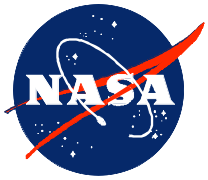


National Aeronautics and Space Administration

Volume 5, NASA Enterprise Architecture: NASA To-Be Architecture, Approach to Design and Implementation.

(Building Out the Service and Technical Reference Models)

Version # 3.0
September 7, 2004

Table of Changes

Date of Change	Section(s) Affected	Brief Description of Change	Change Made By	Organization
March 26, 2004	Initial Version	Final Version 2.2	Chief Technology Officer, Code AO	NASA Office of the CIO
July 2, 2004	Minor editorial updates, Added Table of Changes and Document Outline	Final Version 2.3	Chief Technology Officer, Code AO	NASA Office of the CIO
August 13, 2004	Revised structure and annual updated content	Draft Version 3.0	Chief Technology Officer, Code AO	NASA Office of the CIO
Sept 7, 2004	Formatting of Document, Software Engineering content	Final Version 3.0	EA Core Team, Chief Technology Officer, OCIO	NASA Office of the CIO

DOCUMENT OUTLINE

NASA Enterprise Architecture: Volume 1, Overall Architecture and Governance

- Executive Overview
- Introduction
- NASA'S Information Resource Management Strategy
- The NASA Enterprise Architecture
- "To be" Directions
- Policies and Procedures
- Appendix A: Enterprise Architecture RoadMap
- Appendix B: The Bell South Lifecycle Model

NASA Enterprise Architecture: Volume 2, Office Automation, IT Infrastructure, and Telecommunications Investment Category

- Introduction
- Center "As-is" Technical Architectures

NASA Enterprise Architecture: Volume 3, Program Unique IT and Multi-Program / Project IT Investment Category

- Introduction
- Mission IT "As-is" Architectures

NASA Enterprise Architecture: Volume 4, Structure and Strategies

- Introduction
- NASA IT Strategy, Goals and Objectives
- Enterprise Architecture Authority and Management Structure
- Structure of the NASA Enterprise Architecture
- Office Automation, IT Infrastructure, and Telecommunications (OAIT) Investment Category - Technical Summary Description
- Program Unique IT and Multi-Program / Project IT Investment Category – Technical Summary Descriptions
- Gap and Flashpoint Analysis

NASA Enterprise Architecture: Volume 5, NASA To-Be Architecture, Approach to Design and Implementation

- Introduction
- NASA Portfolio Model
- The NASA Enterprise Architecture Vision
- Current and Future State of the NASA Portfolio
- Customized NASA IT Portfolio and FEA Service Component Model
- Summary

NASA Enterprise Architecture Volume 6: Policies and Procedures

- Introduction
- Summary

Abbreviations and Acronyms

ADA	American with Disabilities Act
ACDS	Administrative Contacts Database System
ACS	Advisory Committee System
ACTS	Advisory Council Tracking System
ADM	Administrative
ADS	Art Database System
ADSC	Application Development Support Contract
ADSI	Active Directory Services Interface
AHS	Application Hosting Service
AHU	Air Handling Unit(s)
ALIS	Ames Locator Information Service
AMES or ARC	Ames Research Center
AMS	NASA Acquisition Management System
APD	Ames Policy Directive
API	Application Programming Interface
ARC	Ames Research Center
ARCLAN	Ames Research Center Local Area Network
ARRS	Agency Reimbursable Reporting System
ARS	Access Request System
ASAL	Administrative Services Address Labeling System
ATM	Asynchronous Transfer Mode
AV	Audio Visual
AWCS	Agency-Wide Coding Structure
BCP	Best Current Practices
BES	Blackberry Enterprise Server
BESS	Budget Execution Support System
BGP	Border Gateway Protocol
BNC	British Naval Connector
BPS	Budget Preparation System
BRI	Basic Rate Interface
BRIC	Knowledge Information Center-Code BR
BRT	Business and Restricted Technology
BUMS	Business Management System
CAD	Computer Aided Design
CADB	Copernicus Art Database (Test and Deploy)
Caltech	California Institute of Technology
CATS II	Corrective Action Tracking System
CATV	Cable Television
CBR	Constant Bit Rate
CBS	Chief Billing Systems
CBX	Central Branch Exchange
CCB	Configuration Control Board
CCC/Harvest	A change management tool by Platinum Technology
CCCB	Center level Configuration Control Board
CCMIS	Call Center Management Information System
CCSDS	Consultative Committee for Space Data

CCTV	Closed Circuit Television
CEE	Collaborative Engineering Environment
CEF	Central Engineering Files
CENTRX	Central Exchange
CFB-R506	Code CFB Reimbursable 506
CG	Character Generator
CI SSMM	Code CI Senior Staff Meeting Minutes
CIBS	Code CI Budget
CIFS	Common Internet File System
CIO	Chief Information Officer
CLASICS	Contact List and Special Interest Computing System
CMM	Capability Maturity Model
CMMS	Corrective Maintenance and Management System
CMOS	Complimentary Metal Oxide Semi-conductor
CMOTS	Career Management Office Tracking System
CMS	Correspondence Management System
CNE	Center Network Environment
COBRA	Cost/Obligations Budgeting Resource Allocation
Code CI - POCs	Point of Contact
Code R-POC	Code R - Point of Contact Database
CODECS	Coder Decoder
COFEDB	Centennial of Flight Event Database
CONG MAPS	Congressional Maps System
COPPA	Child Online Privacy Protection Act
COTR	Contracting Officer's Technical Representative
COTS	Commercial Off-The-Shelf
CRCS	Central Resources Control System
CRLF	Carriage Return / Line Feed
CS	Civil Service
CSDB	Customer Services DataBase
CSO	Computer Security Official
CSOC	Consolidated Space Operations Contract
CVS	A version management tool
DAR	Designated Agency Representative
DBA	Database Administrator
DBAT	Design, Build, Assemble, and Test
DCMS	Discrimination Complaints Management System
DDMS	Design Data Management System
DES	Data Encryption Standard
Designer	Toolset to model, generate and capture the requirements and design of applications
Destination Earth	What On Earth? ESE For Kids Only Game
DFMS	Direct Financial Management System
DFRC	Dryden Flight Research Center
DFRC	Dryden Flight Research Center
DHCP	Dynamic Host Configuration Protocol
DISA	Defense Information Systems Agency
DMZ	Demilitarized Zone
DN	Distinguished Name
DNS	Domain Name Systems

DNS	Domain Name Service
DoD	Department of Defense
DoS	Denial of Service
DSN	Defense Systems Network
DSN	Deep Space Network
DTA	Data Access Service
DTV	Digital Television
DV	Digital Video
DVD	Digital Video Disk
DVE	Digital Video Editor
EADS	EADS North America, Inc. PointSpan 6880 PABX switch manufacturer
EAWG	Enterprise Architecture Working Group
EBS	Emergency Broadcast System
ECAL-R	Enterprise Calendar-Code R
ECRS	Environmental Compliance and Restoration System
ECS	The Enterprise Control Server for the PABX
ECS/EMS	Event Management System
EDMS	Electronic Document Management System
EDS	Exhibits Database System
EFF	Electronic Frontier Foundation
EIA	Electronic Industries Alliance
EIA	Electronics Industry Association
ELS	Electronic Library Service
ELVCom	Expendable Launch Vehicle Compendium
EMA	E-Mail Assistant
EMACS	Extensible, customizable, self-documenting real-time display editor
EMCS	Energy Management Control System
EO	Executive Order
EOC	SSC Emergency Operations Center
ERA	Electronic Registration Application
ERASMUS	NASA Financial Dashboard
ERP	Enterprise Resource Portal
ERRMIS	Training, Awards and Travel Mgmt. Information System
ERWIN	Data Modeler , by AllFusion
e-SPACE	Electronic Strategic Planning and Consensus Engagement
ESSEX	Centrex Type arrangement directly with RBOC
ESX	Earth Science Extranet
F2MS	Freedom2Manage Survey
FAAD	Federal Assistance Award Data System
FACF	Financial and Contractual Status System, Financial
FACT	Financial and Contractual Status, Tables Maintenance System
FAS	Funds Availability System
FAST	Financial Accounting System/Teleprocessing
FASTCASH	FAST Cash Management System
Fax	Facsimile
FCACM	Full Cost Accounting Content Manager
FCA-HP	NASA Full Cost Initiative Homepage
FCC	Federal Communications Commission
FEDTAG	FEDTAG Federal Transportation Advisory Group

FHDS	Facilities Help Desk System
FIPS	Federal Information Processing Standards
FM	Frequency Modulation
FOIA	Freedom of Information
FOIA	Freedom Of Information Act Database
FOIA - 94/95	Freedom of Information Act - History Database
FORM 295	Form 295 Database
FORM 6 - CFS	Form 6 - Code CFS
FOSC	Facilities Operating Services Contractor
FPDS	Federal Procurement Data System
FQDN	Fully Qualified Domain Name
FRMT	Fairmont
FSOP	Financial Status of Programs
FSS	Facility Sustainment System
FTE	Full Time Equivalent
FTP	File Transfer Protocol
FTR/PR	Financial Transaction Report/Procurement Report
FTS	Federal Telecommunications System
FUS	Facility Utilization System
FY	Fiscal Year
GB	GigaBits
GBLT	Greenbelt
Gbps	Gigabits per second
GISS	Goddard Institute for Space Studies
GLAS	General Ledger Accounting System
GOS	Guest Operations Database System
GP	General Purpose (Desktop Seats)
GRC	Glenn Research Center at Lewis Field
GRIN	Great Images in NASA
GSA	General Services Administration
GSFC	Goddard Space Flight Center
GUI	Graphical User Interface
H.323	ITU Video Conferencing Standards (H Series)
HAMS	Headquarters Account Tracking and Management System
HATS	Headquarters Action Tracking System
HCSS	Code H Customer Satisfaction Survey
HD	High Definition
HDTV	High Definition Television
HHAD	HQ Honor Awards Database
HHTI	Home and Home Technology Information Website
HLFC	Highlight Financial Cost
HONURS	HQ ODIN New User Request System
HPSS	Headquarters Personel Security System
HQ	NASA Headquarters
HQ NEF Search	NASA Electronic Form Search
HQAEARS	Headquarters Affirmative Employment Analysis & Reporting System
HQDMS-A	Headquarters Document Management System
HQDMS-B	Code B Headquarters Document Management System
HQDMS-BWPCP	Headquarters Document Management System - Basis Web Password Change Page

HQDMS-CIC	CIC Headquarters Document Management System
HQDMS-CP	Headquarters Document Management System - Code CP
HQDMS-G	Headquarters Document Management System -Code G
HQDMS-GP / LDD	LDD Legal Documents Database
HQDMS-I	Code I Headquarters Document Management System
HQDMS-JE	HQ Document Mangement System - Code JE
HQDMS-LD	Headquarters Document Management System - Code LD
HQDMS-M	Headquarters Document Management System - Code M
HQDMS-Q	Headquarters Document Management System - Code Q
HQDMS-U	Code U Document Management System
HQDMS-ZH	ZH Headquarters Document Management System
HQDRW	Headquarters Data Reconciliation Warehouse
HQDSW-CFB	Headquarters Decision-Support Warehouse - Code CFB
HQeD	Headquarters e-Directory
HQLI	Headquarters Line Item Database
HR	House Resolution
HRTS	Human Resources Tracking System
HTTP	Hypertext Transfer Protocol
HTTPS	Secure HTTP
IADS	International Agreements Database System
IBM	International Business Machines Corporation
IBMP	Institute for BioMedical Problems
ICONS	Inventions and Contributions System
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFM	Integrated Financial Management
IFMP	Integrated Financial Management Program
IFM-UIDB	NASA HQ IFM User Information Database
IG I	nspector General
IMAP	Internet Message Access Protocol
IMAP4	Internet Message Access Protocol version 4
IMPASS	Imagery, Media, and Public Affairs Support Services
IMR	Inbound Message Relay
IP	Internet Protocol
IPSec	IP Security
IRIS	Incident Report Information System
IRS	Infocom Reader Survey
IS	Information Systems
ISAS	Institutional Services and Support (IT support contract)
ISCP	Inside Cable Plant
ISD	Information Systems Directorate
ISDN	Integrated Services Digital Network
ISO	International organization for standardization
ISO9000	ISO 9000 Project Implementation System
ISP	Internet Service Provider
IT	Information Technology
ITS	Information Technology Security
ITSM	IT Security Manager

ITSP	
ITU	International Teleconferencing Union
IV&V	NASA Independent Verification and Validation Facility
IVR	Interactive Voice Response System
IWMS	ISEM Work Management System
IXC	Interexchange Carrier Access
JAVA	Portable programming language or platform consists of pre-defined set of JAVA classes
JCSS	Code J Customer Satisfaction Survey
JDBC	Sun's database-independent SQL-level API for database connection
JENS	JSC Emergency Notification System
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
JumpStart	Automatic installation of the SUN Solaris operating systems and additional software
Kbps	Kilobits per second
KIC-A	Knowledge Information Center-Code AE (KIC-AE)
KIC-FT	Knowledge Information Center-Code FT
KIC-ISEM	Knowledge Information Center for ISEM
KIC-J	Code J Knowledge Information System
KIC-M	Knowledge Information Center-Code M
KIC-Q	Knowledge Information Center - Code Q (KIC Q)
KIC-R	Knowledge Information Center-Code R
KIC-Z	KIC-Z Knowledge Information Center CATF
Kmail	Kennedy Mail System
KSC	Kennedy Space Center
KVM	Keyboard Video Mouse
LADS	Legislative Affairs Database
LAN	Local Area Network
LARC or LaRC	Langley Research Center
LaRC TV	Langley Television
LaRCNET	Langley Local Area Network
LaRCViN	Langley Video Network
LBV	Low-Bandwidth Videoconference unit
LCD	Liquid Crystal Display
LDAP	Lightweight Directory Access Protocol
LDIF	LDAP Data Interchange Format
LESCO	Contractor Name
LIMS	Logistics Technology Automation Network
LPAR	Logical Partition
LTS	Agency-Wide Litigation Tracking System
M&O	Management and Operations
MA	Maintenance (Desktop Seats)
MAF	Michoud Assembly Facility
MAN	Metropolitan Area Network
MAPI	Messaging Application Programming Interface
MAPS	Mail Abuse Prevention System
MBPD	Master Buy Plan Database
Mbs	Megabits per second
MCU	Multipoint Control Unit
MFI	Major Facility Inventory

M-HATS	OSF Web HATS Interface
MIC	Meeting in conference
MIME	Multi-purpose Internet Mail Extensions
Minority Outreach Web Site	Minority Outreach Web Site
MIPS	Millions of Instructions Per Second
MM	Multi-mode fiber
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MPEG	Moving Pictures Experts Group
MR	Material Request
MS	Message Store
MSDS	Media Services Database System
MSFC	Marshall Space Flight Center
MSN	Mission Information
MSP	Managed Service Provider
MTA	Message Transfer Agent
MUA	Mail User Agent
MX	Mail Exchange
NACC	NASA ADP Consolidation Center
NAD	Network Active Device (Desktop Seats)
NAIS	NASA Acquisition Internet Service
NAS	Network Access Server
NASA	National Aeronautics and Space Administration
NASA HPEDIT	NASA Homepage Editor
NCC	Nasa Clearance Clearinghouse
NCCS	NASA Communications and Computing Services
NCIS	NASA Commercial Information System
NCRS	Name Check Request System
NCTN	NASA Commercial Technology Network Homepage
NDES	NASA Data Entry System
NEC	Neptune Event Calendar
NEC	Nippon Electric Corporation
NEMS	NASA Equipment Management System
NFMS	NASA Functional Management System
NIS II	Office of Inspector General Nationwide Information System II
NISN	NASA Integrated Services Network
NISSU	NASA Information Systems Services Utility
NMC	Network Monitoring Center
NOC	Network Operations Center
NOVIS	Naked-eye Orbital Visibility Information System
NPD	NASA Policy Directive
NPDMS	NASA Property Disposal Management System
NPG	NASA Procedures and Guidelines
NPMS	NASA Procurement Management System
NPPS T&A	NASA Personnel and Payroll SystemTime & Attendence
NPSS	NASA Personnel Security System
NRL	Naval Research Laboratory
NSMS	NASA Supply Management System

NTLM	NT LAN Manager (Windows NT Challenge/Response authentication)
NTP	Network Time Protocol
NTSC	National Television Standard Committee - Commission
NVSS	NASA Vendor Survey System
OAO	Orbiting Astronomical Observatory
OAT HP	Office of Aerospace Technology Website
OAT-IN	Office of Aerospace Technology Intranet
OCI	A library of standard database access and retrieval functions for C interface
Octel 300	Octel 300 Serenade voicemail system
ODBC	Open database connectivity, an API with which to access Data Sources
ODIN	Outsourcing Desktop Initiative for NASA
OFSA	Office of Safety and Facility Assurance
OMB	Office of Management Budget
OPSEC	Open Platform for Secure Enterprise Connectivity
ORACLE	Corporation with products for database, application, and development tools
ORR	Operations Readiness Review
OS	Operating System
OSCP	Outside Cable Plant
OSDBU	Office of Small and Disadvantaged Business Utilization
OSF-IN	Office of Space Flight Intranet
OSI	Open Systems Interconnection
OWEB	ODIN WEB Seat Ordering Application
PA	Public Address
PABX	EADS PointSpan 6880 Switch (Rev 2.0.Z)
PBMA	PBMA Process Based Mission Assurance
PBS	Public Broadcasting Service
PBX	Private Branch Exchange
PC	Personal Computer
PCITS	Principal Center for Information Technology Security
PCTR	Personnel Ceiling Transation Report
PDS	PDS Personnel Database System
PERL	A portable programming language mostly used in system and web services
PFSS	Parking and Fare Subsidy System
PIO	Process Imporovement Opportunity
PIP	Premium Service
PKI	Public Key Infrastructure
PLDS	Photo Library Database System
PMAS	Code R Program Management Accomplishment System
POP	Post Office Protocol
POP3	Post Office Protocol version 3
PRC	Program Review Center
PRDB	Procurement Request Database (Code U)
PRI	Primary Rate Interface
PRN	Printer (Desktop Seats)
PSLA	Project Service Level Agreement
PSRS (Web-Based)	Web-Based Program Status Review System
PTD	Propulsion Test Directorate
PUB	Public Access
QoS	Quality of Service

R!50	A nearline storage by Network Appliance
R.W.A	Registration Site Web Application
RADIUS	Remote Access Dial In User Service
RAM	Random Access Memory
RAMIS DL-MAC	RAMIS DL-MAC RAMIS Downloader - Macint
RAS	Remote Access Service
RBL	Real-time Blackhole List
RBOC	Regional Bell Operating Company
RBS-GSFC	Reimbursable Billing System-GSFC
RBS-JPL	Reimbursable Billing System-JPL (RBS-JPL)
RCM	Remote Communications Modules
RDBMS	Relational Database Management System
RDMS	Relational Database Management System
RDN	Relative Distinguished Name
RF	Radio Frequency
RFC	Request for Comment (Internet Society or IETF draft)
RIB	Code R Image Bank
RIDERS	RIDERS
RIID	Records Inventory and Information Directory
RISO BB	Code R ISO 9000 Bulletin Board
RISO DD	OAT Documents and Data
RISO OJT	OAT On-the-Job Training (OJT) Materials
RISO OWI	Code R Approved OWI's (Working Files)
RISO REP	Code R Repository
RISO TT	This 'n That
RITA	Relocation Income Tax Allowance
RMRS	Resource Management Reporting System
RPI	Real Property Inventory
RSS	Relay Spam Stopper
RTCMD	Recording Tracking Classified Material Destruction
RTIFM	Road to IFM
RWES	RSVP Web E-mail System
SA	System Administrator
SAN	Storage Area Network
SAP	Status of Approval Programs
SASL	Simple Authentication Security Level
SBAR	Speaker's Bureau Asset Repository
SBC	SBC Communications
SBDS	Speaker's Bureau Database System
SBR	Small Business Report
SD	Standard Definition
SDC	Stennis Data Center
SDTV	Standard Definition Television
SEDB	Special Event Database System
SEDSA	Schedule of Estimated Distribution of Selected Accounts
SFA	Space Flight Awareness Honoree Database
SIDD	Shuttle-Interagency Debris Database
SLI	Space Launch Initiative
SMB	Server Message Block

SMIME	Secure Multipurpose Internet Mail Extensions
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SOLAR	Site for On-line Learning and Resources
SQL	Structured Query Language
SRFR	Secure Remote File Site
SRL	SAFE AND ROOM LOCATION
SSC	Stennis Space Center
SSH	Secure Shell Protocol
SSL	Secure Socket Layer Protocol
St Dept Word Macro	St. Department Word Macro
STADS	SAP Time and Dollars System
STD	Standard
STI	Scientific and Technical Information
SUDO	A tool which allows SA to give certain user(s) to run some commands as root.
TCP	Transmission Control Protocol
TDD	Telecommunications device for the deaf
TGIR	Turning Goals Into Reality Registration
TIA	Telecommunications Industry Association
TIMS	Token Information Management System
TLC	Time and Labor Collection
TLS	Transport Layer Security
TMS	Travel Management System
TOIP	Telecommunications over Internet Protocol
TOS	Type of Service
TSU	Travel System-U
TTL	Time to Live
TTSC	Test and Technical Services Contactor
TV	Television
UBE	Unsolicited Bulk Email
UCE	Unsolicited Commercial Email
UDP	User Datagram Protocol
UIS	User Information System
UMC	Universal Modular Chassis
UMIS	University Management Information System
Unix	Unix Operating System
UPATS	Unit Price Agreement Tracking
UPS	Un-interruptible Power Source
URI	Uniform Resource Identifiers
UTNS	User Training Needs Survey
UUCP	Unix-to-Unix Copy Protocol
VAFB	Vandenberg Air Force Base
VBS	Video Bridging Services
VCR	Video Cassette Recorder
VCRS	Video Conference Request System
VDA	Virtual Private Network
VFDS	Video File Database System
VIP	Virtual IP
Visual Cafe	Development/integration tool for JAVA by Symantec

ViTS	Video Teleconferencing System
VLAN	Virtual Local Area Network
VOIP	Voice over Internet Protocol
VoTS	Voice Teleconferencing Services
VPN	Virtual Private Network
VRA	ViTS Roll-About
VRRP	Virtual Router Redundancy Protocol
VSA	Vendor Specific Attribute
VTC	Video Teleconferencing Center
VTR	Video Tape Recorder
W2K	Windows 2000
WAN	Wide Area Network
W-AO OCIO	Office of the Chief Information Officer Home Page
Web Tads – Web access Time and Attendance	
Website-AFU	Code AF Updates
Website-CIS	Code CI Services
Website-Code AE	Website-Code AE
Website-Code CI	Website-Code CI
Website-Code CP	Website-Code CP
Website-Code FP	Website-Code FP
Website-Code G	Website-Code G
Website-Code I	Website-Code I
Website-Code ID	Website-Code ID (Export Control)
Website-Code JM	Code JM/ARL Home Page
Website-Code K	Website-Code K
Website-Code RG	Website-Code RG Code RG Aerospace Website
Website-Code Z	Code Z Website
Website-CPUB	Web-Based Response to Public Queries
Website-ECP	Website -ECP-TBD
Website-FOIA	Website-FOIA
Website-OSF	Office of Space Flight Website
Website-SPB	Website-SPB Speaker's Bureau Website
Website-VITS	Website-VITS VITS Web Page
Websphere	Software platform by IBM
WFF	Wallops Flight Facility
W-HQ ITC	HQ Information Technology & Communications Division Home Page
WIMS	Workforce Information Management System
WITS	Washington Interagency Telecommunications Service
W-P NWP	Code P NASA Web Page (HQ Web Page)
WSTF	White Sands Test Facility
W-U PWS	Code U Public Website
W-UM SSC	W-UM SCC Code U&M Space Station Commercialization Web Site
WWW	World-Wide-Web
WYE	Workyear Equivalent
X.500	Directory Access Protocol (ISO/TSU-T suite of standards)
X.500 BACKSTORE	X.500 BACKSTORE
X.509	Version 3 Public-Key Certificate (ISO/TSU-T suite of standards)
XML	eXtensible Markup Language

