.8 Gbps peak
- 5 Gbps total capacity
- > 0.2 Gbps previous utilization

Provisioning of new requirement

Testing for new requirement

Original utilization
Incorporate Commercial Cloud Services

TeraGrid (XD) Open Science Grid

Microsoft Cloud UW Digital Well

Amazon EC2 Science Cloud

TeraGrid (XD) Open Science Grid

Microsoft Cloud UW Digital Well

Amazon EC2 Science Cloud

NASA Portal - Inside and Public (existing)

NASA Data Centers Public and Private clouds (existing)
Recommendation: To enable NASA to gain experience on emerging leading-edge IT technologies such as:

- Data-Intensive Cyberinfrastructure,
- 100 Gbps Networking,
- GPU Clusters, and
- Hybrid HPC Architectures,

we recommendation that NASA aggressively pursue partnerships with other Federal agencies, specifically NSF and DOE, as well as public/private opportunities. We believe joint agency program calls for end users to develop innovative applications will help keep NASA at the leading edge of capabilities and enable training of NASA staff to support NASA researchers as these technologies become mainstream.

Adopted by NAC March 2012
Partnering Opportunities with DOE: ARRA Stimulus Investment for DOE ESnet

National-Scale 100Gbps Network Backbone

Source: Presentation to DOE ESnet Policy Board
100 Gbps Consortium for Petascale Science

- NASA Goddard
- International Center for Advanced Internet Research at NW Univ.
- Mid-Atlantic Crossroads
- Laboratory for Advanced Computing at the Univ. Chicago
- Johns Hopkins University
- Naval Research Laboratory
- StarLight Communications Exchange Facility
- Metropolitan Research and Education Network

Consortium support comes from: DOE’s ESnet Advanced Network Initiative, Ciena, and Sidera Networks

Other key demonstration partners are: SCinet, NLR, Internet2, Brocade, Fujitsu, cPacket, Arista, and Force10

Update to ITIC NAC Report Aug 2012

www.nas.nasa.gov/SC12/demos/demo19.html
Evaluations/Demonstrations of 100 Gbps IPv4/IPv6 Disk-to-Disk File Transfer Performance Across LANs & WANs

An SC12 Collaborative Initiative Among NASA and Several Partners

SC12@Salt Lake City

www.nas.nasa.gov/SC12/demos/demo19.html
98.4 Gbps sustained Across the Country! Essentially 100x Large Flows on Shared COS

NASA’s High Performance Network Innovators: Bill Fink, Paul Lang, and HECN Team

High End Computer Networking (HECN) Science and Exploration Directorate, GSFC

http://science.gsfc.nasa.gov/606.1/HECN.html
While the CSO appears to be doing an amazing job managing the communications requirements and responsibilities for the agency, it may be time for them to develop the business case for acquiring dedicated fiber-optic pathways in support of current and future high data-volume traffic: e.g. interfacing to NASA's supercomputers.
The ITIC is encouraged by the multi-center collaborations involved in engineering activities to upgrade Marshall's Huntsville Operations Support Center (HOSC) and Payload Operations and Integration Center (POIC).

Not only with the traditional Human spaceflight centers such as JSC and KSC, but also engineering expertise and tools from GSFC, ARC, JPL, etc, are being incorporated into this activity.
Internet Connectivity to ISS

- IP Encapsulation expands the use of standard internet protocols to access ISS resources beyond file transfer

- **Puts user at payload experiment**

- Control Center monitors user traffic; does not allow unsecure protocols nor unauthorized access
3D HDTV Camera on ISS

♦ Joint project with Panasonic to demonstrate functionality and usefulness of all-in-one 3D HDTV camera
  • Cameras for flight and training provided at no cost by Panasonic

♦ Panasonic 3DA1 3D HDTV camera was carried to the ISS on STS-135 and returned on SpaceX-1
  • Proved all-in-one stereoscopic camera can provide useful 3D HDTV video
  • First experience with file based video workflow
  • After 19 months on orbit there were no visible pixel defects
    – Currently analyzing camera to determine actual number of dead pixels
    – Dead pixels masked by in-camera pixel correction algorithm

NASA MSFC
Mission Operations Laboratory
External HDTV Camera Project

- Recently approved by NASA International Space Station Program Manager
- Attach a HDTV camera to the side of existing ISS external analog camera housings
  - Saves having to develop a new pan & tilt system
  - Use external **wireless communication system** for camera control and video transmission