Table of Contents

DOCUMENT OUTLINE ..... **II**

NASA ENTERPRISE ARCHITECTURE: VOLUME 1, OVERALL ARCHITECTURE AND GOVERNANCE II
NASA ENTERPRISE ARCHITECTURE: VOLUME 2, OFFICE AUTOMATION, IT INFRASTRUCTURE, AND TELECOMMUNICATIONS INVESTMENT CATEGORY II
NASA ENTERPRISE ARCHITECTURE: VOLUME 3, PROGRAM UNIQUE IT AND MULTI-PROGRAM / PROJECT IT INVESTMENT CATEGORY II
NASA ENTERPRISE ARCHITECTURE: VOLUME 4, STRUCTURE AND STRATEGIES II
NASA ENTERPRISE ARCHITECTURE: VOLUME 5, NASA TO-BE ARCHITECTURE, APPROACH TO DESIGN AND IMPLEMENTATION II
NASA ENTERPRISE ARCHITECTURE VOLUME 6: POLICIES AND PROCEDURES II

1 INTRODUCTION **18**

2 BACKGROUND **18**

2.1 NASA PORTFOLIO MODEL 18
2.1.1 Office Automation, IT infrastructure, and Telecommunications (OAIT) *18*
2.1.2 Multi-Program/Project IT *20*
2.1.3 Program Unique IT *21*

3 NASA IT PORTFOLIO AND FEA SERVICE COMPONENT MODELS **21**

4 THE NASA ENTERPRISE ARCHITECTURE VISION **23**

4.1 MEETING STRATEGIC GOALS OF AGENCY 23
4.1.1 Project Formulation Process *26*
4.1.2 Guiding Principles *30*

5 CURRENT AND FUTURE STATE OF THE NASA PORTFOLIO **34**

5.1 PROGRAM UNIQUE MISSION IT 34
5.1.1 GSFC - Hubble Space Telescope Mission Ops IT *34*
5.1.2 JSC Software Development/Integration Laboratory *35*
5.1.3 JSC Space Shuttle Program Cockpit Avionics Upgrade *36*
5.1.4 JSC Space Shuttle Program Flight Software *37*
5.1.5 JSC Space Shuttle Program Integration *38*
5.1.6 JSC Space Station Production Facility *39*
5.1.7 JSC Space Station Training Facility *40*
5.1.8 KSC Ground Operations *41*
5.1.9 KSC Integrated Logistics *41*
5.1.10 KSC Launch Control System (LCS) *42*
5.1.11 KSC Operational Television System Modernization *43*
5.1.12 KSC Shuttle Processing Support *44*
5.2 MULTI-PROGRAM/PROJECT IT 45
5.2.1 ARC Aerospace Technology Support System *45*
5.2.2 ARC High End Computing *46*
5.2.3 GSFC - Earth Observing Sys Data Info Sys *47*
5.2.4 GSFC - NASA Center for Computational Sciences *48*
5.2.5 GSFC - Space and Ground Network IT Support *49*
5.2.6 JSC Flight Operations *50*
5.2.7 JSC Integrated Planning System *51*
5.2.8 JSC Mission Control Center *51*
5.2.9 MSFC Payload Operations and Integration Center *52*
5.3 OFFICE AUTOMATION, IT INFRASTRUCTURE AND TELECOMMUNICATIONS (OAIT) 53
5.3.1 Financial Services *53*
5.3.2 Communications Services *54*
5.3.3 Computing Services *58*

5.3.4 Electronic Work Environment *62*
5.3.5 Cross-Cutting Portfolios *65*

6 CUSTOMIZED NASA IT PORTFOLIO AND FEA SERVICE COMPONENT MODELS 72

7 TRANSITION APPROACH 74

8 APPENDIX A DETAILED PROGRAM PLANS 75

8.1 NASA INTEGRATED SERVICES ENVIRONMENT INTEGRATION PROJECT (NISE) 75
8.2 NASA SECURITY PERIMETER (NSP) 85
8.3 XML 88
8.4 WIDE AREA NETWORK 92
8.5 PUBLIC WEB 96

9 APPENDIX B EXAMPLES 103

9.1 JOHNSON SPACE CENTER MISSION CONTROL CENTER (JSC MCC) 104
9.2 INTEGRATED FINANCIAL MANAGEMENT PROGRAM 105

Figure Reference

FIGURE 1, FEA SRM COMPONENTS 22
FIGURE 2, REVISED NASA PORTFOLIO SRM 74

Table Reference

TABLE 1, NASA IRM IT STRATEGIC GOALS 24

1 Introduction

This volume of the NASA Enterprise Architecture constitutes the "To-Be" sections of the NASA Enterprise Architecture. The items described in this volume constitute a candidate portfolio of new IT capabilities and upgrades to existing IT capabilities as required to meet the NASA mission. As candidate new initiatives from this portfolio are validated by studies and business cases, decisions will be made regarding their funding, specific schedules and inclusion in this or future budget submissions. This document contains the Target and transition architecture components within the FEA model. The "As-Is" descriptions are contained in Volumes 2 and 3 of the overall submission.

NASA currently has in place rather extensive documentation and processes that meets or exceeds the requirements of terrestrial systems that the FEA largely envisions.

NASA's resources expenditures are necessarily driven by mission requirements that are often unique in the Federal Government in that they are tested with every mission. NASA maintains an Agency-wide IT investment portfolio in alignment with mission and business needs, by addressing these key questions, in the order presented:

- What are the strategic objectives of the Agency?
- What information is needed to support the Agency?
- What applications are needed to supply the information?
- What technologies are needed to support the applications?

2 Background

2.1 NASA Portfolio Model

The NASA Service and Technical Architectures utilize the FEA models. Within this structure, the NASA Enterprise Architecture is structured into three major investment categories or portfolios.

2.1.1 Office Automation, IT infrastructure, and Telecommunications (OAIT)

This category includes Office Automation investments that provide general purpose computing (e.g. email, desktops, help desk services) for both civil servants and contractor personnel, regardless of the program or project supported or fund source. Nine portfolios (Voice, WAN, LAN, Video, Desktop Hardware/Software, Data Centers, Application Services, Messaging and Collaboration, and Public Web) have been defined across three major service areas (Communications, Computing, and Electronic Work Environment.)

The complete OAIT portfolio has two major components which are described in separate OMB 300 submissions, including:

- OAIT General Purpose IT Investments: NASA Office Automation, IT Infrastructure, and Telecommunication.
- OAIT Financial Management IT Investments: HQS - Integrated Financial Management Program (IFMP)

These portfolios are separate only because OMB requires separate Financial Management reporting.

The NASA Enterprise Architecture portfolio is structured to provide the framework for managing NASA IT infrastructure assets and services from an Agency perspective. The NASA Integrated Information Infrastructure Program is structured to align with the Agency's, Enterprise Architecture. The Enterprise Architecture integrates functions historically managed either as a separate Agency programs (e.g., Outsourcing Desktop Initiative for NASA (ODIN), NASA Data Center (NDC), Integrated Financial Management Program (IFMP)) or managed primarily from a Center perspective (e.g., Local Area Networks, security). The NASA Enterprise Architecture framework incorporates at its foundation a strong crosscutting security component.

The Enterprise Architecture portfolio provides an Agency perspective and management model for the investments captured in the Office Automation, IT Infrastructure, and Telecommunications portion of Exhibit 53 as submitted to Office of Management and Budget (OMB). The components that make up the investments defined in the OMB Exhibit 53 are as follows:

Communications Services
- Wide Area Network
- Local Area Network
- Voice
- Video

Computing Services
- Desktop Hardware and Software
- Application Services
- Data Centers

Electronic Work Environment
- Messaging and Collaboration
- World Wide Web

In addition, there are a set of cross-cutting portfolios that include:
- IT Security
- XML
- Software Engineering, and

- Asset Management.

For the General Purpose Infrastructure (i.e., the OAIT), the NASA Portfolio model can be thought of as the key sets of systems of applications that provide broad-based re-usable services and which provide management and investment focus. Within the General Purpose Infrastructure services, applications are classified according to the FEA Service Reference Model.

2.1.2 Multi-Program/Project IT

Multi-Program/Project IT is defined as IT infrastructure, products, and services that are not part of OAIT but do meet IT requirements that are not unique to a single program/project. These investments typically benefit multiple missions, programs or projects and "end of life" for a single project would not eliminate the need for the investment. Three major service areas and nine portfolios have also been defined for this category. The service area names are identical to those in the OAIT category, as are the portfolio names with one exception: Compute Engine Hardware/Software replaces the Desktop Hardware/Software portfolio. This is in recognition that in this investment category, computing platforms may range from science and engineering workstations to supercomputers. If the platform is used as an employee's workstation it should be reported as OAIT even though it might be used for development as well as for office automation and back office services. Compute engines, as referenced here, are intended to capture equipment in laboratories and other facilities. Examples of Multi-Program/Project IT are the Space Network, Ground Network, Flight Dynamics Facility (FDF), and NASA Center for Computational Sciences (NCCS), EOSDIS, NAS.

Many of NASA's Mission Operations require IT services that are focused on the mission requirement and are not suitable for provisioning through a General Purpose Infrastructure. In general, the service requirements include such factors as very high reliability, very high performance or unique functionality or the missions involve human life or very large operational investments requiring dedicated processing capabilities. These unique requirements notwithstanding, all such systems are included explicitly in the NASA Architecture. It must also be noted that in a number of such Mission areas, NASA is a major participant in Inter-Agency and industry working groups or task forces supporting efforts to develop standards and solutions that can be leveraged across applications and agencies where possible. In addition, efforts are made to architect Mission Systems so as to utilize common components of the OAIT infrastructure where the requirements allow.

Multi Program/Project areas are managed within the Mission Directorates responsible for the Missions. The major systems considered in the Enterprise Architecture are the same systems identified to the Office of Management and Budget in the NASA budget process. These Multi-Program IT Investments are, by Center responsible:

- ARC High End Computing
- GSFC - Earth Observing Sys Data Info Sys
- GSFC - NASA Center for Computational Sciences

- GSFC - Space and Ground Network IT Support
- JSC Flight Operations
- JSC Integrated Planning System
- JSC Mission Control Center
- MSFC Payload Operations and Integration Center

2.1.3 Program Unique IT

Program Unique IT is defined as infrastructure, products and services that are either physically embedded in a flight or test article, or exist solely to meet the requirements of a single specific program or project. These investments would typically not be needed after "end of life" of the unique program or project that generated the requirements for the investment. It is possible that equipment purchased as part of these investments could be reused. It is expected that this would be reported as part of a new investment. The portfolio structure for this category is based on the NASA theme(s) and program(s) of which these investments are a part.

Components that are excluded are those that are an integral part of some device whose principal function is not the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information are excluded from all categories. Examples are a processor in an electron microscope or a control processor in a robotic arm.

For the Multi Program/Project investments, the NASA Portfolio model can be thought of as the key sets of systems of applications that provide re-usable services across operational programs, which provide management and investment focus, and which allow for potential movement to the general purpose OAIT portfolio if or when such movement is beneficial. Within the Multi Program/Project investments, applications are classified according to the FEA Service Reference Model where appropriate. In addition, NASA has begun to identify where the current FEA service model does not sufficiently reflect mission operations functions that are more specific to NASA.

3 NASA IT Portfolio and FEA Service Component Models

The NASA IT investment portfolio components have a simple mapping to the FEA Service components, as illustrated in Figure 2.2-1. Figure 2.2-1 depicts the NASA IT Portfolio components mapped against the FEA SRM model components.

Figure 1, FEA SRM Components

The OAIT Application Services portfolio provides applications to support Customer Services, Process Automation Services, Business Management Services, Digital Asset Services, and the Business Analytical Services domains. The Integrated Financial Management systems are the primary source of support for the Back Office Services domain. The OAIT Support Services domain is included in the Computational Services (Desktop Computing and Data Centers) portfolios and the Communications Services, Electronic Work Environment Services, and Cross-Cutting services portfolios. These portfolios cover services which are either most appropriately addressed from an Agency-wide perspective or are most cost-effectively provided through a common infrastructure.

For services which are either more specialized or which have significantly higher performance, security, reliability or other requirements which would not be practical to provide ubiquitously in the infrastructure, then they are provided by the appropriate Multi Program/Project portfolio as opposed to the OAIT portfolio.

An example of such services falling in the Business Analytical Services domain (Analysis and Statistics and Visualization service types) are highly specialized or tightly integrated engineering analysis tools However, even in this instance, programs have found particular situations where the services can be provided within the OAIT portfolio. For example, at the Jet Propulsion Laboratory, one tool, the MATLAB analytical application, has actually been configured to provide service from the general IT infrastructure portfolio to mission critical functions such as analytical support for the Mars Exploration Rovers and the Stardust mission.

Another example is in the Compute Engines portfolio, which provides supercomputers and high performance clusters of processors for computationally intensive engineering and science programs. Since only a portion of the NASA activities require computationally intensive resources, it is not currently cost-effective to implement and/or fund such resources as a ubiquitous service of the OAIT infrastructure.

4 The NASA Enterprise Architecture Vision

4.1 Meeting Strategic Goals of Agency

The overarching statement of requirements is that IT must enable a mobile workforce in support of the NASA mission by enabling anywhere, anytime access to information and people. This overarching requirements statement, while providing a succinct and relevant vision, requires development into actionable requirements.

In addition, new drivers such as recommendations in the Report of the President's Commission on Implementation of United States Space Exploration Policy (The Aldrich Commission) may create other pressures to change. Three recommendations of the Aldrich Commission in particular are of key importance to IT:

- Dramatically increase private sector involvement (Recommendation 3-1),
- Change NASA Centers to the Federally Funded Research and Development Centers model (Recommendation 3-3), and
- Use a "system of systems" approach to capability architecture and implementation (Recommendation 3-5).

Jointly, these recommendations will drive NASA IT strategies toward ever more strongly embracing federated models of operation across many domains, those operations based upon open standards components and interfaces, and integration with external business partners and with other key Agencies via e-government initiatives.

The NASA Strategic Plan describes the Implementing Strategies:

- IS-1: Achieve management and institutional excellence comparable to NASA's technical excellence;
- IS-2: Demonstrate NASA leadership in the use of information technologies;
- IS-3: Enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost;
- IS-4: Ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure; and
- IS-5: Manage risk and cost to ensure success and provide the greatest value to the American public.

The Implementing Strategies are implicitly or explicitly dependent upon shared information, communications, information processing, collaboration, electronic work environment, and other IT functionalities.

The IRM Strategic Plan of September 2003 defines the NASA IT Strategic Goals, Objectives, Strategies, and Performance Measures for the Agency in support of the NASA Strategic Plan and Implementing Strategies.

These IRM strategic goals support the overall NASA Strategic Mission. The IRM Strategic Plan defines five strategic goals, each with accompanying strategic objectives:

Table 1, NASA IRM IT Strategic Goals

Goal 1: Provide an infrastructure that can evolve and adapt to emerging technologies and service models.
Objective 1.1: **Develop, communicate, and manage a consistent NASA Enterprise Architecture**
Objective 1.2: **Facilitate the deployment of Agency-wide applications**
Objective 1.3: **Enable effective and efficient integration with e-Gov initiatives**
Goal 2: Optimize investments in mission and program-unique IT systems by utilizing common infrastructure tools and services where practical.
Objective 2.1: **Create an IRM strategy aligned with program and mission needs.**
Objective 2.2: **Provide a secure and highly reliable infrastructure.**
Objective 2.3: **Provide greater knowledge management and information sharing.**
Goal 3: Provide a customer focus to the provisioning of common IT services across NASA;
Objective 3.1: **Enable NASA people to communicate across an integrated infrastructure.**
Objective 3.2: **Ensure availability of common services across all Centers.**
Objective 3.3: **Provide the tools needed to support a mobile workforce.**
Goal 4: Protect and secure the Agency's information assets.
Objective 4.1: **Correct known vulnerabilities.**
Objective 4.2: **Monitor and evaluate compliance with Agency and Federal Policies.**
Objective 4.3: **Facilitate account and password management.**
Goal 5: Maintain an Agency-wide IT investment portfolio in alignment with mission and business needs,
Objective 5.1: **Ensure investment decisions reflect optimal use of available funds**
Objective 5.2: **Integrate the CPIC process with the Agency's overall budget process**
Objective 5.3: **Manage IT investments using Agency standard program/project management practices.**

In summary the five primary IT goals are:

1. Provide an infrastructure that can evolve and adapt to emerging technologies and service models
2. Optimize investments in mission and program unique IT systems by utilizing common infrastructure tools and services where practical
3. Provide a customer focus to the provisioning of common IT services across NASA
4. Protect and secure the Agency's information assets
5. Maintain an Agency-wide IT investment portfolio in alignment with mission and business needs

The IRM plan has articulated that achieving the Agency Strategic Goals requires a skilled workforce unencumbered by physical location, enabled with the right capabilities provided by a robust toolset that can be used with consistent interoperability and supported by a strong foundation.

The skilled workforce, unencumbered by physical location will require of the IT Infrastructure anywhere, anytime access to information and people. This will be provided by tools for Virtual Teaming, Collaboration, and electronic messaging which can be used from the desktop or from mobile platforms such as laptops and PDA's.

The IT architecture will enable the workforce with the right capabilities through a robust toolset implementing device independent messaging, boundary-less access to authorized resources and collaborative tools that enable knowledge capture, sharing and re-use. The architecture will also provide an Electronic Work Environment with integrated e-mail and calendaring, e-mail storage, search, and retrieval, instant messaging, secure messaging, wireless access, file sharing, web-based conferencing, and an XML repository.

Consistent interoperability with a secure foundation will be provided by a consistent network security perimeter, with on-demand secure connections among working groups across centers and partners, a Wide Area Network with guaranteed performance, and a NASA-wide account management, cyber ID management, and Directory.

The Agency operating model now requires increased capability to work across centers, often generating requirements that, by their nature, are best met at the agency level. The global shift in how information and knowledge is generated, used and managed, when coupled with the competition for limited budgets, dictates a more strategic approach to providing information infrastructure services across NASA. In addition to the various external drivers, there are a number of NASA-specific drivers for approaching IT systems more strategically. These systems are sorted by NASA Goals:

- Goal 1 Provide an infrastructure that can evolve and adapt to emerging technologies and service models
    - Positioning the IT infrastructure to support Agency-wide applications such as Integrated Financial Management (IFM)

- Goal 2 Optimize investments in mission and program unique IT systems by utilizing common infrastructure tools and services where practical
    - OneNASA (Using IT as an integrating system and provider of common tools)
    - Providing greater knowledge management and information sharing
    - Leveraging the OAIT infrastructure where possible

- Goal 3 Provide a customer focus to the provisioning of common IT services across NASA
    - Supporting a robust collaborative program and management environment
    - Ensuring availability of integrated services across Centers

- Goal 4 Protect and secure the Agency's information assets
    - Improving security

- Goal 5 Maintain an Agency-wide IT investment portfolio in alignment with mission and business needs
    - Improving NASA's IT infrastructure to meet the NASA Vision and Strategic Plan
    - Achieving reduced cost of services to the customers (programs, projects, and General and Administrative users)

These specific functional and technical capabilities provide a clear roadmap to near-term initiatives, and the NASA EA will establish the roadmap for a portfolio of further enhancements as required by the missions and operations of the Agency.

The Agency has a large scientific user community that accesses terabytes of data, which is processed and archived by NASA Missions. Access to these large data stores by millions of internet customers, major universities, and foreign partners needs to continue to be responsive and the security architecture should provide the security that is needed but done in a way that is transparent to our customers and partners. Consistent interoperability with a secure foundation will be provided by a consistent base set of security rules applied at the network security perimeter, with on-demand secure connections among working groups across Centers and partners, a WAN with guaranteed performance, and a NASA-wide account management, cyber ID management, and Directory. The architecture should be flexible to account for differences in security requirements and high bandwidth or low latency requirements

The NASA approach to architecture utilizes a tactically oriented technical view driven by a strategically oriented business view. The high level architecture does not change tactical decisions to employ new technologies and allows technologists to define tactics within the strategic framework. The high level architecture thus does not attempt to capture all detailed tactical technical decisions, but rather focuses on the few key technology strategy directions that are required to keep technology and strategy in alignment.

4.1.1 Project Formulation Process

Background

NASA document NPR- 7120 provides the guidelines for well coordinated, disciplined, full life cycle approach to high visibility aerospace projects. The costs associated with these high value projects demand no less in the way engineering and management excellence. NASA applies the same well coordinated, disciplined, full life cycle approach to IT management in general including the Program Unique, Multi-mission and OAIT category of projects.

The Strategic Management Handbook defines the responsibilities of management officials for the processes. Responsibilities for oversight, insight, and execution of programs/projects are specifically assigned to officials at various levels of Agency management. As part of the

strategic management process, NASA Program Managers are appointed or approved by the Mission Directorate Associate Administrators.

Planning Process

The General NASA IT planning process is unambiguously and intimately tied to the Mission of NASA. NPR-7120 provides for several high level processes that are used in planning IT at NASA.

- The PAPAC (Provide Aerospace Products & Capabilities) process delivers space, ground, and aeronautical systems; technologies; services; and operational capabilities to NASA customers so they can conduct research, explore and develop space, and improve life on Earth. The PAPAC process includes both technology development to meet unique programmatic requirements, and crosscutting technology development programs that support multiple applications.
- The Manage Strategically process provides policy, objectives, priorities, and resources to allow the Agency to develop, conduct, and evaluate programs and projects.
- The Generate Knowledge crosscutting process provides a framework for ensuring that NASA's basic and applied research is consistent with the Agency's strategic plans and that the quality of the research is maintained to the highest standards.
- The Communicate Knowledge process serves to disseminate this knowledge to increase the understanding of science and technology, advance its broad application, and inspire achievement and innovation.

Step One

Before and during a new project, IT service requirements are analyzed by each program. Mission Directorates and supporting functions, including the Office of the Chief Information Officer, are party to analysis and prioritization.

Step two

IT service requirements are reviewed and categorized as being Program-Unique, Multi-Program/Project, or Office Automation, IT Infrastructure, and Telecommunications in nature. Program plans and Business Cases are developed in each category. Requirements are included as a part of Program-Unique investments or Multi Program/Project if the requirements are sufficiently different from general infrastructure services or have other factors such as extreme reliability or performance which would cause them to be difficult or cost-ineffective to include in the OAIT infrastructure. Programs review Program-Unique requirements for potential consolidation of services across multiple programs/projects or potential utilization of the OAIT infrastructure.

Step Three
Business Cases and potential upgrade or development project decisions are then made as part of the appropriate portfolio of investments.

Step Four

All programs continuously self-evaluate their current state, evaluate progress toward planned states, and weigh future and emerging requirements into an ongoing plan.

4.1.1.1 Services Determination

The required services are analyzed and categorized according to the Federal Enterprise Architecture Service Reference Model (reference Figure 2.2-1 and the discussion in section 2.2). Each program develops its Business Case (OMB 300 package) examining the services required and the services available from various portfolios. If the service requirement can be satisfactorily met with existing OAIT services, then it is. If the service has special requirements such as very high reliability or very high performance, and has the potential to meet the requirements of several different programs, then it is categorized in the Multi Program/Project portfolio and the appropriate program management cooperates to effectively provide the service. Otherwise, the required service is incorporated in the appropriate Program Specific portfolio.

4.1.1.2 Supporting IT Determination

The Office of the Chief Information Officer coordinates the development of all Business Cases and is a party to analysis of the service requirements and development of the investment portfolios. The OAIT portfolio is developed in response to the common requirements that are surfaced. All the NASA Strategic Plan Implementing Strategies implicitly require IT capabilities such a messaging, collaboration, Web, shared information, shared applications and Agency-wide information sharing functionalities exhibited by an Electronic Work Environment.

These requirements also arise as a result of NASA missions becoming longer in duration, involving broader teams of participants across the Agency, across other Agencies and Industry partners, and Internationally, and an increased need to allow for remote or virtual participation in selected Agency operations.

As new program directions continue to expand the sphere of operations of both manned and unmanned missions, they now extend over much greater time periods than ever before. The International Space Station is now manned continuously and Earth science and outer planet observations require greater mission spans than ever before. In the past, it was acceptable to require mission teams to physically assemble at the same location for all key operations. In the future, the Agency must allow for external partners (international partners, principal investigators, and science and engineering teams) the capability to use new tools such as internet access to ongoing operations and study or design team exercises. These are direct mission requirements inasmuch as the evolving missions of the Agency can no longer be conducted in an effective manner if these collaboration functions are not readily encompassed by the IT Enterprise Architecture.

Emerging requirements of collaboration technologies are driven not only by the need to enhance direct mission design or engineering team interoperations, but to make it possible for all facets of service and lines of business to more efficiently operate. Emerging collaboration technology is driven by industry competition, the President's Management Agenda (PMA), and federal and Agency budget pressures.

Collaborative technologies offer the potential to pool skilled workforce resources across the Agency, create efficiencies, reduce travel costs, and enhance clarity of communication, ideas, and thought. In order to provide the flexible ability to create new teams and changed access to information and applications as programs proceed through their life cycles will require the NASA infrastructure move to directory enabled and role based communications and security models.

In the past the Agency functioned as a loose federation of generally independent Centers. Mission and Administrative functions of One NASA now require Agency-wide participation at all levels. NASA has recognized this requirement and begun to address it by establishing the NASA Shared Services Center (NSSC) concept, currently nearing the early stages of implementation. The NSSC as currently envisioned focuses primarily on such Administrative common services as Human Resources and Procurement. The physical location of the NSSC is under consideration. Also, under the auspices of the NASA Chief Engineer and the NASA CIO, a high priority is to implement Collaborative Engineering capabilities. Collaborative Engineering capabilities will require moving well beyond the current predominant paradigm of Center-specific analytical and collaboration tools to a paradigm of shared and interoperable applications across the Agency. Providing Agency-wide shared applications services will also require the NASA infrastructure move to directory enabled and role based communications, security and applications access models.

Over the last several years, more and more business communications have begun to occur in unconventional environments. Airports, cars, and home offices have become frequent settings for impromptu teleconferences and E-mail communications. Organizations can be distributed and work as a single entity if employees are provided the tools they need to communicate effectively. The workforce becomes less centralized as it become more mobile, telecommuting and quick response time becomes the norm, particularly for certain collaboration and decisions. The workforce is using laptops, cell phones with digital interfaces, and PDAs to a greater extent than ever before.

Although NASA as an Agency is in the business of science, engineering and education, a critical function is communication and management. It is the critical integration point for the NASA Centers, partners, and the general public. Thus, as a result of the required emphasis on management and communication both internally and externally, the trend toward an increasingly mobile workforce can also be seen at NASA -- particularly at the most senior management and executive levels across the Agency, including the Administrator. Whether presenting budget briefings on Capitol Hill, participating in missions at remote NASA Centers, traveling internationally to work with partners, or simply making the best of a long commute to stay in touch with co-workers, NASA employees require "edge connectivity" – real-time access to their business communications regardless of physical location. The E-Presence initiative will

eventually provide fully integrated home office and wireless connectivity for the NASA population.

Please see the examples contained in Appendix B.

4.1.2 Guiding Principles

The following represent the design/selection principles for the new and evolving Enterprise Architecture. The architectural structure follows the systems design principle of attempting to de-compose form, function, and implementation into separable domains that exhibit common requirements and enable common solutions.

Virtual Enterprise Principle: Investments should support seamless integration across the virtual enterprise.

Does the solution directly connect to external entities?

Does the system plan provide for mapping or conversion tools for external data feeds?

Does the solution enable increased integration with external suppliers or users?

Does the system have or utilize existing security controls to integrate external entities in the future?

Does the solution follow industry standards for external interfaces?

Does the solution accommodate the possibility of future business process outsourcing?

Does the solution allow for future NASA work in new areas or reductions in current areas?

Can the solution handle foreign nationals and external users?

Scalability Principle: Systems should be scalable to support use by different size organizations and to handle decline or growth in business levels.

Can the solution handle large unexpected growth or decline in demand?

Can small organizational units be added with proportional increase in total cost of ownership?

Can the solution scale to be cost-justified to implement in small organizations or remote sites?

Does the solution have a stable charge-back model, representing the total cost of ownership, for customers despite their cyclical or varying demand?

Diversity Principle: Systems should support a diverse business and IT environment.

Are the data structures generic or industry standard and not NASA unique ?

Does the solution support changing interface requirements?

Does the solution support current and changing industry standards?

Can the solution integrate with multiple hardware and software platforms?

Can the solution link to existing legacy hardware and software platforms?

Does the solution support multiple and changing business workflow models?

Does the solution avoid customizing COTS software in the solution?

Organization Principle: Systems should be independent of organization.

Are all coding and data structures independent of current organization charts?

Can the solution be easily placed at another Center or in another Enterprise?

Point to Point Principle: Systems should minimize point-point interfaces to reduce complexity.

Does the solution create or maintain a data hub (a data hub services many applications with the same data) or does it serve as a "gold source" for certain data elements?

If the solution contains a data hub or "gold source" what is the subject area?

Does the solution link to a data hub

Has the solution avoided replicating information that exists in a data hub somewhere?

Does the solution reduce linkage complexities?

Does the system have less than 5 point-to-point interfaces (not through a hub)?

Operational/Decision Support Principle: Systems should optimize both operational and decision support needs of the business process.

Does the solution support decision support without impacting operational transactions?

Does the solution support operational processing without impacting decision support?

Is information structured to support changing decision support needs?

Phasing Principle: Systems should be phased to provide self-standing business benefits in three to nine month increments to meet eventual business objectives.

How many phases have been identified?

How many funded?

Will the implementation deliver direct business benefit within 9 months?

Has the solution avoided using elements that risk obsolescence before the final phase?

Ownership Principle: Systems should have a clear, recognized business owner and a clear, recognized IT owner.

Are the respective owners identified and do they understand their responsibilities?

Does the business owner have operational responsibility for the project solution?

Operations Principle: Systems should fit the existing infrastructure, or have a viable plan to develop and operate an extension to the architecture.

Does the solution fit existing operations and support models?

What is the plan for sustaining evolution through enhancements after development?

Is there a plan to develop and operate the solution?

Is there a transition plan to get rid of old applications, transitioning between systems, and have a training plan?

How will the solution handle user accounts?

Commonality Principle: Systems should be common across organizational units and geographies unless detrimental to the NASA mission.

Are business processes related to this solution common across all organizational units and geographies in NASA to enable the creation of a global solution?

Will the solution support all business units and geographies in NASA?

If the solution does not support all business units, is there a negative impact to the NASA mission with local or regional solutions?

If distinct solutions exist, have external system interfaces and internal data structure definitions been made common across the solutions?

Natural Boundaries Principle: Systems should be separated at natural solution domain boundaries and integration between these systems should be loosely coupled.

Which NASA processes does the solution support?

Which information entities does your solution support?

Which solution domain is the solution a part of (e.g., HR, Finance, Engineering …).
Which systems of information does the solution require information from?

What other systems are operating in that solution domain?

Is the system tightly coupled with other solutions in the same domain in order to support integration?

Does the solution provide loose coupling across solution domain boundaries in order to support modularity?

In defining the natural boundaries decomposition, both logical and physical design principle considerations are applied. Logical considerations must be applied when considering data and applications, as the highly distributed nature of modern business dictates. NASA, like many other Agencies, has a highly mobile work force and highly distributed business partner and customer base. Data, and the applications that process it, cross many hardware, software and network domains. However, all data live on and all processing takes place on some specific elements of hardware, software and network, which have distinctly physical characteristics.

Security Principles: We have found the following Security design principles (NIST Special Publication 800-27a draft: Engineering Principles for Information Technology Security (A Baseline for Achieving Security)) to be helpful in setting an approach to articulating the NASA To-Be architecture:

- Principle 3. Clearly delineate the physical and logical security boundaries governed by associated security policies.
- Principle 5. Assume that external systems are insecure.
- Principle 26. Protect information while being processed, in transit, and in storage.
- Principle 16. Isolate public access systems from mission critical resources (e.g., data, processes, etc.).
- Principle 12. Implement security through a combination of measures distributed physically and logically.
- Principle 15. Formulate security measures to address multiple overlapping information domains.

In all that follows, it must be emphasized that both logical and physical considerations must be considered in design and implementation. Neither alone is sufficient. Thus, for example, when a One-NASA Network architecture is proposed, it must be recognized that although some views may focus on the physical characteristics, the logical rules are still there.

Pre-existing principle: If a commercial or Government created product already exists and would fulfill the mandatory requirements imposed on a design, it must be considered and dispositioned before moving ahead on a custom development as dictated in the FAR.

5 Current and Future State of the NASA Portfolio

5.1 Program Unique Mission IT

5.1.1 GSFC - Hubble Space Telescope Mission Ops IT

Current State

The Hubble Space Telescope has been in an operations phase since launched on April 24, 1990. Four successful servicing missions have made dramatic improvements in the telescope. The planned investment is to keep the system functioning smoothly through the remainder of the Hubble Space Telescope mission. All funding for the Hubble Space Telescope comes from NASA, which is fully responsible for the maintenance of the satellite. The Hubble Space Telescope is unmatched by any ground based or space borne observatory. The demand for Hubble Space Telescope observing time by the worldwide science community is increasing. The Hubble Space Telescope Project is in the Operations phase of NASA IT Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA Project under NASA's NPG 7120 process.

The HST Program is re-assessing program plans due to the cancellation of Servicing Mission 4 on January 16, 2004. Development of the Cosmic Origins Spectrograph is complete. Wide Field Camera 3 (WFC3) development continues on the existing plan.

Future State

The planned investment is for hardware and software maintenance and support, to keep the system functioning smoothly through the remainder of the Hubble Space Telescope mission, currently planned to end in 2010. The Hubble Space Telescope Operations Project will continue ground system development and maintenance of the highly distributed, commercial-off-the-shelf-based ground system. The investment supports core mission functions of the Space Science Enterprise. Continued funding is required because no alternative private sector or other government source can efficiently support the function.

Based on HST spacecraft hardware reliability projections, the probability of continued HST science operation decreases to approximately 50% by the end of calendar year 2005. To extend the life of HST science operations beyond that time, the program is implementing methods to extend the operational life of HST, e.g., development of a 2-gyro control mode for science operations and optimizing battery management.

5.1.2 JSC Software Development/Integration Laboratory

Current State

The International Space Station (ISS) prime contract was awarded in 1993 to Boeing as a performance based contract for the total integrated design, development, manufacture, and integration of the U.S. On-Orbit Segment (USOS) of the ISS. As such, Boeing is responsible for integrating all ISS systems and subsystems such as the Command and Data Handling (C&DH) subsystem, including International Partner/Participant (IP/P) elements which interface with the USOS, government furnished equipment (GFE) developed by other contractors and provided to Boeing, providing ground support equipment (GSE), and providing technical support for ground and orbital operations. The Software Development and Integration Laboratory (SDIL)/Avionics is the command and data handling (C&DH) subsystem utilizing the onboard computer and network capabilities of the ISS. It also includes the ground support and test functions for the associated ground operations and sustaining engineering. As such, this "project" supports the International Space Station. The C&DH functions executed using the onboard computer and network capabilities are an embedded technical subsystem of the ISS spacecraft vehicle. The C&DH subsystem is a critical subsystem of the ISS, providing the essential capabilities to perform guidance, navigation, and control commands to keep the ISS in orbit, and to handle critical on-orbit activities, such as power distribution, crew housekeeping activities, and research and science experiments in the laboratory module.

Future State

Primarily provide avionics support activities on the C&DH subsystem. Those activities are:

- Hardware/Software Integration (HSI)
    - Perform ISS hardware/software integration, design integration, command and telemetry verification, and stage software verification; Provide flight support including C&DH MER console support and mission flight following; Provide flight software support at KSC and MOD personnel
- Guidance, Navigation & Control (GN&C)
    - Perform engineering analysis, GN&C subsystem integration, and design of mission specific Pre-Position Loads (PPLs); Provide sustaining engineering support for the GN&C subsystem; Provide GN&C support to MEIT.
- Communications & Tracking (C&T)
    - Perform C&T subsystem analysis and subsystem integration; Prepare CoFR packages; Perform Audio, Space to Space, Space to Ground Ku-Band, and S-Band evidence of requirements closure; Provide sustaining engineering support for the C&T subsystem; Provide C&T support to MEIT.
- C&DH Hardware Maintain and sustain C&DH hardware;
    - Perform C&DH networks analysis; Provide sustaining engineering support for Avionics ORUs and cabling for PMA's, Node 1 and Truss Elements; Provide C&DH support to MEIT.

Consolidated Laboratories

- Provide and sustain the SVF, PSPF and SITE test rigs and expand the ISIL ITR; Perform SDIL systems engineering, maintenance and operation and perform test rig management; Provide computed systems security for all systems and ADPE.ISIL Laboratory Improvements to Support Flight: Identify and implement laboratory fidelity improvements to support near-term flights

ASIL Implementation –

- Define requirements, design, implement and perform, operate and maintain an integrated test system to support long-term ISS program objectives for hardware/software integration and flight support. The investment is in the Steady State portion of NASA's CPIC process.

5.1.3 JSC Space Shuttle Program Cockpit Avionics Upgrade

Current State

The Multifunction Electronics Display Subsystem (MEDS) replaced the suite of electro-mechanical gauges and cathode ray tubes (CRT) and their associated controlling processors with a suite of multifunction, color, flat panel Liquid Crystal Displays (LCD) in 1999. The key processing elements in MEDS were the Integrated Display Processor (IDP), the Multifunction Display Unit (MDU), and the Analog-to-Digital Converter (ADC) unit. The IDP's primary functions included (a) acting as the transparent interface to the Orbiter General Purpose Computers (GPC) on the Flight Critical and Display/Keyboard buses, (b) coordinating the MEDS configuration, (c) formatting GPC and ADC data for display on the MDU's, and (d) accepting operator inputs from switches and keyboards. The MDU's primary functions included (a) drawing the displays and (b) processing MDU edge-key operator inputs for MEDS unique capabilities. The ADC's primary functions were to convert analog signals from existing Orbiter sensors to digital values for use by the IDP.

Future State

The CAU will implement new Orbiter cockpit avionic hardware and software to meet the man-machine interface requirements identified by the Space Shuttle Cockpit Council to enhance overall crew safety. Orbiter cockpit displays and crew interface capabilities will be significantly improved by replacing the existing Integrated Display Processors (IDPs) with higher performance Command and Display Processors (CDPs). These units will provide expanded processing performance to enable dramatic improvements in information access and display capability as well as the implementation of the new Abort Flight Management software function. As part of the Space Shuttle project approval process, the CAU Project has been fully reviewed and approved previously by the capital planning and investment committee. In addition the project has been approved each year since its inception in FY2000 by both the Program Operating Plan reviews and numerous independent audits and reviews. Space Shuttle Program Management as well as NASA Enterprise management are updated on a periodic (monthly and quarterly respectively) basis as to the status of technical objectives, risk monitoring and amelioration, and resource/schedule management status and projections through earned value reporting.

5.1.4 JSC Space Shuttle Program Flight Software

Current State

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate and support NASA's launch requirements, specific program investments are required. NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities.

The Flight Software Element (FSW) is responsible for the maintenance, testing, reconfiguration and configuration management of the Onboard Shuttle Software. Execution of these responsibilities is accomplished by several teams within FSW: the Shuttle Avionics Integration Lab (SAIL), the Primary Avionics Software System (PASS), the Backup Flight System (BFS), the Multifunction Electronic Display System (MEDS), the secure client/server computing environment (ASDEP), and Cockpit Avionics Upgrade (CAU). All IT resources identified for FSW are dedicated to these responsibilities. The JSC Space Shuttle Program Flight Software Investment is in the Operations phase of NASA Information Technology (IT) Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

Currently, the FSW is supporting the Operational Increments (OI's)-28, -29, and -30. OI-41, which provides the CAU with safety enhancements, is scheduled for release in August 2004.

Future State

The Flight Software (FSW) Information Technology (IT) plan is a part of the Space Flight Operations Contract (SFOC) overall annual Level A (5 year) and Level B (annual Fiscal Year) Information Technology Plan deliverables to the Space Shuttle Program (SSP) Chief Information Officer (CIO). FY04 Plans reviewed and approved in September 2004 by the SSP CIO with concurrence from the Johnson Space Center (JSC) CIO, Kennedy Space Center CIO and Marshall Space Flight Center CIO. The FSW portion of the SFOC IT Plan focused on the essential needs to maintain the resources necessary to continue to provide the unique IT support required by the FSW organization. The organization and their supporting contractors have a requirement to develop, verify and maintain Shuttle Fight Software in a JSC designated "critical" "mission" client server environment using TCP/IP protocols, in support of the SFOC contract. A secure LAN infrastructure and development environment is required to support this requirement. The ASDEP and FSW/PASS systems are designed to provide the secure client/server environments. FSW has its own firewalls setup which was necessary to gain NASA security approval to use client/server technology to access NASA mainframes.

OI-42, also a CAU release, is currently under development and scheduled for release in 2006. Both OI's will support safety, reliability, and affordability.

5.1.5 JSC Space Shuttle Program Integration

Current State

Space Shuttle Program Program Integration (SSP PI) includes elements managed by the Space Shuttle Program Office at the Johnson Space Center (JSC) and conducted primarily by United Space Alliance, including payload integration into the Space Shuttle, systems integration of the flight hardware elements through all phases of flight, and configuration management of program hardware, software, and requirements. The information technology parts of SSP PI include such applications as Baseline Accounting and Reporting System, Mission Requirements control System, Automated Scheduling and Planning, Automated Mission & Payload Tracking System, Shuttle Drawing System, Program Compliance Assurance and Status System, Shuttle Integration Accounting Status System, Verification Information System, Work Authorizing Documentation System, Waivers/Exceptions, Operations and Maintenance Requirements and Specifications Change Processing, Document Configuration Management System, Technical Document Management System 2, Shuttle Payload Integration and Cargo Evaluation System, Critical Math Model Database, Launch Management System. The major expenses are either sustaining or migrating mainframe projects to a web-based, client-server environment. This also includes the cost allocations for the office automation services supporting the employees of this function.

Future State

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate and support NASA's launch requirements, NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities.

The SSP Program Integration (PI) Information Technology (IT) plan is a part of the Space Flight Operations Contract (SFOC) overall annual Level A (5 year) and Level B (annual Fiscal Year) Information Technology Plan deliverables to the Space Shuttle Program (SSP) Chief Information Officer (CIO). FY04 Plans reviewed and approved in September 2004 by the SSP CIO with concurrence from the Johnson Space Center (JSC) CIO, Kennedy Space Center CIO and Marshall Space Flight Center CIO. The major IT expenses deal with either sustaining the above systems or migrating mainframe projects to a web-based, client-server environment using state of the art technology for data access, availability and transfer.

In addition, the Space Shuttle Program is assumed to be required to be operable until 2010 per the President's new Vision for space exploration.

5.1.6 JSC Space Station Production Facility

Current State

This facility, separated into Development, Integration, and Production environments, provides tools for engineering analysis for International Space Station Program (ISSP) development and sustaining; for management of program manifests and on-orbit inventory, etc.; for access to and maintenance of critical Program data (including Station physical properties, drawings, etc.) required for NASA, Boeing and other Program Participants to meet their Program commitments. These tools are a combination of COTS and internally developed applications specifically to provide support to the ISSP. The JSC Space Station Production Facility Investment is in the Operations phase of NASA IT Capital Planning & Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

Future State

The ISS Production Facility Investment is helping the International Space Station to fulfill elements of the NASA Mission Statement. Within the NASA Strategic Plan the International Space Station's primary support lies within two NASA sub goals:

- Goal 8 – Ensure the provision of space access and improve it by increasing safety, reliability, and affordability
    - Sub goal 8.4. Assure capabilities for world-class research on a laboratory in low earth orbit.

- Goal 9 – Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery:
    - Sub goal 9.4 Demonstrate the ability to support a permanent human presence in low-Earth orbit (LEO) as a steppingstone to a human presence beyond LEO.

In more general terms, the International Space Station supports NASA's strategic posture by supporting more general goals.

- To understand and protect our home planet: The ISS serves as a versatile platform in the fulfillment of NASA's Earth Science activities. Through use of the observation facility on the ISS, NASA's astronauts are able to obtain high quality scientific observations of the Earth. The research program planned for the ISS allows better understanding of life on Earth by isolating and analyzing similar phenomenon in microgravity. This research, when fulfilled, allows researchers to have a more meaningful understanding of and to develop means to improve life on Earth. Furthermore, the Department of Defense is a member of the anticipated ISS user community, and plans are currently underway to

identify opportunities to fly DOD experiments that will facilitate the protection of our country and our world.

- To inspire the next generation of explorers: As part of the human space flight program, the ISS serves as the premier means of inspiring today's students to study math and science. Moreover, the ISS serves as a means of inspiring people around the world of the greatness of what humanity can achieve when people from around the world work together toward common peaceful goals.

The ISS Program is helping fulfill the following goals:

- Understand Earth's system and apply Earth system science to improve the predication of climate, weather, and natural hazards
- Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia
- Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics
- Engage the public in shaping and sharing the experience of exploration and discovery

5.1.7 JSC Space Station Training Facility

Current State

The benefits inherent in ISS operations are possible only by ensuring that the operators have the necessary knowledge and skills. The operators are the ISS crew and the flight controllers in the ground control centers. Assurance of prerequisite knowledge and skills prior to ISS mission operations is made possible by extensive training. ISS training is mandatory before and during flight. This investment is the Space Station Training Facility (SSTF). It consists of a set of simulators that provide application services in support of ISS training needs. Each simulator is designed to focus on specific types of training. The primary customers are the instructors, crew, and flight controllers. Other customers include the Mission Control Center test team and ISS procedure developers. The ISS Program Manager is the key stakeholder. The SSTF has three main simulators: Full Task Trainer (FTT), Part Task Trainer (PTT), and American Segment Trainer (AST).