- **Minimum requirements**
  - Will include Zoom lens
  - 1280 x 720 progressive @ 60 frames-per-second
  - H.264 video encoding
  - Use commercial-off-the-shelf cameras
    - Camera selection process is underway
    - May use more than one commercial camera

NASA MSFC
Mission Operations Laboratory
Disruption Tolerant Networking (DTN)

- DTN “adapts” Internet Protocols for in-space application
  - Store-and-forward improves automation, throughput, latency
  - For LEO missions automates AOS/LOS type disruptions
  - For deep space missions, fixes the IP problems with long signal delays

- NASA has two activities – MSFC/MOL performs in both:
  - NASA DTN Project – under SCaN at NASA HQ
  - International DTN Standards – under CCSDS, SCaN/AES

- Current ISS DTN system has three nodes
  - Onboard ISS Bioserve payload
  - HOSC
  - CU-Boulder (Payload operations)

- MOL developed the HOSC DTN node to support other payloads with DTN services when they request it

- MSFC/MOL is engaging ISS to encourage more extensive deployment of DTN onboard

NASA MSFC
Mission Operations Laboratory
NASA’s Current ISS-based International DTN Flight Test and Demonstration Activities

- JAXA DTN DTRS testing (delayed by ISS-DRTS terminal failure and by NASA funding issues)
- JAXA DTN on ISS testing (on hold)
- ESA-DTN: “QuickStart-a” and “OPSCOM-1”
- Future DTN ICU gateway studies (JSC)
- Ongoing 24x7 ISS Payload operations (CU/CGBAs)
- SWRDFS file handling upgrade to CFDP and DTN (JSC)
- DTN on SPHERES (ARC, JSC)
- DTN OPS-LAN gateway: proxy for legacy ISS applications (JSC)

Key:
- Other funding
- DTN Project funding

DTN Protocol Validation

Ad-hoc testbeds

NASA MSFC
Mission Operations Laboratory
The Expressome as the “Telescope for Life Sciences”

High Content Screening: as platform for high density/high throughput life science utilization of ISS

- Transcriptome
  - mRNA transcription
- Proteome
  - Protein expression
  - Intron/exon editing
  - Protein activity control
  - Signaling
  - Phosphorolation
  - Nitrosylation
- Metabolome
  - Substrates, intermediates, & products for enzyme pathways
- Epigenome
  - Changes in DNA & histone chemistry

Transcriptome
Proteome
Metabolome
+ Epigenome
= Expressome

Human Exploration & Operations Mission Directorate:
Division Director:
D. Marshall Porterfield
geneLAB Science Campaign Platform

2. NASA develops CONOPS, performs all associated science activities, and manages payload integration.

3. ISS flight experiment operations.

4. Sample return for Omics analysis.

5. Space Bioinformatics database.

1. NRA funds Science Advisory Team to plan and oversee scientific requirements.

Human Exploration & Operations Mission Directorate
Division Director: D. Marshall Porterfield
geneLAB multi-investigator utilization
open source science innovation

Expressomics
Bioinformatics

Individual PI Flight experiments

Open innovation approach to doing science

NRA to perform ground research based on data in informatics database
Non-NRA Outside Data users
CASIS

New scientific insight and publications

geneLAB RFI release soon...

Human Exploration & Operations Mission Directorate
Division Director: D. Marshall Porterfield
There are multiple opportunities for ITIC to work with the Human Exploration and Operations Committee on IT innovations within the ISS program & the HOSC/POIC upgrades.

Topics Could Include:

- Bioinformatics Infrastructure
- Human-Robotic Information Integration
- Advanced Media Technologies
- Laser communications
- Solar System Internet
**Recommendation:** NASA should formally review the existing national data cyberinfrastructure supporting access to data repositories for NASA SMD missions. A comparison with best-of-breed practices within NASA and at other Federal agencies should be made.

We request a briefing on this review to a joint meeting of the NAC IT Infrastructure, Science, and Education committees within one year of this recommendation. The briefing should contain recommendations for a NASA data-intensive cyberinfrastructure to support science discovery by both mission teams, remote researchers, and for education and public outreach appropriate to the growth driven by current and future SMD missions.

* To be completed after a joint meeting of ITIC, Science, and Education Committees in July 2012 and the final recommendation submitted to July 2012 NAC meeting