Future State

The development phase of the SSTF lifecycle is currently in the final stages of completion. Remaining TSC deliverables consist of training loads that support Shuttle Return To Flight (RTF), primary functionality for subsequent ISS flights, and residual platform enhancements. There are three remaining RTF deliverables under TSC. One is generic in nature and the other two are specific to the next two flights to the ISS. These deliverables will be used for ISS training upon delivery. Development of these loads is in the Development/Modernization/Enhancement (DME) category of the NASA Capital Planning and

Investment Control (CPIC) process. The operations effort to support ISS training with these deliverables is in the Steady State (SS) category of the CPIC process

5.1.8 KSC Ground Operations

Current State
Ground Operations is in the Operational phase of the NASA Capital Planning and Investment Control Process. Ground Operations are networks, tasks, and functions that are not covered in the Launch Control Systems and directly support Shuttle Processing at the Kennedy Space Center. This covers all platforms and LAN operational functions and associated maintenance and support of ADP hardware and software. This category also covers the O&M of the various Instrumentation systems such as the Ground Measurement System, Permanent Measuring System, Catenary Wire Lightning Instrumentation System, Lightning Induced Voltage Instrumentation System, the Shuttle Modal Inspection System, and others. The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board.

Future State

The SSP Program Integration (PI) Information Technology (IT) plan is a part of the Space Flight Operations Contract (SFOC) overall annual Level A (5 year) and Level B (annual Fiscal Year) Information Technology Plan deliverables to the Space Shuttle Program (SSP) Chief Information Officer (CIO). FY04 Plans reviewed and approved in September 2004 by the SSP CIO with concurrence from the Johnson Space Center (JSC) CIO, Kennedy Space Center CIO and Marshall Space Flight Center CIO. The major IT expenses deal with either sustaining the above systems or migrating mainframe projects to a web-based, client-server environment using state of the art technology for data access, availability and transfer. This investment is closely coupled with shuttle processing. The loss of this investment would require us to revert to manual based systems. This would increase our headcount and impact our processing schedule.

5.1.9 KSC Integrated Logistics

Current State

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate and support NASA's launch requirements, specific program investments are required. NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities. The

Integrated Logistics organization supports NASA's strategies for future IT initiatives while complying with consolidated IT standards. The Integrated Logistics organization maintains current Logistics systems as well as spares and provides repair support for the Operations Center for Shuttle Avionics Integration Laboratory (SAIL), Training Operations Center (TOC) and Integration and Program Requirements-Multi-facility. The Integrated Logistics organization provides spares/repairs for IT hardware and software supporting NASA Shuttle Logistics Depot (NSLD) Special Test Equipment and CAD systems that support manufacturing and repair activities.

The Integrated Logistics organization continues to support current and future process improvements and support the IT requirements for the migration of the Logistics systems to the enterprise Peoplesoft Tool. PeopleSoft Inventory - The first release of the PeopleSoft Inventory and Manufacturing system was completed in July 2002. The focus is on system improvements such as the streamlined demand process, inventory out-of-balance corrections, Shelf-Life Management, Contamination /Decontamination requests, ASRS Mini-loader interface. Peoplesoft is required to process the Space Shuttle at KSC. The Integrated Logistics function is in the operational phase. The Space Flight Operations Contract (SFOC) covers all Information Technology (IT) related activities including the design, development, implementation and maintenance of computer-related hardware and software systems as required to process the Space Shuttle at KSC. This includes Integrated Logistics which provides for repairs, spare parts, and warehousing for the Space Shuttle Orbiters, and associated Ground Support Equipment (GSE). The Integrated Logistic investment reduces lifecycle cost of replacement equipment. The requirements for lifecycle cost for replacement of Ground Support Equipment (GSE) is the only supported funding in the lifecycle cost of this GSE.The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board.

Future State

The SSP Program Integration (PI) Information Technology (IT) plan is a part of the Space Flight Operations Contract (SFOC) overall annual Level A (5 year) and Level B (annual Fiscal Year) Information Technology Plan deliverables to the Space Shuttle Program (SSP) Chief Information Officer (CIO). FY04 Plans reviewed and approved in September 2004 by the SSP CIO with concurrence from the Johnson Space Center (JSC) CIO, Kennedy Space Center CIO and Marshall Space Flight Center CIO.

The major IT expenses deal with either sustaining the above systems or migrating mainframe projects to a web-based, client-server environment using state of the art technology for data access, availability and transfer. This investment is closely coupled with Shuttle Processing. The loss of this investment would require us to revert to manual based systems. This would increase our headcount and impact our processing schedule.

5.1.10 KSC Launch Control System (LCS)

Current State

The Launch Control System (LCS) function is in the operational phase of the NASA Capital Planning and Investment Control (CPIC) process. The Launch Control System (LCS) is required at Kennedy Space Center to process and launch the Space Shuttle. It consists of Shuttle Data Center (SDC), Checkout Control and Monitor Subsystem (CCMS) Operations, Record and Playback Subsystem (RPS), and Other Non-System Specific Systems (Other O&M). The Shuttle Data Center provides storage and recall of all shuttle processing and launch data. The CCMS is a custom design computer hardware and software system for processing and launching the Space Shuttle. The system currently operates with 100 consoles, 240 peripherals, 12 million lines of Launch Processing System (LPS) source code, and 1.6 million lines of executable Ground Operations Aerospace Language (GOAL) code. The Record and Playback Subsystem (RPS) primary function is to record unprocessed Shuttle on board instrumentation data during tests and launch countdowns. The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board.

Future State

The SSP Program Integration (PI) Information Technology (IT) plan is a part of the Space Flight Operations Contract (SFOC) overall annual Level A (5 year) and Level B (annual Fiscal Year) Information Technology Plan deliverables to the Space Shuttle Program (SSP) Chief Information Officer (CIO). FY04 Plans reviewed and approved in September 2004 by the SSP CIO with concurrence from the Johnson Space Center (JSC) CIO, Kennedy Space Center CIO and Marshall Space Flight Center CIO. The major IT expenses deal with either sustaining the above systems or migrating mainframe projects to a web-based, client-server environment using state of the art technology for data access, availability and transfer.

Shuttle Engineering and the Business Office review each element on a yearly basis to address supportability, maintainability and upgrades. All elements are required for KSC to process and launch the Space Shuttle and/or its payloads. This investment is closely coupled with shuttle processing. The loss of this investment would require us to revert to manual based systems. This would increase our headcount and impact our processing schedule.

5.1.11 KSC Operational Television System Modernization

Current State

The Space Shuttle program plays a vital role in enabling NASA's vision and mission. This includes advancing human exploration and providing safe access to space in support of human operations in low-earth orbit. In order to maintain a viable human transportation capability that will operate and support NASA's launch requirements, specific program investments are required. NASA is revamping its approach to selecting and managing these investments to ensure Shuttle operability into the next decade and avoid future project overruns. These

investments will be consistent with NASA's strategy of ensuring the Space Shuttle remains viable until a new transportation system is operational. These projects will provide revitalization of the infrastructure, and combat obsolescence of vehicle, ground systems, and facilities. The Operational Television System function is in the operational phase of the NASA Capital Planning and Investment Control (CPIC) process. OTV provides operational and safety situational awareness required by the KSC test team in support of Launch & Landing functions by being a second set of eyes or even being the only method of viewing hazardous or high energy activities in support of Shuttle Processing and Launch. OTV is funded and managed by the Shuttle Program. OTV allows us to meet strict safety of flight requirements. OTV is not a general-purpose television system. It is a closed network used for operations, launch and landing system.

Future State

The OTV Investment includes the acquisition of hardware and associated software required for the upgrade of the KSC Shuttle video system, which includes items such as cameras, lenses, recorders, monitors, routing switcher, control system(s), and video processing modules. The Investment also includes labor costs associated with design engineering, installation, testing, and training. The capability provided by this investment mitigates risks, due to obsolescence of existing system elements that contribute to increased operations and maintenance (O&M) costs due to failure rate and repair/replacement costs. The obsolescence risk provides a threat to Shuttle processing schedules as the OTV system provides required surveillance of operations. This threat is also mitigated by this investment. Additionally, the new capability provided by this investment will meet the requirement from the NASA Inter-Center Photo Working Group (IPWG) for improving imaging quality through digital techniques that resulted from the Columbia Accident Investigation Board recommendations. The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board. The SSP Program Integration (PI) Information Technology (IT) plan is a part of the Space Flight Operations Contract (SFOC) overall annual Level A (5 year) and Level B (annual Fiscal Year) Information Technology Plan deliverables to the Space Shuttle Program (SSP) Chief Information Officer (CIO). FY04 Plans reviewed and approved in September 2004 by the SSP CIO with concurrence from the Johnson Space Center (JSC) CIO, Kennedy Space Center CIO and Marshall Space Flight Center CIO. The major IT expenses deal with either sustaining the above systems or migrating mainframe projects to a web-based, client-server environment using state of the art technology for data access, availability and transfer. This investment is closely coupled with shuttle processing. The loss of this investment would require us to revert to manual based systems. This would increase our headcount and impact our processing schedule.

5.1.12 KSC Shuttle Processing Support

Current State

The Shuttle Processing Support investment is in the Control phase of the NASA Capital Planning and Investment Control (CPIC) process. Kennedy Space Center (KSC) still uses a significant

portion of converted Apollo infrastructure, facilities and equipment for Shuttle Processing. The Launch Site Equipment (LSE) budget helps maintain this aged infrastructure, facilities and equipment with a current replacement value (CRV) in excess of $3B. Space Flight Operations Contract (SFOC) and other contractors maintain current capability and replace equipment with similar equipment. The LSE's budget funds the major refurbishment of ground equipment and provides new capabilities when required.
LSE projects typically involve redesigns driven by obsolescence problems or to correct problems necessary to "keep the doors open". Only summary data, a brief project description and Part II are provided.

Future State

This investment is used to support Space Shuttle processing, launches, and landings. An example of the current FY year and FY 05 planned major investments include replacement of the Crawler Transporter Shoes, since the existing shoes are exhibiting extremely high failure rates and can no longer be utilized after 38 years of support. The Shuttle Processing Support investment reduces lifecycle cost of maintenance replacement equipment. The requirements for lifecycle cost for maintenance replacement of obsolete Ground Support Equipment (GSE) only support funding if the lifecycle cost of the replacement GSE is less than the existing GSE.
The FY04 information technology annual review/approval (Capital Planning and Investment Control process) for this investment was held September 26, 2003 by the Shuttle Program IT CPIC Review Board. The SSP Program Integration (PI) Information Technology (IT) plan is a part of the Space Flight Operations Contract (SFOC) overall annual Level A (5 year) and Level B (annual Fiscal Year) Information Technology Plan deliverables to the Space Shuttle Program (SSP) Chief Information Officer (CIO). FY04 Plans reviewed and approved in September 2004 by the SSP CIO with concurrence from the Johnson Space Center (JSC) CIO, Kennedy Space Center CIO and Marshall Space Flight Center CIO. The major IT expenses deal with either sustaining the above systems or migrating mainframe projects to a web-based, client-server environment using state of the art technology for data access, availability and transfer. This investment is closely coupled with shuttle processing. The loss of this investment would require us to revert to manual based systems. This would increase our headcount and impact our processing schedule.

5.2 Multi-Program/Project IT

5.2.1 ARC Aerospace Technology Support System

Current State

Fiscal Year 2004 is the FINAL YEAR of this system. The ARC Aerospace Technology Support System provides Ames Research Center's Information Technology support of Aerospace Technology Enterprise programs. IT resources include computers from specialized, small desktop and instrument control computers to powerful, large supercomputers, as well as

specialized networking hardware. Software includes commercial science and technology applications and tools, as well as ad hoc, custom-built programs and objects. Services include maintenance, system and network administration, operational support and software maintenance. These investments are in the operations phase of the NASA Capital Planning and Investment Control process and are managed as part of the supported NASA Aerospace Enterprise programs under the NASA Procedures and Guidance (NPG) 7120 program management process.

Future State

FY 2004 is the FINAL YEAR of this system. Beginning in FY2005, the IT resources will be managed directly by the many funding programs and projects. Each project will also individually report its IT acquisitions.

5.2.2 ARC High End Computing

Current State

The NASA Advanced Simulation (NAS) Program supports the scientific and modeling requirements of the entire agency. The NAS provides an integrated environment for simulation that includes high speed access to the cutting edge High-end Computing (HEC) platforms, assistance with application porting and scaling, storage, pre and post processing support, visualizations, training and on line and help desk support. The center provides a numerical simulation capability that allows NAS to initiate the most demanding projects in science and engineering while providing a capacity that insures that all the enterprises can pursue their highest priority projects with minimum interference. The program will enable factor of 10-100 advances in vehicle, earth, space and life sciences modeling.

Future State

To achieve NASA's mission objectives, NASA must:

- Design and develop advanced aerospace systems;
- Develop an in-depth understanding of Earth, planetary, solar, and deep-space systems;
- Ensure the safe and effective human presence in a broad range of space environments.

These tasks have in common the need to rapidly develop in-depth and quantitative understanding of complex systems (engineering, physical, and biological systems, respectively). When physical experimentation is not possible, the burden falls on theoretical analysis. The theory governing these processes are often coupled non-linear partial differential equations that are not amenable to "back of the envelope" solution. As a result, developing high-resolution solutions to these equations involves performing trillions of computations. Since these computations must be performed within the time constraints of ongoing development activities (e.g., vehicle design), results are often needed in hours or, at most, a few days.

To deliver the benefit of such computational modeling and simulation it is essential to have a high-performance computing and communications system tailored to meeting the specific requirements of the NASA community. This system must include sufficient and appropriate computing and computer communication assets as well as the software to support the porting, optimization, and execution of the computational code and the post-processing of the computational results.

To ensure the future of this investment, the following criteria must be met:

- Demand for NASA Advanced Simulation (NAS) computing resources, including substantial latent demand, will continue over the planning horizon.
- High performance computer systems will continue to have a useful life of about three years.
- Industry price/performance improvements will continue at the historical rate (approximate doubling of performance for a given cost every 18 months.)
- Human resources policy will support the retention of sufficient skilled technical civil service personnel to provide expert oversight of contractor services.

5.2.3 GSFC - Earth Observing Sys Data Info Sys

Current State

The Earth Observing System (EOS) Data and Information System (EOSDIS) is a comprehensive distributed system designed to support NASA's EOS. EOSDIS archives, manages, and distributes Earth science data from NASA missions and provides spacecraft control and science data processing for the EOS missions. EOSDIS has been archiving and distributing pre-EOS data since 1994. Currently EOSDIS supports both the pre-EOS and EOS data. EOSDIS has been distributing Earth Science Enterprise (ESE) data to a broad user community, enabling research, applications, education and policy analysis. EOSDIS is now supporting Aura mission that was launched in July 2004. It is an essential component of NASA's Earth science program in order to ensure that the valuable data from its Earth observing satellites are captured, preserved and made available to the user community for scientific research and applications of national importance. A large community has now become accustomed to data and information products from EOSDIS as evidenced by the number of users of EOSDIS (over 2.3 million accessing and over 280,000 ordering data in FY 2003 and similar statistics expected in FY 2004).

Future State

Due to the longevity of the systems and the services needed to meet the objectives of the Earth Science Enterprise, EOSDIS needs to adapt to the rapid changes in technology, incorporate advances in information technology, and evolve with time in order to remain a viable system supporting the user community

For its success, EOSDIS depends on the network infrastructure that exists in the US to provide the data to the users. These consist of both NASA’s internal networks and networks funded and

managed by other entities (E.g., NSF). International partners' contributions to the overall interoperable data system are also important to the success of EOSDIS. It is assumed that these capabilities will continue to be available and evolve over the long life cycle of EOSDIS. It is assumed that the funding will be available to support EOSDIS through FY 2014 - four years beyond the design life of Aura, the last of the series of EOS satellites that was launched in July 2004.

5.2.4 GSFC - NASA Center for Computational Sciences

Current State

The NASA Center for Computational Sciences (NCCS) supports primarily scientific modeling in the Earth sciences. The NCCS' high performance computer systems, mass data storage systems, and high performance networks serve about 1,000 users. NCCS is an ongoing operational data center, but most of NCCS funds are classified as DME (planning and acquisition) rather than Steady State. This is primarily because the purchase prices of new systems, which are replenished every few years, are much greater than system maintenance costs. Consequently, the NCCS investment is Mixed life cycle. The overall investment has been reviewed on August 13, 2004 by the Program Management Council (PMC) and the NASA headquarters OCIO as part of the NASA CPIC control processes. The investment is meeting its value objectives and a decision to continue funding has been made.

(Most hardware assets have an approximate three year lifecycle. NCCS constantly refreshes and updates its suite of hardware, software, mass storage, and network infrastructure, consistent with resource availability.)

NCCS supports scientific modeling research in the Earth, space, life, and microgravity sciences. The NCCS is a key resource in the effort to restore international leadership to the U.S. program in weather and climate prediction to increase understanding of Earth's climate system, natural and human influences on climate, and consequences for life on Earth. NCCS system applications will lead to greater understanding of the Earth system, the solar system, and the universe through computational use of space-borne observations and computer modeling. The three largest Earth Science projects that the NCCS supports are the Data Assimilation Office (DAO), the NASA Seasonal to Interannual Prediction Project (NSIPP) (Note: DAO and NSIPP merged as the GMAO - Global Modeling and Assimilation Office), and the Computational Technologies (CT) Project of the Earth Science Technology Office (ESTO). The Goddard Institute of Space Studies (GISS) is also a major NCCS user.

Future State

The future state planning uses the following assumptions:

- Assumed that demand for NCCS computing resources, including substantial latent demand, will continue over the planning horizon.
- Assumed that high performance computer systems will continue to have a useful life of about three years.

- Assumed that industry price/performance improvements will continue at the historical rate (approximate doubling of performance for a given cost every 18 months.)
- Assumes that NCCS will compete major acquisitions of system integration services about every 5 or 6 years.
- Assumes that human resources policy will support the retention of sufficient skilled technical civil service personnel to provide expert oversight of contractor services.
- Assumes that the 2001 HPC system performance was cost-effective.

5.2.5 GSFC - Space and Ground Network IT Support

Current State

The Space and Ground Network IT Support is in the operation phase of the NASA IT Capital Planning Investment Control Process. The National Aeronautics and Space Administration Space and Ground Networks, in operation since the 1980s, provide mission communications for multiple Space Network and Ground Network tracking stations. These existing communication facilities are operated and maintained for pre-launch checkout, launch and landing, and on-orbit tracking, telemetry data acquisition, and command services for crewed and robotic low-Earth orbiting spacecraft, and suborbital rockets and balloons. The Space Network includes nine geosynchronous satellites, and is currently supported through non-NASA reimbursable funding.

Space Network - The Tracking and Data Relay Satellites (TDRS) in geosynchronous orbit are situated in Earth orbit such that they can provide continual, global coverage. There are several services provided by the Space Network to our customers. They include telecommunications, tracking and spacecraft clock calibration, testing, and analysis. The Space Network is operated 24x7, 365 days per year. This is driven by the need to control and operate the TDRS constellation and the fact that our customers request support at all hours. Included in this list of customers are the International Space Station and the Space Shuttle, both of whom schedule continuous coverage from the network.

The Ground Network (GN) - provides launch support, orbiting spacecraft support, and sounding rocket and atmospheric balloon mission support. The GN also supports critical Space Shuttle launch, emergency communications, and landing activities. The GN provides for the implementation, maintenance, and operation of the tracking and communications facilities necessary to fulfill program goals for flight projects in the NASA mission set. Missions supported also include NASA inter-agency collaborative programs, commercial enterprises, and other national, international, and commercial enterprises on a reimbursable basis.

Future State

Space and Ground Network systems represent the provision of telecommunication services needed to ensure that the goals of NASA's exploration, science, and research and development programs are met; that they are met cost-effectively; and that mission operations and planning are performed in an integrated and standardized way.

NASA will continue to require spacecraft command, tracking and telemetry data acquisition services for 60 orbital and suborbital missions, as well as launch vehicle tracking for 25 launches per year. Space and Ground Network Systems will continue to support non-NASA customers on a cost-reimbursable basis. NASA is a major customer of commercial service providers, and has a vested interest in their success. NASA is committed to seeking and encouraging commercialization of NASA operations services and to participate in collaborative interagency, international, and commercial initiatives.

5.2.6 JSC Flight Operations

Current State

FO, as the contractual arm of the JSC Mission Operations Directorate (MOD), directly supports NASA's goal of flying missions safely with mission objectives achieved by providing the products, services and facilities used to prepare and support such missions. The major functions for flight operations include management and integration, mission operations, vehicle operations, flight systems operations, flight control, flight crew and flight controller training functions, flight design & dynamic operations, preflight and flight control team functions, flight planning, payloads and assembly operations, crew procedures, and operational readiness for the Shuttle Program missions. Primary training facilities include the Shuttle Mission Training Facility, Flight Operations Trainers and the Space Station Training Facility. Shuttle onboard flight software is built and certified in the FO Software Production Facility. The JSC Flight Operations Investment is in the Control process of NASA Information Technology (IT) Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process

Future State

The Flight Operations functions will continue to provide the products, services, and facilities needed to prepare for and support HEDS missions, including the Shuttle and Space Station programs. Development efforts will be largely based on new and evolving program requirements changes, such as Shuttle return to Flight activities or planning for the return to the moon. Maintaining the current functionality of the Flight Operations systems is essential to fulfilling the goals of the NASA Mission Statement. Additional investments in Information Technology will be necessary not only to maintain the existing equipment, but also to replace the equipment as it becomes non-maintainable due to escalating sustaining costs or due to the unavailability of commercial vendors.

The FO project under SFOC contract, is assumed to continue as a NASA contract thru September 30, 2006. NASA is negotiating with United Space Alliance (SFOC contractor) to extend the SFOC beyond FY06.

5.2.7 JSC Integrated Planning System

Current State

The Integrated Planning Systems (IPS) provides the ground system computational capabilities which the Space Shuttle and the International Space Station (ISS) mission planners and flight controllers use for pre-mission planning, shuttle profile design and analysis including powered flight guidance and control software verification, post-mission analysis, and near real-time mission support. IPS is comprised of an Open Systems standards based data processing platform on which applications are hosted. IPS is a distributed system with Workstations (WS's) connected to computational and data servers. IPS provides a standard set of mission planning applications for producing the integrated mission activity timeline, and utilizes a central data management system to store and distribute products.

The JSC Integrated Planning System investment is in the Operations phase of NASA IT CPIC process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

Future State

The Integrated Planning Systems (IPS) will continue to provide the ground system computational capabilities which the Space Shuttle and the International Space Station (ISS) mission planners and flight controllers of the Mission Operations Directorate use for pre-mission planning, post-mission analysis, and near real-time mission support.

Maintaining the IPS' current functionality is essential to fulfilling the goals of the NASA Mission Statement. Additional investments in Information Technology are necessary not only to maintain the existing equipment, but also to replace the equipment as it becomes non-maintainable due to escalating sustaining costs or due to the unavailability of commercial vendors.

5.2.8 JSC Mission Control Center

Current State

The JSC Mission Control Center (MCC) directly supports NASA's goals by providing command and control capabilities for safe mission operations of the International Space Station and Space Shuttle. The MCC provides common infrastructure architecture of distributed COTS, Unix workstations, servers, networks, voice systems, data storage and retrieval, and platform software to support multiple vehicles. The general-purpose software architecture provides a level of software infrastructure independent of program and vehicle. The support functions include flight reconfiguration product generation, mission planning, command and control flight operations, flight controller & crew training, & software development.

The JSC Mission Control Center is in the Operations phase of NASA IT CPIC process, and this IT investment is managed as a component of the NASA project under NASA's NPG 7120 process.

Future State

The MCC will continue to provide the US command and control capabilities for the International Space Station (ISS) and the Space Shuttle programs to meet the NASA HEDS goals. The MCC will continue to provide mission, SIMs, and Tests Command & Control, Data Archive, Trajectory, Weather and Voice support. Residual development efforts are largely based on new and evolving program requirement changes.
Maintaining the MCC's current functionality is essential to fulfilling the goals of the NASA Mission Statement. Additional investments in Information Technology are necessary not only to maintain the existing equipment, but also to replace the equipment as it becomes non-maintainable due to escalating sustaining costs or due to the unavailability of commercial vendors.

5.2.9 MSFC Payload Operations and Integration Center

Current State

The Payload Operations Integration Center (POIC), located within the Huntsville Operations Support Center (HOSC) at Marshall Space Flight Center, is the primary single NASA ground system responsible for integrated operational payload flight control and planning for the International Space Station program supporting the Biological and Physical Research and Space Flight Enterprises. The POIC is in the Operations phase of the NASA IT Capital Planning and Investment Control (CPIC) process, and this IT investment is managed as a component of the International Space Station Program under NASA's NPG 7120 process.

The POIC provides payload telemetry processing, command uplink, and planning capabilities for a large number of local POIC Cadre flight controllers and remote ISS payload users/customers and other facilities located throughout the world. Additionally, the Telescience Resource Kit (TReK) software is provided to remote customers in order to simplify interaction with the ISS vehicle and the POIC information systems. POIC software is provided to other NASA centers and customers including: the Kennedy Space Center (KSC) (which utilizes a copy of the POIC software within the Payload Test and Checkout System (PTCS)); and a multitude of ISS payload customers using TReK software. The POIC integrates/controls: ISS payload flight operations, simulation, and mission-test preparation activities. ISS core systems and payload telemetry data is received, processed, stored, retrieved, displayed, and distributed to local and remote payload users/controllers. The POIC provides the capability to receive commands from local and remote users, analyze the uplinks for authenticity/authorization, performs required hazardous command checks, transmit the commands to the ISS (via the Mission Control Center-Houston (MCC-H)), and log all the command system activities for analysis/ troubleshooting purposes. The POIC provides the capability to uplink/downlink files to/from the ISS and store/retrieve mission-related documents, procedures, and files. The POIC also provides the integration point for

planning all ISS payload operations by: assessing/integrating user operational requirements, analyzing available on-orbit and ground resources, and generating detailed execution timelines scheduling the user operations in a safe and efficient manner.

Future State

5.3 Office Automation, IT Infrastructure and Telecommunications (OAIT)

5.3.1 Financial Services

5.3.1.1 Integrated Financial Management project (IFMP)

Current State

The Integrated Financial Management (IFM) Program is a large and complex initiative that will change the way financial and business management is performed throughout NASA. NASA is the first Federal agency to implement a commercially provided Enterprise Resources Planning (ERP) system across the entire organization. The IRS and other Federal agencies are benchmarking IFMP's success for their own ERP implementation planning.

Center and/or Enterprise unique approaches will be replaced with a single set of standard integrated business processes. Each and every NASA employee will be impacted by these changes. New IFM systems will improve business processes by minimizing data redundancy, standardizing information and electronic data exchanges, processing and recording financial events effectively and efficiently, and ensuring consistent information throughout the Agency. The IFM Program consists of functional module projects that effect business process changes and that acquire and implement appropriate information technology tools to substantially improve the Agency's performance.

The Program was reformulated in March 2000 and will complete implementation of all modules within the CPIC process by the end of FY 2006.IFMP is composed of the 8 integrated projects listed below of which 1-4 are fully implemented, 5 and 6 are in formulation/development phases, and 7 and 8 are scheduled to begin in FY04/05 and be completed by the end of FY06. (System upgrade to new software version is not considered a separate project in the Exhibit 300.) Project, Completion Date

Module List

1. Resume Management, FY02 (Complete)
2. Position Description, FY02 (Complete)
3. Travel Management, FY03 (Complete)
4. Core Financials, FY03 (Complete)
5. Budget Formulation, FY04 (Complete)

6. Integrated Asset Management, FY06
7. Contract Management, FY06
8. Human Resources, FY06

Those project components that are not complete are discussed in the future state description below.

Future State

- Module 5
    - Budget Formulation, implemented FY '04, supports budget development, advocacy, internal/external reporting, and full cost budgeting and management. It includes templates, reports, and associated processing within a software and data warehouse tool set to facilitate G&A and service pool planning, workforce planning, Center POP submissions and phasing plans, NASA budget aggregation, and the NASA budget submission and pass back process with OMB and Congress.
- Module 6
    - Integrated Asset Management, currently in formulation, encompasses four major areas of the management of facilities, logistics, aircraft, and environmental programs. This includes management of assets and inventories, maintenance, and reporting internally to NASA and externally. Current asset management systems do not comply with specific mandates, such as OMB's regulation on aircraft operations. NASA struggles to have visibility into contractor-held assets (e.g., Form 1018s). As a result, the agency received a material weakness for the agency's FY 2002 Financial Statements from the NASA Inspector General on NASA's management of contractor-held property. With the implementation of this module, this material weakness will be resolved.
- Module 7
    - Contract Management, formerly referred to as Procurement, is scheduled to be implemented in FY 06. It will provide a comprehensive tool to support contract writing, contract administration, procurement management, and data and reporting management materials for NASA. It will provide detailed and quantitative data to facilitate, economize and expedite procurement processes and will be integreated with existing IFMP systems. Other procurement functions are now being evaluated by the functional community for inclusion in this project.
- Module 8
    - Human Capital, formerly referred to as Human Resources is scheduled to be implemented in FY '05 & '06. It will integrate traditional HR functions with other IFMP modules as well as ePayroll. The Human Capital module will support a broad range of HR functions across the Agency. Functionality being considered are Awards, labor distribution, performance and training and events management.

5.3.2 Communications Services

5.3.2.1 Wide Area Network

Current State

This component consists of a set of Wide Area Networks (WANs) that provide production services as well as services provided by several commercial Internet Service Providers. The bulk of the services are provided through the NASA Integrated Services Network (NISN) managed at the Marshall Space Flight Center. Many Centers also have other WAN gateway connections for either mission specific functions or for services not available through NISN.

The NISN WAN provides for the transport and delivery of NASA WAN communications services both domestically and internationally. The NISN provides both digital and analog services, dedicated and switched circuits, packet data transport, multi-protocol Wide Area access, domain name services, and various data networks.

At each Center it is typical that the WAN connects to the local area network (LAN) via a security perimeter network referred to as the "Isolation Network". This isolation network provides firewalls and/or routing to separate external networks, public networks, and internal networks. The NISN network currently provides much of the functionality for the majority of the Agency including NOC functions, cost optimization and responsive services.

Future State

The Current NISN network is based upon ATM technology which has been in place for a number of years. The new Exploration Directorates may need higher bandwidth circuits to exchange CAD information. While ATM fulfills most of the current requirements it may be time to review new offerings such as dramatically increasing bandwidth capabilities or direct SONET interaction in support of the Exploration Directorate. Once the mission requirements are clearly known, a business case will be generated to determine whether either of the above options along with any additional administrative features would add sufficient value to merit purchase. NASA plans to evaluate the Requirements in a Business case and project plan for improved WAN specifications and availability performance. If the WAN Upgrade Project is implemented it will be part of the overall NASA Integrated Infrastructure Program (IIP).

5.3.2.2 Wan Upgrade Project

The WAN Upgrade Project is a part of the overall NASA Integrated Infrastructure Program. The NASA Integrated Infrastructure Program is a transformation strategy for managing the Information Technology (IT) infrastructure as an integrated architecture, and providing an infrastructure that NASA can evolve and adapt.

In June 2003 the NASA CIO assembled a team of NASA WAN and Local Area Network (LAN) representatives, and independent advisors to define a network architecture capable of supporting the NASA Integrated Services Network (NISN) mission, the mission support infrastructures, and

OneNASA initiatives into the future. The WAN Architecture Team identified the following objectives for the WAN Implementation Sub-Project:

- Migration to Synchronous Optical Network (SONET)/Lambda services in the NASA WAN core
- Demarcing carrier services and monitoring equipment at carrier independent exchange facilities (CIEFs)
- Providing SONET/Lambda services to NASA Centers
- Providing incremental security improvements leading to eventual implementation of an NASA security perimeter
- Providing traffic flow monitoring within the NASA WAN

Please refer to Appendix A for the WAN detailed Project plan.

5.3.2.3 Local Area Network

Current State

The LAN component incorporates all IT investments required to provide networking services within a building, campus, data center or Center, including hardware, software, and services (including wireless LANs, remote access, Domain naming services, network management, X500/directory services).

The NASA Center local area networks (LANs) utilize off-the-shelf products to provide standards based connectivity to research, support, and infrastructure devices. Each Center LAN has Border router and firewall protection.

Every Center network utilizes a combination of media that includes copper, fiber, and optical wireless. All Centers provide nearly complete coverage of buildings at 10 Mbps, considerable coverage at 100 Mbps, and only a few Centers have significant 1000 Mbps coverage.

The primary media access technology is Ethernet with a small and decreasing percentage of Fiber Data Distributed Interface (FDDI). Most routable protocols are supported including Internet Protocol (IP), AppleTalk, DECNet, and Internetwork Packet Exchange (IPX). These allow for a wide array of applications that support the user's requirement for electronic messaging, data streaming, file sharing, and file storage.

All reporting Centers have indicated at least some level of concern over aging or outmoded equipment, although the levels of concern vary widely.

Future State:

The operational state of LAN services varies greatly from Center to Center. Since this capability evolved over time, there are a diverse set of LAN architectures across the Agency. NASA's approach to integrating the management of the LAN environment is to define an Agency standard LAN architecture which Centers will build to as future LAN upgrades take place. The definition of this architecture was completed and approved in June 2003, and most Centers have

LAN upgrade projects progressing as funding permits. The base universal requirements for the future state of the LAN in each center is to upgrade to a minimum 100 Mbps, and in some cases 1Gbps or 10Gbps, without requiring a considerable amount of redesign. One of the underlying reasons for this upgrade is to allow for reasonable use of voice and video over the shared infrastructure.

5.3.2.4 Voice

Current State
The Voice component includes all elements that provide voice services to users including hardware, software, services, and communications that are not provided by NASA WANs. The voice element includes local and long-distance telephone services, cell phone service, satellite phone service, teleconferencing, voice mail, fax, and ancillary services such as two-way radios, emergency warning systems, and public address systems. Long Distance Service (LDS), 800 numbers, and calling cards are obtained from the GSA FTS2001 contract. Several Centers have upgraded their voice network infrastructure in recent years. At this time, integration and consolidation efforts are focused primarily on the use of common service providers where feasible. Transition to the use of Voice over Internet Protocol (VoIP) is viewed as the most viable means of consolidating this service Agencywide in the future, but a recent feasibility study conducted by GSA on NASA's behalf determined that this is not a cost-effective approach for the Agency at this time. However, as the technology matures, the use of VoIP will potentially enable not only the consolidation of voice services, but also the convergence of the voice and data infrastructures.

Future State:

NASA continues to abide by Federal directive to buy its Telephone services from the FTS2001contract. Additionally, Voice over IP (VoIP) is in serious consideration for future agency-wide use. Currently, testing is being done to see if this technology is a viable, option for future use. If a transition to VoIP were to take place in the future, it would replace all or part of the current landline telephone service.

5.3.2.5 Video

Current State

ViTS: The Video Teleconferencing Systems (ViTS) facilities are used for teleconferencing between Centers. ViTS provides digital video recording and production, video distribution systems, and video repositories. These video services may support multiple key mission responsibilities of NASA in addition to servicing general purpose communication functions. Video distribution, videoconferencing and audio/visual capabilities are important contributors to automating or facilitating many general purpose functions such as meetings, conferences, and general employee communication. The mix of criticality and degree of functionality at each Center is dependent upon its particular mission role.

Every Center has one or more ViTS facilities with services provided through the NASA Integrated Services Network (NISN). ViTS provides interactive point-to-point and multipoint conferencing capabilities to NASA locations, selected contractor facilities, and public video conferencing services. ViTS is primarily based on circuit-switching technology, uses FTS-2001 services. NISN provided ViTS services include provisioning and maintaining special video conferencing rooms, scheduling of videoconferences, and the transmission and distribution of the video and audio among the participating locations.

NASA TV: NASA is charged to provide the highest quality operational support to the Office of Public Affairs and NASA's programs as related to the Agency's statutory obligation to provide for the widest and most practicable dissemination of information to the public. NASA Television operates as a primary distribution point for the majority of NASA's video to U.S. national and local media, international media, and other clients. In addition, video data and distribution is important to manned space mission operations, Earth and space science programs, and various aspects of technology programs. Finally, video distribution, videoconferencing and audio/visual capabilities are important contributors to automating or facilitating many general purpose functions such as meetings, conferences, and general employee communication. The mix of criticality and degree of functionality at each Center is dependent upon its particular mission role.

Future State

There are two potential initiatives under consideration in the Agency to upgrade Video services. The first is a continuing evaluation and planning for movement to High Definition TV services. There will be a complete transition from analog to digital in the Digital Television (DTV) project. This will include the push for a High Definition Television (HDTV) standard agency-wide. There are no immediate funded initiatives in this area. Along with the HDTV standard, there is a potential for High Definition cameras to be utilized for video content that requires a higher resolution than current digital standard definition, such as video scanning and recording of launch vehicles prior to and during launch. This, in fact, will be in serious consideration for future implementation by the MSFC. The Columbia Accident Investigation and Subsequent Board recommendations included improvements in this area. At this time, the recommendations are under study. There is a corresponding evaluation in process regarding the impact such recording and playback would place on the KSC LANs and the NASA WAN.

In addition, future upgrades agency wide will be required to further incorporate the Video Teleconferencing System (ViTS).

5.3.3 Computing Services

5.3.3.1 Desktop Hardware and Software

Current State

The NASA Desktop Component consists of the desktop elements of the overall Computing Services Segment. This includes Wintel, Mac and Unix desktops as well as laptops and locally attached printers, all of which are provided with a wide variety of services.

The Desktop Component provides two major functions: (1) hardware and software sufficient to conduct client-side Office Automation, Personal Productivity, and general analytical functions (including science or engineering analyses that do not present special requirements) and (2) connectivity to the networks and host based services for corporate functions.

This component interfaces to the Application Services component for access to a wide variety of both centralized and distributed applications requirements for users. It interfaces to the Data Center component where centralized support functions can be leveraged for economies of scale and increased reliability both within the specific Center and across the Agency. It interfaces to all components of the Communications Services segment and of the Electronic Work Environment segment.

Desktop service provisioning is accomplished either via the NASA-wide ODIN contract or through Center-specific Support contracts. The local ODIN service provider services most of the General Purpose desktops. In addition, at some Centers where mission requirements permit, a portion of Mission Support and Mission function desktops are also provisioned by ODIN.

In support of NASA's Enterprise Architecture, NASA Standard 2804, Minimum Interoperability Software Suite defines a complete suite of required Office products, electronic mail client, web browser, PDF viewer, calendar, access capability to centrally served Windows applications, electronic forms, and other recommended software for meeting required functionalities. The standard includes specific Operating System releases for PC, Mac and UNIX systems. Other functionalities include required ftp clients, news readers, viewers, anti-virus, audio/video players, PKI client software and recommended secure shell, 3270 client emulators, X-windows, PostScript viewers, and data conferencing clients.

The specific hardware implemented for each ODIN seat is determined by a benchmarking process conducted for NASA by Alterion, Inc. and must be compliant with NASA Standard 2805, Minimum Hardware Requirements for Interoperability. Hardware and software for non-ODIN (Mission Support or Mission) seats is determined by the user. However, if the seat is used to interoperate with the rest of the NASA Infrastructure, it is required to comply with NASA Standards 2804 and 2805 and with Security requirements of NPG 2810.1.

Future State

There are no immediate plans to significantly change the Desktop Hardware and Software component approach to the current standard or the way in which it is maintained. The process has ensured three key architectural features:

- that NASA desktops - PC, Mac and Unix – maintain a cost-effective parity with generally available commercial products,

- that there is a standardized set of capabilities the other architectural components can build or design to, and
- the desktop standard loads may be defined and held for a sufficient window of time to enable effective configuration management processes.

As the Agency moves to shared application services and more heavily adopts a web services model, it may be possible to simplify the basic desktop hardware and software configuration profiles and reduce the complexity of managing the desktop. It must be noted that provisioning of shared application services does not inherently imply centralization of services, although that is a likely approach. Due to the wide scope of common desktop uses across Agency functional users, great care will have to be taken so that mission productivity is not adversely impacted. There remain many applications which may not be readily scalable and others which are not amenable to centralization.

Agency-wide compliance with ODIN and NASA desktop standards will be a continual process. The need for greater CPU power and additional features, such as CD writers, DVD writers, and flat panel monitors, as and agency standard is increasing.

The workforce becomes less centralized as it become more mobile, telecommuting and quick response time becomes the norm, particularly for certain collaboration and decisions. The use of mobile computing assets as a "desktop" will need to be better addressed. The workforce is using laptops, cell phones with digital interfaces, and Personal Digital Assistants (PDAs) to a greater extent than ever before.

5.3.3.2 Application Services

Current State

Application Services is a component that provides an end service to end users, including design, development, help and other support that are not provided by the Desktop component. Included are IT investments in hardware (not a part of a Data Center), software and services required to provide application services remote from a desktop and not provided by a Data Center.
The goal of this Service Area is to (1) provide an underlying capability for subsets of the customer community to meet their unique needs when requirements dictate and to (2) provide the opportunity for those customer subsets to leverage economies of scale as relative costs and service requirements permit.

There are hundreds of applications services in place within the Agency. Applications may be custom developed or may be COTS/GOTS solutions. Some application services provide services to the entire Agency, other applications services provide services to specific centers, while yet others provide services to small subsets of users with special requirements. Thus, not all applications are inherently scalable to the Enterprise.

The scope of support ranges from general-purpose web applications that provide access to user managed content, to full-featured transaction processing and workflow management systems. In

addition, individual organizations develop and maintain organizational web systems and applications.

There are three ways in which this component reduces costs or improves efficiencies.

1. First, the applications rely on a common component infrastructure. The organization and management of the full spectrum of application services is built upon the common component infrastructure. Applications are acquired or built consistent with the common Desktop environment standards whenever possible. Client-server or multi-tier applications are encouraged to utilize servers in a Data Center whenever possible. Compliance with Communications standards and Collaboration and Messaging standards are also reviewed so as to insure interoperability and cost-effectiveness.
2. Second, the applications utilize economies of scale. The common component architecture fosters specific applications implementers to choose to use base-lined hardware and server software in the Data Centers and/or the outsourced desktop support structure as much as possible.
3. Third, NASA fosters a broad utilization of IT to meet specialized requirements. Although NASA has many functions in common across the Agency, there are also widely varying requirements for which decentralized or federated services are optimal.

Future State:

Provide Shared application services--In the past the Agency functioned as a loose federation of generally independent Centers. Mission and Administrative functions of One NASA now require Agency-wide participation at all levels. NASA has recognized this requirement and begun to address it by establishing the NASA Shared Services Center (NSSC) concept, currently nearing the early stages of implementation. The NSSC as currently envisioned focuses primarily on such Administrative common services as Human Resources and Procurement. In addition, it will be implemented to establish a consolidated shared services organization to provide a higher quality, more cost effective and efficient services for select NASA business and technical services. The physical location of the NSSC is under consideration. Also, under the auspices of the NASA Chief Engineer and the NASA CIO, a high priority is to implement Collaborative Engineering capabilities. Collaborative Engineering capabilities will require moving well beyond the current predominant paradigm of Center-specific analytical and collaboration tools to a paradigm of shared and interoperable applications across the Agency. Providing Agency-wide shared applications services will also require the NASA infrastructure move to directory enabled and role based communications, security and applications access models.

- Agency-wide, there is an anticipated need to continually upgrade to keep all application services up-to-date and integrated. Architectural changes will be made, pertaining to the individual needs of each center. For example, the JSC is making architectural changes to allow for the separation of developed and COTS workloads in order to reduce the likelihood of integration problems. The LaRC is making adjustments to shift from specialized computers to commodity off-the-shelf personal computers, because of rising computer hardware maintenance costs, in addition to, the increased computing speed s an graphic display capabilities of commercial software vendors. Some of these architectural

changes may be generally applicable to more than one center, which will be observed and addressed by the NSSC.

5.3.3.3 Data Centers

Current State
The Data Center component is defined to be IT hardware and software that is used for multiple purposes. NASA Data Centers provide users and project or departmental applications the following in NASA's distributed networked environment:

- Hosting of Legacy Mainframe systems
- Convenient and secure access to structured and unstructured data repositories
- Database hosting, configuration, and administration
- Application hosting configuration, integration, and administration
- Network attached storage and near-line storage.
- Experienced administration staff
- Leveraged economies of scale
- Site- or bulk-license purchase

Many of these Data Centers functions are outsourced to contractors and operate under performance based contracts such as ODIN.

Future State:

Agency-wide, there is an increased need to reduce the reliance on mainframe technologies, as well as the consideration of the usage of a common data center. There are a few possibilities currently in consideration: bringing in new business to combat costs, migrating mainframe applications to a server platform, or outsourcing remote operations on local or remote equipment. Each option must be extensively considered with a detailed analysis for flexibility, cost, and security issues before the next step can be reached.

There are also individual needs seen by each center, most of which are in the initial stages of execution. Each Center and mission system will continue to evaluate broader usage of common data centers. For example there is an initiative to centrally host NASA email systems at the NASA data Center in Huntsville Alabama.

5.3.4 Electronic Work Environment

5.3.4.1 Messaging and Collaboration

5.3.4.1.1 e-Presence /Exchange/Mobile workforce

This component provides e-mail, instant messaging, calendaring and various collaborative tools to NASA employees to improve the ability to work together and coordinate with NASA partners across all disciplines.

Elements of this collection of services are in different states of standardization and maturity. E-mail is highly standardized and interoperable across the Agency. Instant messaging is not standardized, and is only available in pilot modes in general. A calendar function has been required at the desktop, but due to product incompatibilities and incomplete requirements, no Agency-wide service has yet been established but isolated Center solutions exist. There have been multiple pilot implementations of various collaborative tools at most Centers with mixed results. However a new pilot is underway to evaluate Microsoft Exchange for against most of the Agency Messaging and Collaboration requirements.

E-mail: E-mail standard clients are specified in NASA Standard 2804, Minimum Interoperability Software Suite for PC, Mac and UNIX desktops. E-mail is governed by the following standards: NASA-STD-28 NASA Electronic Messaging Architecture, Standards and Products, and NASA-STD-2808 NASA Interoperability Profile for NASA E-mail Clients collectively they define an architecture, implementation, operation, and interface standards of email at NASA.

Future State:

An extensive integrated e-mail and collaboration study was produced at NASA detailing the requirements of NASA messaging & collaboration and the technologies that could be used to address those requirements. The results favored Microsoft Exchange to provide the features those users wanted and required to fulfill their jobs (integration of mail, task management, calendaring, file sharing, and correspondence management). The results were briefed to the NASA Administrator and subsequently lead to an extensive pilot project for NASA HQ being initiated. Exchange provides: email, calendaring, Instant messaging, PKI encryption, Blackberry support, collaboration, and other features.

NASA HQ is currently underway to build a replacement email system that cures all identified problems. It will offer increased storage per user and provide access to manage main folders via IMAP and WebMail, both over encrypted channels. There is also an increase to the number of users within the Blackberry System, adjustments and upgrades will be supported as needed. Any additional use of technology, such as XML, in collaboration with Agency-wide messaging and calendaring tools will be looked at and assessed for future use.

5.3.4.1.2 Collaborative Tools

Current State

Collaborative Tools: In 2002, the NASA CIO provided funding to support the Team Collaboration Pilot. This pilot focused on products to support virtual team meetings and spaces. The key objective of the pilot was to assess the value of such tools as applied to NASA teams.

The core business drivers include: enable work to get done with less reliance on travel; enable collaboration across NASA centers and external partners.

Future State

In the area of Team Collaboration, the pilot project evaluated a number of tools, selected WebEx for synchronous virtual team meeting support, and conducted an extensive two year implementation supporting a wide variety of NASA teams. The tool was provisioned in a fully outsourced Application Service Provider (ASP) business model. The tool was widely accepted and just recently the decision was made to create a collaborative services seat as an option on the ODIN desktop outsource contract. In this way, the collaboration capability will be provided as an agency level service, still using a form of ASP business model, and utilizing a convenient and existing funding model and implementation contract.

5.3.4.2 World Wide Web

Current State

This component includes Center and agency-wide development and hosting services focused on providing web access for the public to information about NASA – whether for business opportunities, for general public awareness, for educational purposes, or for dissemination of knowledge gained from NASA research and operations. NASA publishes more than two-million web pages devoted to space science in its fulfillment of the Space Act that established the Agency. The Internet is the ideal medium for NASA in the dissemination and exchange of ideas.

NASA has deployed an initial version of a OneNASA Portal which is intended to begin to provide the public with a single point of entry to NASA's web environment, providing the audience with an easy way to navigate through NASA's public web content without knowledge of NASA's organizational structure. Over the past two years NASA has developed and fielded an integrated One NASA Public Web Portal at http://www.nasa.gov. The service has been outsourced, and supporting editorial review processes, information gathering and dissemination processes, and content management services have all been developed and the service is now the official portal for public information. Not all content or public web sites have yet been consolidated, however, a very large amount of some of the most visible NASA public data has been and is regularly maintained. In fact, mission data from the Mars Explorer Rovers has been all hosted via the outsourced portal and relieved the Agency networks of very high traffic demands.

Future State:

The future state of Web management at NASA is described in the Portal Project section below.

5.3.4.2.1 Portal Project

The public portal project is being extended in scope and effect into a broader project to consolidate all web publishing. With the transformation of NASA and the need for consistent information to be delivered from each NASA site, it is essential that the information from each Center on the web is made consistent. Migration to the NASA Portal has, to date, been a voluntary choice for each mission, program, project, or Center, but this has led to a continued inconsistency in the linkage to a single set of NASA goals and initiatives. At this time, NASA leadership has decided to make the Agency's best content consistent and available through the NASA Portal at www.nasa.gov. This entails bringing both critical, popular, and informational NASA public sites into the Portal, as had been originally intended. The infrastructure has been built to accommodate the migration of the essential sites noted below, but changes in the information architecture and navigation structure will be required. In addition, a significant amount of work is required to migrate existing content, train current publishers, and establish the workflows necessary for ongoing publishing needs.

There is also a push for XML to be implemented in a secure, cost-effective and strategic manner for an agency-wide information exchange. NASA HQ will again continue to take a leading role in pioneering safe and effective use of technology, balancing risk against impact. A regular refresh of all web servers will significantly reduce risk in this area as well.

5.3.5 Cross-Cutting Portfolios

5.3.5.1 IT Security

5.3.5.1.1 NASA Security Perimeter (NSP)

This project will provide agency-wide Network Security Perimeter implementation standards. This project plans to utilize state of the art technologies to ensure network availability, reliability, security, and compatibility with enterprise applications. In addition, this project will test and evaluate the functionality, performance, interoperability, and ease of use of various leading vendor solutions. This project will benefit each and every field center by providing needed guidance on standard architectures and designs representing NASA's "best practices" for NSPs as well as detailed testing, characterization, and evaluation of hardware/software implementations of this architecture. In addition this project will purchase upgrade hardware and software systems to replace existing equipment at those Centers where required, to ensure the uniform provisioning of common services and capabilities across NASA Centers.

Current status

Several meetings have occurred between the Centers' network operations communities to review proposed approaches and reference design. Agency firewall and VPN solution is being evaluated and a recommendation is being developed. First generation network flow based monitoring complete and next version of the monitoring software are being deployed. Further resolution of

Agency Security Perimeter (ASP) requirements, roles, architecture, and implementation will further assist in defining NSP technical controls to be standardized and implemented. Please refer to Appendix A for the NSP detailed Project plan.

5.3.5.2 XML

As generally recognized, and documented in the NASA XML Business Case, government, industry, and academia are all embracing XML as a technology that will assist in the sharing and reuse of information. Virtually all major software vendors including IBM, Microsoft, Sun, SAP, Oracle, and Software AG have made XML important parts of their product offerings.
The Office of Management and Budget has included XML as a key technology in the Federal Enterprise Architecture (FEA). Since agency Enterprise Architectures must align with the FEA, NASA must include XML as part of its infrastructure capabilities.

XML has been so widely adopted because it is an open standard and is relatively simple to learn and use. It provides a self-describing way of labeling both text and data. XML allows information content to be processed with very little human involvement and exchanged across diverse computer hardware, operating systems, and applications. These capabilities are extremely valuable to an organization like NASA that has diverse missions, works with many external partners, and by necessity must use computer hardware and software supplied by many different vendors. The value of XML will continue to grow as Web Services become an increasingly important tool for conducting business. This project supports the goal of the NASA Integrated Information Infrastructure Program -- provide the information systems and technologies that enable anywhere, anytime access to information and people. Enabling consistent implementation of agency-wide services and applications is fundamental to providing the information systems and technologies that enable anywhere, anytime access to information and people. The objectives of the NASA XML Project are to:

- Provide to NASA programs and projects the tools, mechanisms, and assistance they need for discovery of XML-related information in order to increase re-use of information and interoperability of information systems
- Increase awareness of and share lessons learned about XML and XML-related technologies
- Provide training to Agency developers on specific aspects of XML-related technologies
- Provide to the NASA CIO recommendations for Agency XML-related policies and standards.

5.3.5.3 Directory/Identity Management

5.3.5.3.1 NASA Integrated Services Environment Integration Project (NISE)

As a key part of the Integrated Information Infrastructure Program (IIIP), NASA intends to implement an Agency-wide information technology (IT) "services layer" that will function as a centrally managed, integrated environment used to:

1. establish, track, and authenticate the identity of all end users entitled to physical access at NASA Centers and facilities;
2. supply logically integrated Agency directory services to authorized users and locations; and
3. grant end-user privileges and access to all managed IT resources. To achieve these objectives and support users in the most effective and efficient manner, the NASA Integrated Services Environment (NISE) will be implemented using a consistent management, business, and technical architecture approach in support of One NASA goals and the NASA Enterprise Architecture (EA).

Efficient delivery of NASA Integrated Services Environment (NISE) services to NASA end users hinges on effective coordination with other Agency projects and initiatives – and the implementation of three major complementary components of NISE identified by Code X and the IIIP Program:

- Identity Management System (IDMS). In support of Code X, IDMS will serve as the authoritative source of validated identities for NASA and will use a Microsoft Identity Integration Server ® metadirectory implementation to provide the Agency directory service with a delegated replica of NASA identity information.
- Cyber Identity Management System (CIMS). CIMS will establish a unified directory that provides a secure, reliable, and accurate source for retrieving and managing end user IT identity and locator information such as name, title, expertise, organization, location, phone number, e-mail address, and other information.
- NASA Account Management System (NAMS). NAMS will provide a secure, consistent, expedient and accurate account management environment across NASA. NAMS also will improve security and auditing capabilities, and it will reduce the cost of managing accounts within networks, applications, databases, and systems across NASA Centers and facilities.

NISE Project objectives support IIIP Program goals and objectives and the NASA strategic vision that requires providing information systems and technologies that enable anywhere, anytime access to information and people.

In order to support these goals and objectives, the NISE Project must identify, define, and implement key components that support the following NASA objectives:

- Provide information tools and services that enhance customer services and operational support to programs and management – Implement a quality focused mission and business-driven services approach that increases reliability, security, and maintainability and reduces cost through the use of shared services.
- Develop, implement, and maintain a secure and confidential IT environment – Implement systems that correct known vulnerabilities, reduce barriers to cross-Center collaboration, and provide cost-effective IT security services.

- Support management of the NASA IT infrastructure as an integrated architecture that can evolve and adapt – Implement standards-based services in the context of an overarching architecture that integrates NASA Centers and appropriately links and shares with other agencies and partners.

5.3.5.4 Software Engineering

This program incorporates software engineering activities in support of the service areas defined below, including requirements development and management, configuration management, system testing and performance monitoring tools. NASA has specific governing policies with respect to software engineering:

- NASA Policy Directive 2820.1, "NASA Software Policies"
- NASA Standard 2100-91, "NASA Software Documentation Standard"
- NASA Standard 2201-93, "Software Assurance Standard"
- NASA Standard 2202-93, "Software Formal Inspection Process Standard"
- NIST Standards

While historically NASA's software engineering activities have focused primarily on mission-specific systems, the Agency is currently in the process of chartering a Software Steering Board to ensure an integrated NASA-wide approach to the areas of software engineering, software assurance, Independent Verification and Validations (IV&V) of software, software related research, and training in software disciplines.

Draft NASA Policy Requirement 7150, "The NASA Software Engineering Requirements", provides a common set of generic requirements for software created and acquired by or for NASA. Software Engineering is the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software: that is, the application of engineering disciplines to software[1].

Software engineering is a core capability and a key enabling technology necessary for the support of NASA's Directorates. Ensuring the quality, safety, and reliability of NASA software is of paramount importance in achieving mission success. It is also a goal of NASA to maintain and advance organizational capability in software engineering practices to effectively meet scientific and technological objectives.

The software management activities define and control the many aspects of a software project from beginning to end. This includes the interfaces to other organizations, determination of deliverables, estimates and tracking of schedule and cost, risk management, formal and informal reviews as well as other forms of verification and validation, and determination of the amount of supporting services. The planned management of these activities is captured in one or more software and/or system plans.

[1] IEEE Standard Glossary of Software Engineering Terminology. 1990

NPR 7150 makes no recommendation for a specific life cycle model. Each has its strengths and weaknesses, and no one model is best for all situations. It is important to evaluate the potential life cycle models and select one that best matches the product being produced. Standards or organizational policy may dictate a particular life cycle model. However the rigors of the environment for space probes typically dictate far more complete review and review.

Software Life Cycle Planning covers the software aspects of a project/program/ from inception through retirement. At project conception, software needs for the project are analyzed, including acquisition, supply, development, operation, maintenance, and supporting activities and processes. The project is scoped and the processes, measurements, and activities are documented in a software project plan.

Both software validation and software verification activities span the entire software life cycle and need to be planned. Formal and informal reviews, inspections, testing, peer reviews, demonstration, and analyses all can be used. Each project is obligated to choose the extent and combination of verification and validation methods and activities that best suit the project. Because peer reviews are such an important verification tool with proven value, there are specific peer review requirements within NPR 7150.

The Software Configuration Management Plan establishes and maintains the integrity of the products of a software project, describes the functions, responsibilities, and authority for the accomplishment and implementation of software configuration management to be performed during the software life cycle. NPR 7150 identifies the required coordination of software configuration management activities with other activities of the project. Use of standard Center or organizational software configuration management processes and procedures is encouraged where applicable.

Much of the project preparation and planning takes place during project formulation. Software planning is seen as an essential part of the early planning phases and must be started as the project begins. This is especially important, as software requirements must be properly incorporated into the Request for Proposals, the evaluation of the contractors, and the contracts themselves. In addition, Software Contract Requirements are applicable for NASA contracted software procurements. The scope of these requirements applies to the re-use of existing software, modification of existing software, contracted and subcontracted software, and/or development of new software.

Since many of NASA's projects now contain off-the-shelf software products, it is important to plan and manage when and how to incorporate them.

Identification and management of risks provides a basis for systematically examining changing situations over time to uncover and correct circumstances that impact the ability of the project to meet its objectives.

The requirements phase is one of the most important phases of software engineering. Requirements provide the foundation for the entire life cycle as well as for the software product, provide a basis for planning and estimating, and are based on customer and user needs.

NPR 7150 provides a minimal set of software engineering requirements in generic terms to be applied throughout NASA and its contractor community. To accommodate the wide variety of software systems and subsystems, it is expected that application of these requirements to specific projects will be evaluated and implemented for each project, with alternate acceptable requirements being applied where justified and approved.

5.3.5.5 Asset Management.

IFMP Integrated Asset Management

Asset Management "As Is" Condition
The following discussion relates to the following FEA LOB sub-functions: Inventory Control; Logistics Management; and Facilities, Fleet, and Equipment Management.

NASA's asset management community has numerous non-integrated systems supporting a myriad of functions, including inventory, logistics, facilities management, fleet management, equipment management, environmental management, and aircraft management. A listing of primary applications supporting the asset management functions are listed in Table 2 below.

Table 2 - Primary Asset Management Applications (Current)

Functional Category	Application
LOGISTICS MANAGEMENT	
Equipment Management	NEMS
Property Disposal	NPDMS
Supply Management	NSMS
Contract Property Management	NESS
Vehicle Management	Vehicle Tracker
Logistics Reporting	LIMS
FACILITIES MANAGEMENT	
Master Site Planning	ESRI ARC/GIS
Construction Project Management	Primavera (P2 or Expedition)
Specifications	SPECSINTACT
Real Property Management	RPI
Facility Utilization	FUS
Facility Maintenance	MAXIMO
ENVIRONMENTAL MANAGEMENT	
Hazardous Materials Management	CMTS
Hazardous Waste Disposal and Management	CMTS
Solid Waste Management	NETS

Functional Category	Application
Permit Management and Reporting	Livelink
Environmental Audits & Inspections	Livelink & CPAR
AIRCRAFT MANAGEMENT	
Aircraft Maintenance	NAMIS
Aircraft Operations	NAMIS
Aircraft Engineering	NAMIS
Aircraft Management/Administrative	NAMIS

The existing levels of automation yield several significant negative outcomes:

The systems are not integrated with other related systems (e.g., finance and procurement).
The systems are not integrated with other Asset Management tools. Often, asset managers must input similar data into multiple systems. In addition to requiring excessive effort, this situation undermines data reliability. For example, the Real Property Inventory (RPI) and Facility Utilization Systems provide NASA with a reasonably accurate Agency view of facility asset and utilization data, but the lack of electronic interfaces makes considerable manual reconciliation necessary.

Much of the data and systems are managed at the Center level, in a de-centralized manner. Most NASA Centers use varying versions of the same product (MAXIMO) for different purposes (e.g., work order tracking, inventory), and the users differ by Center (i.e., more substantial contractor use at some Centers). The current framework of de-centralized Asset Management systems lends to the complexity of providing consistent, standardized, and accurate information for agency-wide access and use.
NASA struggles to have visibility into contractor-held assets (e.g., Form 1018s). In fact, the agency received a material weakness for the agency's FY 2002 Financial Statements from the NASA Inspector General on NASA's management of contractor-held property.

Asset Management "To Be" Condition
Beginning in FY 06, NASA is planning to adopt Agency-wide business processes that will be supported by SAP's Integrated Asset Management (IAM) module, resulting in streamlined and improved asset management capabilities. Additional COTS tools will be implemented to meet specific functional requirements not satisfied by SAP and will be interfaced to provide effortless data exchange between systems. The new module will replace the majority of legacy systems and provide effective management in three functional categories: materials management, operations and maintenance and disposition of assets. Furthermore, Agency-wide reporting and analysis will be improved because all Centers will adopt the same processes and systems to support all management functions.

Implementing the new processes and system will result in the following:

> Agency wide supply chain management enabling cross-functional life cycle planning and processing within Centers, across the Agency and with NASA business partners

Agency wide asset visibility to enable bulk procurement and commodity management
Integration of forecasting and planning, procurement and purchasing, inventory, accounting, and reporting management across functional stovepipes

Management decisions supported by timely and accurate asset information that supports project planning

Proactive rather than reactive decision making capabilities due to more reliable and timely data
Standardized formats and single point of data entry

While the majority of functionality will be provided by SAP's IAM module, various COTS packages will be integrated with the module to increase its functionality and to meet specific NASA requirements.

6 Customized NASA IT Portfolio and FEA Service Component Models

Although not complete, a preliminary analysis of service areas identified by NASA Program Unique and Multi Program/Project investment areas has identified a suggested domain augmentation to the FEA Service Model. At the highest level, the services revolve around services like satellite guidance and navigation, communications budget management, science data acquisition, processing, and control and science data archiving and distribution. Trying to fit such services within the existing SRM categories becomes strained and artificial. For example, science data archiving and distribution constitutes a logical grouping of rather specialized collection of functions to capture, calibrate, process, and make information available to scientists and the public. Another example is Flight Engineering Services, which has many elements in common with services such as Business Analytical Services/Analysis and Statistics/Modeling or Business Analytical Services/Analysis and Statistics/Simulation or Business Analytical Services/Visualization/CAD. However, the granularity of definition is insufficient to capture important differences, including integration with flight operations. For example, CAD itself is a highly diverse set of services where there are different underlying models, user interfaces and different concepts depending upon whether it is mechanical CAD, electrical CAD, thermal CAD, facilities CAD, etc. Additionally, providing such services as a part of space flight operations brings in new integration, performance, and reliability issues.

NASA also recommends that under the Business Analytical Services domain, Systems Engineering is a service type that should be added and that components Configuration Management and Program/Project Management should be added. As shown in figure 5.0-1.

Figure 2, Revised NASA Portfolio SRM

7 Transition Approach

The purpose of transition planning is to lay out the tasks, projects, and activities that need to take place to efficiently transform from the current "as-is" state, to the future "to-be" state. The transition planning process must take into consideration the impacts of a new or altered technology on the Enterprise Architecture, the technology infrastructure, the user community and costs. NASA uses the *NASA Process Recommendation (NPR 2800) 'Managing Information Technology w/Change' and NPD 7120.5B 'NASA Program and Project Management Processes and Requirements'*. These two documents form the core of standard project management and successful transition procedures at NASA. These procedures apply to Program Unique Mission

IT, Multi-Program/Project IT, or Office Automation IT (OAIT). However varying levels of rigor are applied to the each of the project type at NASA due to varying technical demands. Some of the mission attributes of listed below.

For Program unique
Transition strategy designed into the mission to handle unforeseen events.

- Cost of space investment very high
- Mechanical & electrical architecture usually fixed but the software can change to reconfigure spacecraft and sensors
- Must take very carefully measured steps due to high cost of the mission
- Full life cycle reviews including rigorous design reviews and intense Testing

For Multi-mission
Investments based upon the Mission priorities of the Agency and the support infrastructure required to efficiently enable the mission.

- Used for a variety of high value missions
- Usually provides common but crucial but services to NASA
- Changes done by consensus and must include:
    - realistic transition strategy to avoid problems
    - roll back strategy and timetables
    - accommodations to existing missions and blackout periods
    - support for Parallel operation for high risk changes

For OAIT
Investments driven by the Mission priorities of the Agency, new commercially available services & technologies, and business office necessity. The typical transition steps are:

- Business case analysis
- Configuration control board approval
- Spiral development
- Standard life cycle reviews including PDR, CDR, ORR etc
- User training
- Deployment
- O&M

8 Appendix A Detailed Program Plans

8.1 NASA Integrated Services Environment Integration Project (NISE)

As a key part of the Integrated Information Infrastructure Program (IIIP), NASA intends to implement an Agency-wide information technology (IT) "services layer" that will function as a centrally managed, integrated environment used to:

(1) establish, track, and authenticate the identity of all end users entitled to physical access at NASA Centers and facilities;

(2) supply logically integrated Agency directory services to authorized users and locations; and

(3) grant end-user privileges and access to all managed IT resources. To achieve these objectives and support users in the most effective and efficient manner, the NASA Integrated Services Environment (NISE) will be implemented using a consistent management, business, and technical architecture approach in support of One NASA goals and the NASA Enterprise Architecture (EA).

Efficient delivery of NASA Integrated Services Environment (NISE) services to NASA end users hinges on effective coordination with other Agency projects and initiatives – and the implementation of three major complementary components of NISE identified by Code X and the IIIP Program:

- Identity Management System (IDMS). In support of Code X, IDMS will serve as the authoritative source of validated identities for NASA and will use a Microsoft Identity Integration Server ® metadirectory implementation to provide the Agency directory service with a delegated replica of NASA identity information.

- Cyber Identity Management System (CIMS). CIMS will establish a unified directory that provides a secure, reliable, and accurate source for retrieving and managing end user IT identity and locator information such as name, title, expertise, organization, location, phone number, e-mail address, and other information.

- NASA Account Management System (NAMS). NAMS will provide a secure, consistent, expedient and accurate account management environment across NASA. NAMS also will improve security and auditing capabilities, and it will reduce the cost of managing accounts within networks, applications, databases, and systems across NASA Centers and facilities.

The NISE goal is to implement an integrated IT infrastructure based on standards-based systems and processes to provide these services and capabilities. In areas where standards-based solutions are not available or not cost effective, trade-off analyses will be performed to ensure the best solution is deployed today – with the goal of future migration to effective standards-based solutions. Details of the NISE project are contained in the NISE Project Plan. The NISE project plan identifies goals, objectives, management plans, architecture, anticipated costs, and schedules based on NASA Procedural Requirements (NPR) 7120.5B and other NASA and Federal plans and documents.

Background

Throughout much of its history, NASA has been highly decentralized – consisting of an Agency Headquarters, 10 field Centers, and 4 major facilities. While each NASA Center has unique missions and diversified capabilities, change is under way to operate as OneNASA. The OneNASA Initiative will enable the Agency to support a more mobile workforce, offer more shared services, and enable cross-Center learning.

OBjectives

NISE Project objectives support IIIP Program goals and objectives and the NASA strategic vision that requires providing information systems and technologies that enable anywhere, anytime access to information and people.
In order to support these goals and objectives, the NISE Project must identify, define, and implement key components that support the following IIIP objectives:

- Provide information tools and services that enhance customer services and operational support to programs and management – Implement a quality focused mission and business-driven services approach that increases reliability, security, and maintainability and reduces cost through the use of shared services.
- Develop, implement, and maintain a secure and confidential IT environment – Implement systems that correct known vulnerabilities, reduce barriers to cross-Center collaboration, and provide cost-effective IT security services.
- Support management of the NASA IT infrastructure as an integrated architecture that can evolve and adapt – Implement standards-based services in the context of an overarching architecture that integrates NASA Centers and appropriately links and shares with other agencies and partners.

Another specific requirement for the NISE Project in Fiscal Year (FY) 2004 is to:

- Deploy services and support defined in this plan for Agency-wide applications hosted at Marshall Space Flight Center (MSFC) in Huntsville, Alabama.

Among the primary services needed to establish an effective NASA IT infrastructure are the capabilities to: (1) manage user identity in a centralized manner (IDMS); (2) provide only authorized access to IT resources (NAMS); and (3) supply a single source of user identity and locator information (CIMS) that is accurate and available with appropriate safeguards and security across NASA.

Customer Definition and Advocacy

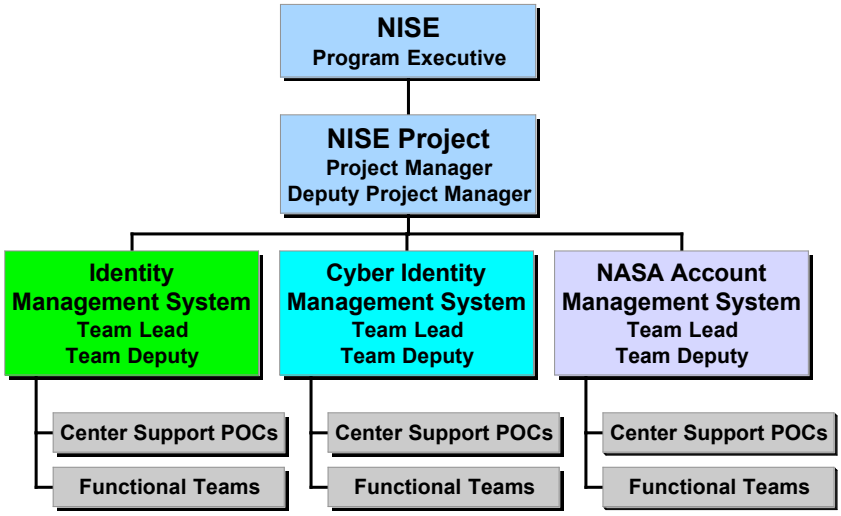
Individual NASA end users, Center organizations, and major Agency applications such as Integrated Financial Management Program (IFMP), Site for On-line Learning and Resources (SOLAR), and the NASA Automated Data Processing (ADP) Consolidation Center (NACC) are customers for the NISE Project. The NISE environment will be managed by the NASA Deputy CIOs for IT Operations and IT Security – along with oversight and guidance for the IDMS system in support of Code X. The NISE environment will respond to the President's Management Agenda (PMA), the Federal Enterprise Architecture (FEA), and applicable legislative mandates, as well as Government and industry standards.

Advocacy is the responsibility of the NASA CIO, with support of Center CIOs and Program Executives.

Management

The figure below shows the organizational structure for the NISE Project and its components.

Figure 3, NISE Project Organization



Project Requirements

IIIP Program Requirements Overview

The NISE Project directly supports accomplishment of the requirements in the NASA IIIP hierarchy. Each lower level is derived from and consistent with higher level requirements. The focus of the NISE Project is on the activities in Level III, Project Requirements.

Table 3, Sources of NISE Project Requirements

LEVEL	REQUIREMENT SOURCE
I	Federal Enterprise Architecture (FEA)
II	Agency Mission and Business Requirements
III	**Project Requirements**
IV	Acquisition and Design Requirements
V	Implementation Requirements

An overview of Level III is provided below. For complete details, please see the IIIP Program Plan.

Level III. IIIP content includes ongoing operational activities within components described in this level, as well as projects for providing enhanced capabilities and correcting security vulnerabilities, enabling NASA Enterprises, Centers, and programs to deliver products and services to customers and stakeholders more effectively and efficiently.

IIIP Requirements Flowdown To the NISE Project

The NASA EA provides the methodology to define how NASA's IT will be implemented and managed. Activities managed at Level III of the IIIP are broadly divided among areas that support Security Services, Communication Services, Computing Services, and the Electronic Work Environment.

The NISE Project is focused on specific elements in the area of Security Services, which is further decomposed into Account Management, Network Security Perimeter (NSP), Cyber Identity Management, and Internet Protocol Address Management.

Federal changes mandated by the Office of Management and Budget (OMB) and increasing use of identity management systems across Government agencies drive the requirements for NASA to develop a robust identity system such as IDMS. Identity management is at the core of the services envisioned through NISE – and IDMS is directly responsive to the PMA mandate to better share information among Government bodies at all levels.

The development, integration, and Agencywide deployment of the Code X IDMS system is a major responsibility of the NISE Project.

The scope of the NISE Project also involves coordination of technical requirements and complementary implementation support for the One NASA Smart Card Project. This effort will implement Federal Identification Cards (FIC) using a dual-chip, contact and contact-less, GSC-IS v2.1 card at each NASA Center and facility.

NISE Project requirements include the requirements of its individual components in addition to overarching integration and security requirements to ensure that NISE provides a unified, consistent, and secure IT services infrastructure across NASA.

NISE Project components will support the following NASA IT infrastructure services:

- A single Agencywide infrastructure for identity management
- A reliable, centralized source of Agencywide directory services
- Accurate and consistently administered account provisioning services
- Uniform security and auditing standards for personal identity
- Effective, accurate, and prompt management of physical and logical access
- Common credential tokens for routine access to NASA physical and logical resources

Technical Summary

The NISE Project will provide integrated IT services for identity management, directory services, and account management. These services are intended to be used across all major

Agency applications and Center systems to authenticate users and to grant access to IT accounts based on approved security privileges and other relevant criteria.

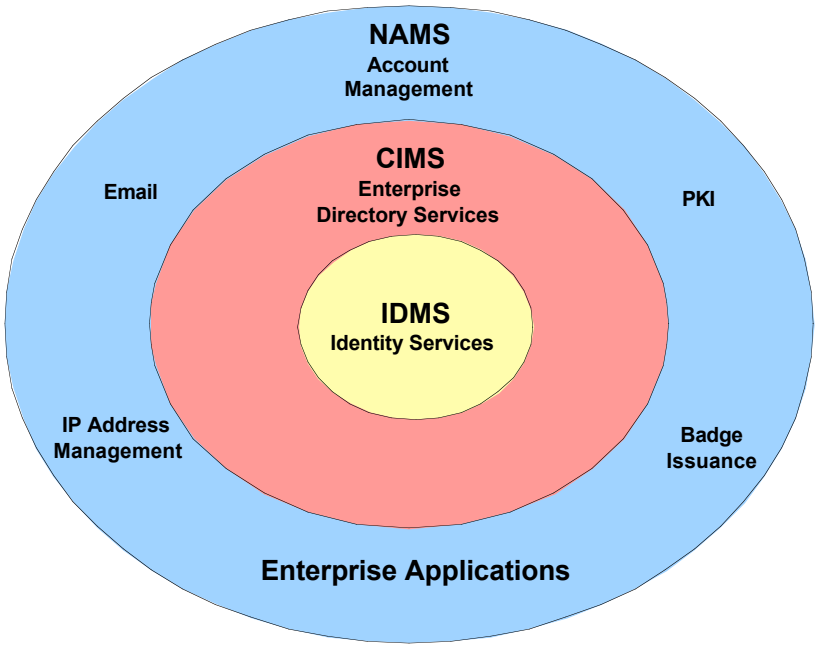
NISE – A System of Systems

The NISE Project will result in an integrated "system of systems" with distinct layers of functionality. The core of the system is identity services – provided by IDMS across all Agency applications and NASA Centers and facilities. "Outer" layers of NISE are customers for the layers of services within – starting from the core IDMS service.

Because of this set of relationships, each major component of NISE will participate in an integrated data architecture designed to ensure that shared data is accurate, current, and of known quality. IDMS personal identity data shall be considered authoritative and measures will be taken to safeguard data accuracy and quality as replicated in CIMS and then shared to support logical uses in the NAMS system.

A structured series of interlinked Interface Definition Agreements (IDA) for each of the NISE components – and all other customer and supplier IT systems – will support management and control of the data elements flowing through NISE Project systems. A conceptual view of the NISE Project system layers is shown below.

Figure 4, NISE Project Systems Layers



Because outer layers depend on inner-layer services, the inner layers will emphasize operational redundancy and contingency as discussed in Section 7.3, Systems Operations Concept. And to the greatest extent possible, inner layers will supply all the data required by the adjacent outer layer, i.e., NAMS will interface with IDMS only through CIMS.

In some cases such as enterprise badge issuance, an application may communicate directly with IDMS, although this is an exception governed by the IDMS data owner, Code X.

System Architecture

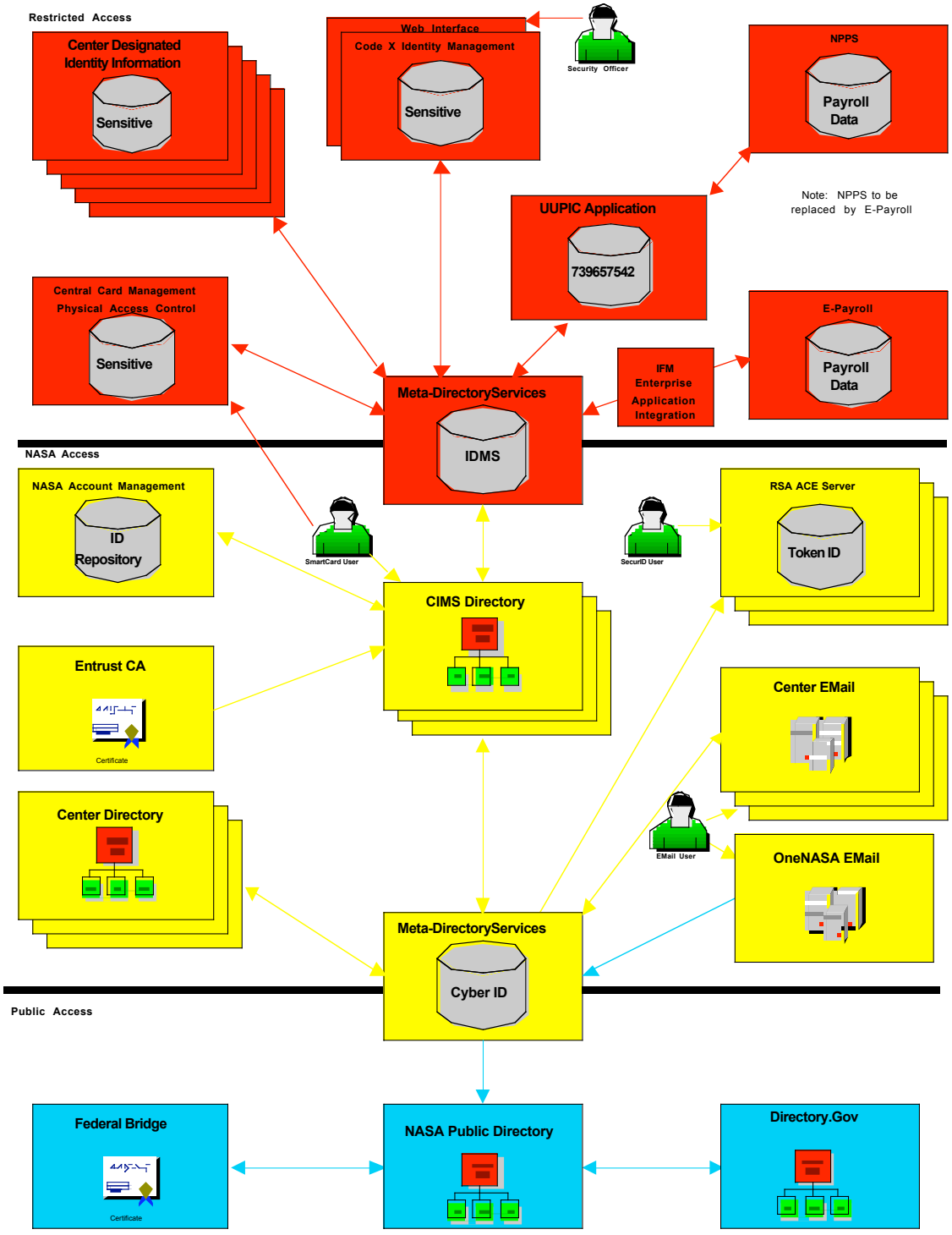
Vendor neutral systems and modular design are central concepts of the NISE architecture. Thus, the NISE environment architecture is intended to use proven "best of breed" products to satisfy its project requirements with the goal that the deployed architecture will be flexible and capable of adapting and evolving to meet the future needs of NASA missions and programs.

Based on this modular structure for NISE, if any component service requires a change that results in selection of a different product, the project will obtain "best of breed" solutions to satisfy emerging system requirements without compromising interface and other requirements for related components. In order to accomplish this goal, each component of the NISE system exposes well-accepted industry standard interfaces to other NISE components.

At a high-level, the complexity of the NASA systems environment provides further support for the need to deploy open systems with well-defined interfaces across the environment that NISE system components will serve and support.

The figure below shows the inter-relationships among IDMS, CIMS, and NAMS and customer applications for these systems. Security plans and procedures supporting each component of NISE will be developed in an integrated, streamlined approach that avoids duplication of efforts and serves to improve the security posture of all NISE systems.

Figure 5, CIMS, and NAMS Relationships



An architectural overview and design rationale for each NISE component is provided in the NISE Project Plan.

Systems Operations Concept

The NISE Project will provide centralized management with the capability for local administration. This approach allows the services to be managed under the same set of administrative controls, policies, and security – and with management processes that are centralized across geographically-dispersed nodes.

The NISE Project will implement a four-tier operational model that includes:

- Hardware – Responsibility for physical hardware maintenance. This may include dispatching operations personnel at NASA Centers and facilities as required.
- Software – Responsibility for operating system versions, patches, and virus updates.
- Applications – Responsibility for application engineering life cycle.
- Monitoring – Responsibility for monitoring all components (hardware, software, and applications).

Service level Agreements (SLA) will be established that support customer requirements for availability and reliability. In order to meet this requirement, each NISE component will provide redundancy at the network and system levels (e.g., disks, power supplies).

Backup tapes will be stored according to NASA-approved requirements. A daily procedure will be defined to store and recover backup tapes by authorized individuals.

Any mission critical components of IDMS, CIMS, or NAMS will be designed to assure continuity of operations. Contingency of Operations will be provided by a number of methods. The method will be determined by the predicted type of outage, its severity and impact on the user environment, and the time required to restore services as defined in applicable SLA and Operating Level Agreements (OLA).

Additional detail will be provided in the NISE Continuity of Operations Plan.

Schedules

The NISE Project Schedule defines the schedule management activities to be addressed across the NISE Project and its components including:

- Schedules to be maintained
- Control points
- Reporting requirements
- Schedule maintenance
- Scheduling tools

The NISE Project Schedule will provide details on the overall schedule management process and establish control points (milestones) at the Enterprise, Project, and Center levels.

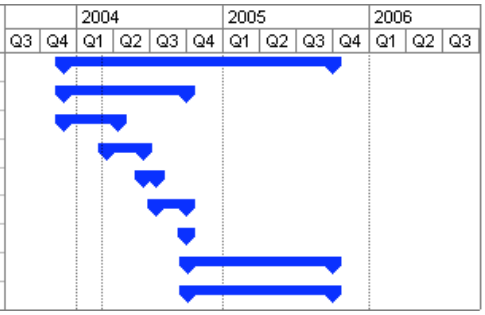
Overall strategies and schedule plans for the FY04 Agency Initial Rollout phase will be confirmed in the first half of FY04. Detailed schedules for Agency Design Phase and Pilot Implementation Phase will be developed during the Formulation Phase in FY04. Schedule baselines, reporting and control points, and schedule commitments will be established at the conclusion of this phase. Timelines for Agency Rollout and Initial Operations are contingent upon establishment of approved plans with each Center to define schedule and resource commitments.

As each major life cycle phase nears completion, schedules and baselines for subsequent phases will be completed and reviewed using information and knowledge gained during the previous phase.

The figure below shows the high-level DRAFT schedule for the NISE Project that responds to project schedule phasing identified in the IIIP Program Plan. This schedule will be updated after the Agency Design Phase is completed in April 2004.

Figure 6, NISE FY04 and FY05 DRAFT Project Schedule

Task Name	Duration	Start	Finish
1 NISE Integration Project Schedule	479 days	Mon 12/1/03	Fri 9/30/05
1.1 FY04 Integration Project	219 days	Mon 12/1/03	Fri 10/1/04
1.1.1 Formulation	96 days	Mon 12/1/03	Tue 4/13/04
1.1.2 Agency Design	66 days	Wed 3/17/04	Wed 6/16/04
1.1.3 Pilot Implementation	21 days	Thu 6/17/04	Thu 7/15/04
1.1.4 Agency Initial Rollout	54 days	Mon 7/19/04	Thu 9/30/04
1.1.5 Initial Operations	1 day	Fri 10/1/04	Fri 10/1/04
1.2 FY05 Integration Project	260 days	Mon 10/4/04	Fri 9/30/05
1.3 Sustaining Operations	260 days	Mon 10/4/04	Fri 9/30/05



Success Criteria

Criteria for success of the NISE Project include the following:

1. Creation and use of an employee identifier for all civil servants and contractors that eliminates the need to use SSNs for employee identification.
2. Creation of a centralized repository of assured identities for NASA civil servants and affiliates that supports the implementation and operations of an Agencywide directory, centralized account management services, and improved and streamlined identity business processes.
3. Improved security evaluations from OMB. The current score issued in FY04 will serve as a benchmark.

4. Establishment of an Agencywide directory service that removes reliance on local X.500 directory resources.
5. Implementation of an accurate, consistent and uniform account management process for NASA applications.
6. Improved security and audit capabilities for Agency account management.
7. Quantifiable improvements in the capability to support IIIP objectives to enable anywhere, anytime access to systems and services across the Agency.
8. Secure, consistent, expedient, accurate account management environment across NASA in support of One NASA.
9. Comprehensive account management solution for both systems and applications environments in a phased approach – in terms of IT management, business, and technical architectures.
10. Development and approval of all critical NISE Project baseline documents including design, architecture, system definition, policy, procedures, and an IT Security Plan.
11. Consistent and uniform Agency processes for account authorization – Request, Create, Maintain and Close Accounts.
12. Consistent and uniform Agency processes for account authentication based on the use of simplified sign-on authentication provided by NASA Smart Cards.
13. Centralized audit trails that track access requests and support independent audits of security practices and procedures.
14. Center cross-platform interoperability with NAMS.
15. Compliance with Agency standards and architecture.

8.2 NASA Security Perimeter (NSP)

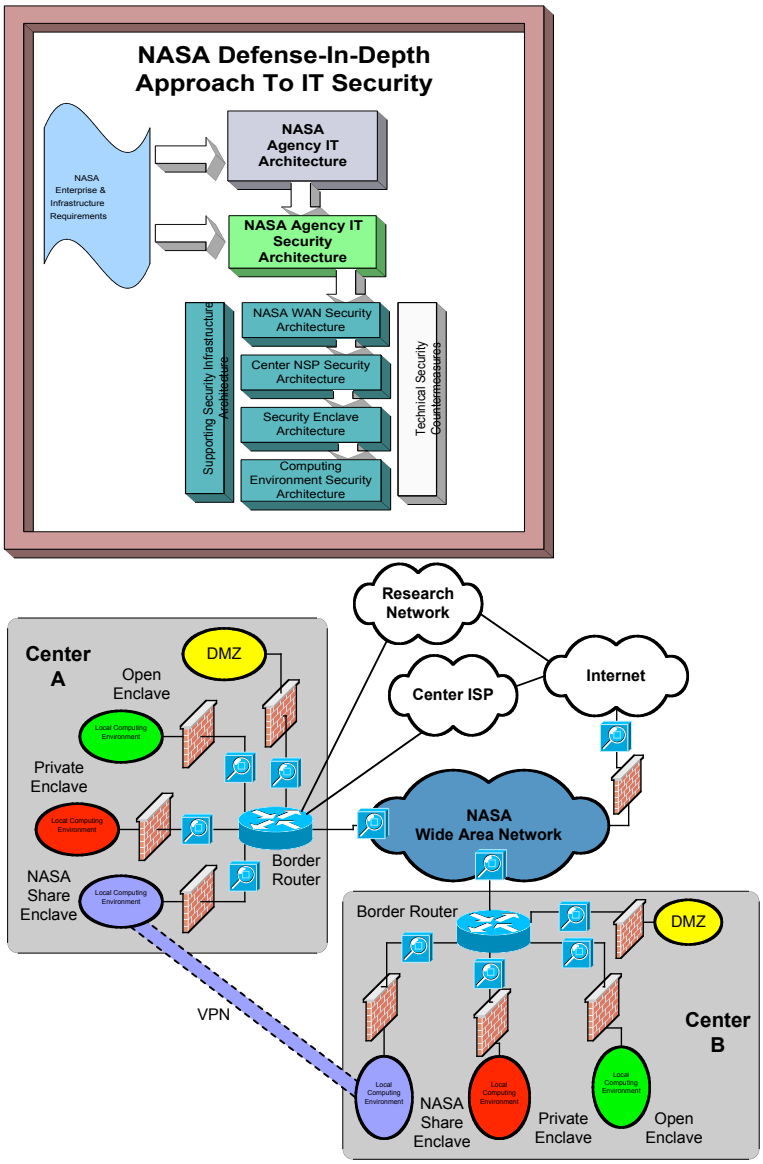
This project will provide agency-wide Network Security Perimeter implementation standards. This project plans to utilize state of the art technologies to ensure network availability, reliability, security, and compatibility with enterprise applications. In addition, this project will test and evaluate the functionality, performance, interoperability, and ease of use of various leading vendor solutions. This project will benefit each and every field center by providing needed guidance on standard architectures and designs representing NASA's "best practices" for NSPs as well as detailed testing, characterization, and evaluation of hardware/software implementations of this architecture. In addition this project will purchase upgrade hardware and software systems to replace existing equipment at those Centers where required, to ensure the uniform provisioning of common services and capabilities across NASA Centers.

Current status – Several meetings have occurred between the Centers' network operations communities to review proposed approaches and reference design. Funding delays have impacted existing schedules. Agency firewall and VPN solution is being evaluated and a recommendation is being developed. First generation network flow based monitoring complete and next version of the monitoring software are being deployed. Further resolution of Agency

Security Perimeter (ASP) requirements, roles, architecture, and implementation will further assist in defining NSP technical controls to be standardized and implemented.

Architecture - This project will provide an agency-wide Network Security Perimeter implementation standard to address the shortcomings of the current disparate Center systems while utilizing state of the art technologies to ensure network availability, reliability, security, and compatibility with enterprise applications. The outcome of this effort is a common implementation of a standardized "One NASA" Network Security Perimeter across the agency. This implementation will provide a single set of consistent Center network perimeter services that will allow the programs and projects throughout the agency consistent network services and security postures that facilitate sharing of data, information and resources throughout the agency without having to interface with up to eleven (11) different security organizations, each of whom has a different set of policies and network security perimeter implementations. In addition this infrastructure allows for commonly applied security zones throughout the agency so that various services and assets can be located and shared securely among the centers, contractors, and partners as needed. This consists of common architecture, network security zones, policies, and hardware/software systems. Sharing of threats and vulnerability information across the agency will be made possible by the standardization of NSPs and by use of Network Security Information Systems, which collects and correlates data from key network security devices throughout the agency. Reaction time to new threats and vulnerabilities will be greatly reduced agency-wide as all centers can benefit from the work, ideas, and experiences of any one center; as well as from centralized threat and vulnerability management assessment and prevention efforts – a logical follow-on part of this work.

Figure 7



Next steps – Assist in the effort to solidify ASP requirements, roles, architecture, and implementation so that there's clear understand functionality, management, and technical controls required for NSP. Implement an agency VPN solution following test and evaluation phase. Revise and finalize agency technical standards documentation to map with requirements of OMB and NIST. Convene Configuration Control Board to ratify standards and initiate governance.

High level schedule

- Finalize Version 1.0 of NSP Technical Implementation guide (Dec, FY04)
- Provide Standards & Guidance for Standardized Guest Network Implementation. Coordinate agency wide implementation. (September, FY04)

- Coordinate Policy and implementation for Agency VPN Access for Employees.(September, FY04)
- Conduct Feasibility Study on Agency Dial-in (December, FY04)
- Conduct flow based IDS/DOS monitoring tools testing for NSP standardization recommendations (November, FY04)
- Devise implementation plan and procure systems for Centers' NSP upgrade (September, FY04)
- Setup Model NSP Prototype(s) for use as reference systems (September, FY04)
- Implement first Agency Shared Secure Enclave by Deploying Agency site-to-site VPN Capability (Q1, FY05)
- Implement agency wide Intrusion Prevention System solution (Initially Passive Monitoring, but eventually migrating to Inline), (Q4, FY05)

End state/deliverables -- The eventual outcome of this project is a common implementation of a standardized "One NASA" Network Security Perimeter across the agency. This implementation will consist of common architecture, network security enclaves, policies, and hardware/software systems (where possible).

8.3 XML

Background

As documented in the NASA XML Business Case, government, industry, and academia are all embracing XML as a technology that will assist in the sharing and reuse of information. Virtually all major software vendors including IBM, Microsoft, Sun, SAP, Oracle, and Software AG have made XML important parts of their product offerings.

The Office of Management and Budget has included XML as a key technology in the Federal Enterprise Architecture (FEA). Since agency Enterprise Architectures must align with the FEA, NASA must include XML as part of its infrastructure capabilities.

XML has been so widely adopted because it is an open standard and is relatively simple to learn and use. It provides a self-describing way of labeling both text and data. XML allows information content to be processed with very little human involvement and exchanged across diverse computer hardware, operating systems, and applications. These capabilities are extremely valuable to an organization like NASA that has diverse missions, works with many external partners, and by necessity must use computer hardware and software supplied by many different vendors. While XML is used in many applications not related to the Web, the value of XML will continue to grow as Web Services become an increasingly important tool for conducting business.

Objectives

This project supports the goal of the IIIP-- provide the information systems and technologies that enable anywhere, anytime access to information and people. Enabling consistent implementation of agency-wide services and applications is fundamental to providing the

information systems and technologies that enable anywhere, anytime access to information and people.

The goals set by the IIIP for the NASA XML Project are:

- "Future proof" information against periodic technology change, facilitate integration and promote collaboration.
- Reduce the cost of integrating data, replication of data and warehousing (where these are clearly needed).
- Allow communication between applications running on different Web servers

The specific objectives of the NASA XML Project conform to the IIIP goals and include:

- Provide to NASA programs and projects the tools, mechanisms, and assistance they need for discovery of XML-related information in order to increase re-use of information and interoperability of information systems
- Increase awareness of and share lessons learned about XML and XML-related technologies
- Provide training to Agency developers on specific aspects of XML-related technologies
- Provide to the NASA CIO recommendations for Agency XML-related policies and standards.
- Coordinate Agency XML Communities of Interest.

Customer Definition and Advocacy

The Project Manager will ensure that customers are an integral part of the Project throughout its life cycle in order to clarify requirements and ensure customer satisfaction with delivery of quality services within budget and schedule. Customers for the NASA XML Project include the Agency's XML application and web developers, the programs and projects that currently utilize XML and XML-related technologies, and programs and projects that could benefit from XML technologies but need assistance in understanding it's the resulting benefits and issues before doing so. The project will involve its customers, including XML practitioners at all levels, through outreach via the NASA XML Working Group as well as through information disseminated via web sites and the Enterprise and Center CIOs.

Advocacy is the responsibility of the NASA CIO and the NASA Deputy CIO for Information Management, with support of Center and Enterprise CIOs. The NASA CIO also serves as the primary liaison for coordination with other Federal agencies and providing information to the Congress, OMB, and other stakeholders.

Technical Summary

The activities conducted under the NASA XML Project will assist the NASA CIO in formulating NASA-wide policy on XML technologies and in developing a strategic vision. The project will deliver recommendations for appropriate uses of XML, assist in the creation and registration of XML artifacts, facilitate communication among NASA communities of interest and external standards bodies, and work with other Federal Government agencies toward common

Government-wide goals. The project will also provide mechanisms for data gathering, web site development, product evaluations, training, logistical support and many other activities. Any activity that is associated with realizing the benefits of XML technology within NASA is within the purview of this project.

Project Requirements

The desired outcome of the NASA XML project is to increase the effective use of XML technologies within NASA, in order to help realize the benefits of these technologies as well as to ensure compliance with new Federal regulations. The requirements for the project are driven by requirements both external and internal to the Agency. The external requirements are driven by the Federal-level changes mandated by the Office of Management and Budget (OMB) and the increasing use of XML by our partners and by Information Technology (IT) vendors' products. XML is directly responsive to the President's Management Agenda mandate to better share information among government bodies at all levels. The requirements internal to the Agency reflect the need to be more efficient and effective in the way that NASA manages its information. The NASA XML Business Case documents in detail the external and internal factors requiring the adoption of XML within the Agency.

System Operation Concept

The NASA XML Project described in this plan will not result in the development of a system, but rather in the delivery of a set of services and capabilities. The only system planned for use in this project is the Department of Defense (DOD) XML Registry. This system is operated by the Department of Defense for the use of its constituent components and for NASA. The operational aspects of this system are out of the scope of this project plan. Also, the project will stand up an Independent Testing and Verification capability which, while not a system per se, will require development of operational concepts and procedures that will be included in that activity.

System Architecture

The product of the NASA XML Project will not be a specific system or application. Rather, it will result in a collection of recommendations, guidelines and procedures based on existing and developed components. The recommendations will include advising the Agency on how to leverage the standards, protocols, vocabularies, and best practices that comprise XML technology as it stands today. Architectural components such as World Wide Web Consortium (W3C) Schema , Web Services Definition Language (WSDL), and Unified Modeling Language (UML), and protocols such as Simple Object Access Protocol (SOAP), and XML Metadata Interchange (XMI) are just a few examples of key components that will be evaluated and considered for Agency use during this project. Nevertheless, wherever pertinent, sound system engineering principles will be followed when developing project products.

If tasked to do so, the NASA XML Working Group will assist in defining the XML infrastructure portion of the NASA Enterprise Architecture under the direction of the Enterprise Chief Architect. Linking its missions and programs to an overall IT strategy, the NASA Enterprise Architecture will support NASA's strategic enterprises, infrastructure, and internal

operations, and will allow the Agency to provide services to citizens in diverse business areas. Moreover, the NASA Enterprise Architecture will be consistent with the goals of the Federal Enterprise Architecture, an initiative led by OMB that is based on a common set of reference models.

The Technical Reference Model (TRM), one of five interrelated reference models comprising the Federal Enterprise Architecture framework, will provide input for the NASA XML project. The TRM, first released in June 2003, is a hierarchical foundation that describes how technology is supporting the delivery of the service component. The TRM outlines the technology elements that collectively support the adoption and implementation of component-based architectures.

The recommendations of the NASA XML project will also be guided by another reference model of the Federal Enterprise Architecture, the Data and Information Reference Model (DRM). The DRM will describe, at an aggregate level, the data and information that support program and business line operations. The model will aid in describing the types of interaction and exchanges that occur between the Federal Government and its various customers, constituencies, and business partners. The DRM is scheduled for release in calendar year 2003.

System Constraints

One important aspect of this project will be the submission and retrieval of XML-related information into and from the DOD registry. The design, capabilities, rules, policies, and processes associated with the registry have been established by DOD and represent constraints on the project. It is not clear at this time whether or not this registry, as it now exists, will meet the evolving XML needs of NASA programs. The project is treating the use of the DISA XML Registry as a risk. Please reference the NASA XML Project Risk Management Plan for the planned mitigation approach for this risk.

Another primary constraint on the NASA XML Project is the requirement to be consistent with the goals of the Federal Enterprise Architecture (via the reference models described above) and the E-Gov act of 2002. The NASA Enterprise Architecture, now being developed, will also constrain this project, since it is important that all aspects of the NASA Integrated Information Infrastructure conform with the architecture.

Facilities

The two ongoing facilities required by this project include the DoD XML registry and the NASA Video Teleconferencing Services (ViTS) rooms that will be used extensively by the XML Working Group meetings. The project will also stand up a web site in support of the NASA XML Working Group.

In FY05 the project will initiate an effort to create a facility for the testing and integration of XML-related products in support of the entire NASA XML community and in support of development of NASA technical standards. Just as the duplicative testing and evaluation of workstation software and hardware once performed by many NASA Centers was replaced by an Agency-wide capability, NASA will stand up an Agency-wide XML support capability that answers the collective needs of individual Centers, programs, and projects. This centralized

capability will not preclude testing and integration by individual initiatives to meet their specialized requirements.

Logistics

Logistical activities will consist primarily of: XML Working Group meetings, training of NASA personnel, attending conferences and meetings of the Federal XML Working Group. Help desk activities in support of registry usage also represent an important logistical component. Operational procedures for the help desk will be developed as part of this project

Schedule

Target dates for activities and milestones relative to Project critical activities have been established, and will be tracked and controlled. The Project Manager will maintain a schedule to support the control points that enable measurement of project accomplishment. The schedule milestones and activities will be specific enough to provide guidance to the project team, while providing management with visibility into the on-going performance of the implementation effort when accomplishments are compared to plans.

8.4 Wide Area Network

Current State

This component consists of a set of Wide Area Networks (WANs) that provide production services as well as services provided by several commercial Internet Service Providers. The bulk of the services are provided through the NASA Integrated Services Network (NISN) managed at the Marshall Space Flight Center. Many Centers also have other WAN gateway connections for either mission specific functions or for services not available through NISN.

The NISN WAN provides for the transport and delivery of NASA WAN communications services both domestically and internationally. The NISN provides both digital and analog services, dedicated and switched circuits, packet data transport, multi-protocol Wide Area access, domain name services, and various data networks.

At each Center it is typical that the WAN connects to the local area network (LAN) via a security perimeter network referred to as the "Isolation Network". This isolation network provides firewalls and/or routing and/or other security functions to separate external networks, corporate networks, and internal networks. The NISN network currently provides much of the functionality for the majority of the Agency including Network Operations Center functions, cost optimization and responsive services.
Future State

The WAN Upgrade Project is a part of the overall NASA Integrated Infrastructure Program. The NASA Integrated Infrastructure Program is a transformation strategy for managing the

Information Technology (IT) infrastructure as an integrated architecture, and providing an infrastructure that NASA can evolve and adapt.

In June 2003 the NASA CIO assembled a team of NASA WAN and Local Area Network (LAN) representatives, and independent advisors to define a network architecture capable of supporting the NASA Integrated Services Network (NISN) mission, the mission support infrastructures, and OneNASA initiatives into the future.

Objectives

The WAN Architecture Team identified the following objectives for the WAN Implementation Sub-Project:

- Migration to Synchronous Optical Network (SONET)/Lambda services in the NASA WAN core
- Demarcing carrier services and monitoring equipment at carrier independent exchange facilities (CIEFs)
- Providing SONET/Lambda services to NASA Centers
- Providing incremental security improvements leading to eventual implementation of an agency security perimeter
- Providing traffic flow monitoring within the NASA WAN

External Drivers

The current Bush Administration has taken an active role in improving the management of IT resources across the Federal Government. The Presidents Management Agenda provides the framework for improved management and coordination of IT and sets forth a number of actions to include: development of the Federal Enterprise Architecture, a business case focused evaluation process for IT activities, and a budget process that provides rigorous standards for determining the merits of IT investments.

Internal Drivers

The nature of NASA business now requires an increased ability to work across Centers generating requirements that, by their nature, are best met at the agency level. The shift in how information and knowledge are generated, used, and managed when coupled with the competition for limited budgets, dictates a more strategic approach to providing information infrastructure services across NASA. There are a number of NASA specific drivers for approaching IT systems more strategically. These include:

- OneNASA
- Fixing and improving NASA's IT infrastructure to meet the NASA Vision and Strategic Plan
- Positioning the IT infrastructure to support Agency-wide applications such as Integrated Financial Management (IFM)
- Ensuring availability of integrated services across Centers
- Supporting a robust collaborative program and management environment
- Achieving reduced cost of services to the customers

- Improving security
- Delivering consistent, quality services to customers

Customer Definition and Advocacy

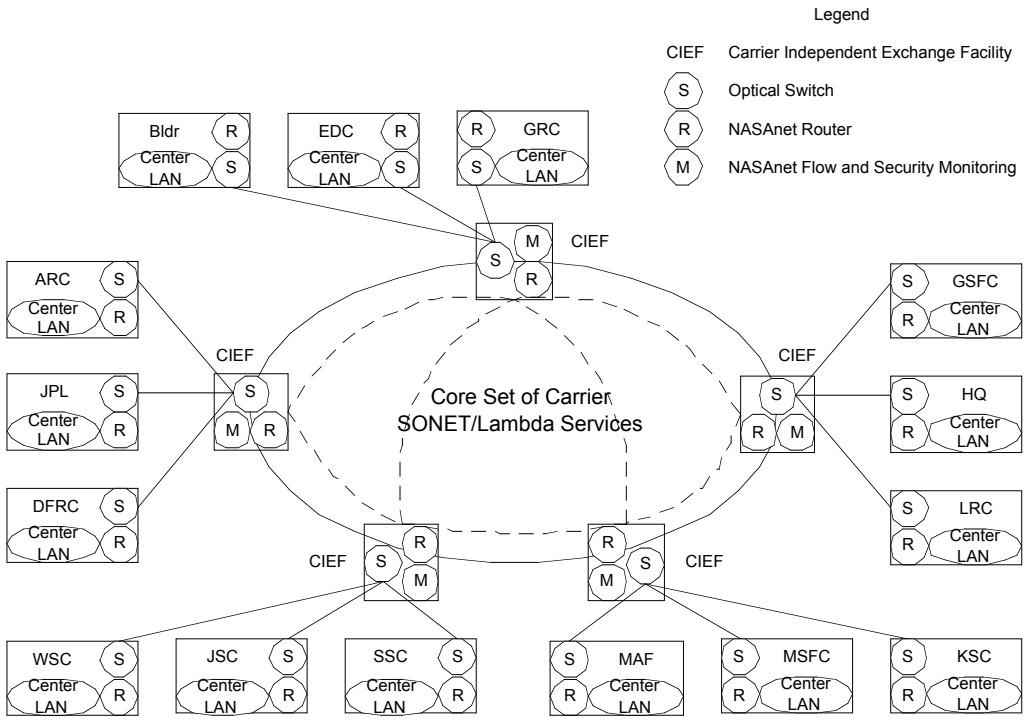
Customers are all users and stakeholders of the NASA WAN services. The Project Manager will ensure that customers are an integral part of the Project throughout its life cycle in order to clarify requirements and ensure customer satisfaction with delivery of quality services within budget and schedule.

To further customer satisfaction and ensure an effective implementation process, the Project Manager, in conjunction with the NISN Project Manager will develop a Network Transition Plan. The transition plan will describe a methodical process for educating users and stakeholders on the changes that will take place, and how they affect the individual user. The plan will further provide for change management, training, and awareness to aid the transition process.

Technical Summary

The WAN Implementation Project is both a consolidation and a modernization effort designed to provide a core service for the NASA customer community. The goal is to implement a network that will improve reliability, availability, network management capabilities, and security in addition to improving overall network capability.

Figure 8, Baseline Architecture (Conceptual)



Schedule

Target dates for activities and milestones relative to Project critical activities have been established, and will be tracked and controlled. The Project Manager will maintain a schedule to support the control points that enable measurement of project accomplishment. The schedule milestones and activities will be specific enough to provide guidance to the project team, while providing management with visibility into the on-going performance of the implementation effort when accomplishments are compared to plans.

Implementation Approach

The implementation approach for the WAN Implementation Sub-Project has four major lifecycle phases, which include a Re-design phase, Core Infrastructure Build-Out phase, Transition phase, and the Operational Phase. The WAN Project Manager and the NISN Project Manager will develop a detailed transition plan and schedule. This transition plan and schedule will be briefed to the NASA customer community prior to transitioning any operational traffic to the new network.

The Phases and key tasks included in the WAN Implementation Sub-Project are:

- Design Phase
- Assess requirements
- Weigh options
- Finalize recommendation

- Core Infrastructure Build-Out Phase
- Implement the core system based on the approved design
- Conduct system and integration testing
- Identify, develop, and test legacy system interfaces, reporting capabilities, and security and control profiles
- Benchmark test the complete core and update procedures
- Transition Phase
- Move services to the new core
- Maintain parallel services
- Turn down legacy services
- Operational Phase
- Extend Information Mission Control Center (IMCC) performance monitoring capability into Centers based on agreements
- Extend Quality of Service (QoS) capability out to edge routers as they are replaced
- Extend IMCC security monitoring capabilities

8.5 Public Web

Current State

This component includes Center and agency-wide development and hosting services focused on providing web access for the public to information about NASA – whether for business opportunities, for general public awareness, for educational purposes, or for dissemination of knowledge gained from NASA research and operations. NASA publishes more than two-million web pages devoted to space science in its fulfillment of the Space Act that established the Agency. The Internet is the ideal medium for NASA in the dissemination and exchange of ideas.

NASA has deployed an initial version of a OneNASA Portal which is intended to begin to provide the public with a single point of entry to NASA's web environment, providing the audience with an easy way to navigate through NASA's public web content without knowledge of NASA's organizational structure. Over the past two years NASA has developed and fielded an integrated One NASA Public Web Portal at http://www.nasa.gov. The service has been outsourced, and supporting editorial review processes, information gathering and dissemination processes, and content management services have all been developed and the service is now the official portal for public information. Not all content or public web sites have yet been consolidated, however, a very large amount of some of the most visible NASA public data has been and is regularly maintained. In fact, mission data from the Mars Explorer Rovers has been all hosted via the outsourced portal and relieved the Agency networks of very high traffic demands.

Future State

The public portal project is being extended in scope and effect into a broader project to consolidate all web publishing.

Overview

With the transformation of NASA and the need for consistent information to be delivered from each NASA site, it is essential that the information from each Center on the web is made consistent. Migration to the NASA Portal has, to date, been a voluntary choice for each mission, program, project, or Center, but this has led to a continued inconsistency in the linkage to a single set of NASA goals and initiatives. At this time, NASA leadership has decided to make the Agency's best content consistent and available through the NASA Portal at www.nasa.gov. This entails bringing both critical, popular, and informational NASA public sites into the Portal, as had been originally intended. The infrastructure has been built to accommodate the migration of the essential sites noted below, but changes in the information architecture and navigation structure will be required. In addition, a significant amount of work is required to migrate existing content, train current publishers, and establish the workflows necessary for ongoing publishing needs.

Purpose of Migration

There are a number of reasons that make this migration necessary within NASA. These reasons are based on the Internet user comments, the new mandates from the Office of Management and Budget (OMB) and need for increased efficiencies in operation of NASA's web presence. Sites need to be migrated into the Portal infrastructure in order to

1. Manage the content and its presentation
2. Have effective search mechanisms through existing and new NASA content
3. Manage the security of the hardware and software components of the web infrastructure to meet the new security mandates for federal agencies
4. Achieve efficiencies in managing the web software infrastructure
5. Respond easily to spikes in public demand for NASA content
6. Keep the public traffic to a minimum on the NASA operational network. This will increase efficiency and safety in operations of NASA's missions and projects.
7. Comply consistently with Information Accessibility (508) and Privacy (P3P) Federal requirements

In addition to the technical considerations, governance practices require that

8. The public is provided access to NASA information and assets through a single interface
9. NASA presents a complete picture of the Agency's work in one Internet location
10. Agency information is presented in an engaging way, particularly for younger audiences
11. A consistent quality of information is provided to the public

Overall, the efficiencies of centralized operations from both content and technology infrastructure are necessary to manage NASA's brand which is considered by the general public and the scientific community as a stamp of authenticity and high caliber.

Content Management

NASA publishes material for different audiences at different levels of technical sophistication. Not all material that is publicly available in the NASA Web space is intended for the broad public audiences that are presently the NASA Portal's primary customers. Survey data clearly

shows that Internet users come to the Portal to obtain information on a broad range of NASA programs, and some of those users are looking for material with more depth than is appropriate for the Portal's top levels. For NASA's online public communications to succeed, the Portal must present the broadest possible view of NASA, while making it easy for users who want detailed information to find it. To give structure to that effort, the following levels of content have been identified.

1. Publicly available content: Any NASA content that is available via the Internet to anyone, without required authentication, regardless of the material's intended audience.
2. General content: Content intended for any general audience, usually at a technical level appropriate for readers without college-level education in science or engineering. In material at this level, technically sophisticated concepts must be clearly explained in laymen's terms.
3. Educational content: Content specifically intended for students or educators, written at a specified grade level. The content may be intended for use in formal educational settings or informal learning environments. Technically sophisticated concepts must not be more sophisticated than the target grade or education level.
4. News media content: Material intended to assist the news media in their coverage of NASA, its missions, its scientific discoveries and technological achievements. Usually more technically sophisticated than general content.
5. Professional content: Content with a specific purpose in mind intended for targeted public audiences such as science and technology enthusiasts, science and engineering professionals and researchers. Professional content could include procurement material for business and industry, grant material for scientists and researchers, or scientific material for use in collaborative research.
6. Regional Content: Content for regions with a major NASA presence such as NASA Centers and JPL.

To accommodate the above categories of content the present Information Architecture (IA) of the NASA Portal will be augmented and a new navigation structure applied that enables Professional and Regional content to be presented in a more prominent way based on findings from usability studies and focus group input. Some of this content may also appear in channels or portlets within the MyNASA section of the portal.

It is important to note that Editorial Management for the levels of content varies depending on the content and where the content is presented within the IA of the portal. The Office of Public Affairs will have editorial responsibility for content appearing in the top level of the IA while section editors from the mission directorates, functional offices and the Office of Education will have editorial responsibility for the other sections of the IA such as audience specific areas and channels appearing within the MyNASA section.

Levels of Integration

Due to the vast number of web sites and millions of web pages in NASA’s repertoire the process of migration maybe just one phase or a number of phases to reach integration with the Portal. The possible phases to be considered based on the complexity of the candidate site and the resources available for the task are as follows:

1. Full Integration: NASA content is physically moved to the Content Management System (CMS) in the Portal infrastructure and made public through the portal's caching network. All content is presented in the Portal's look and feel through the use of templates in the CMS. Content is updated in the Portal CMS by the content authors and developers from the NASA entity owning or generating the content. Metadata consistent with the Portal's standard and the NASA taxonomy standard are applied to all content. The content submitted to the CMS may appear in multiple locations such as the top level of the IA and/or the lower sections of the IA including mission sections and channels within the MyNASA section.
2. Hosting: NASA content is physically moved to a server in the Portal infrastructure and made public through the portal's caching network. The site is not migrated to the CMS due to the need of a server application not available within the CMS. Links to the content are provided within the Portal IA. The content is metatagged as per the Portal and NASA taxonomy standards. The content is managed and updated outside the Portal Content Management System (CMS) by the content owners or providers as per guidelines set by their mission, office or center Editorial Board representatives. The presentation of the content from these sites will utilize design and layout that are identical to the Portal's look and feel or an identified adaptation of the Portal's look and feel based on usability testing. It is important for the content to be indexed from such sites by the NASA Portal search engine to enable users to locate the content in a timely and effective manner.
3. Minimal Integration: This option is the least desirable but will be offered if lack of resources or the priority ranking prevents the full integration or hosting options to be implemented. The web site content remains on existing infrastructure but is made public through the portal's caching network with the URL of the site being presented in the format as the NASA Portal URL i.e. www.nasa.gov/website. Links are provided in the Portal IA at appropriate levels to this content. Content is updated outside the Portal Infrastructure. Just as in the hosting option above, the presentation of the content from such sites will utilize design and layout that are identical to the Portal's look and feel or have an identified adaptation of the Portal's look and feel based on usability testing. Also, it is important for the content to be indexed from such sites by the NASA Portal search engine to enable users to locate the content in a timely and effective manner. This option may also apply to NASA partner sites but will have restrictions as per federal guidelines on how the NASA logo and brand are applied.

Migration Steps

The sequence of tasks for migrating the content from the various NASA sites will be as follows:

1. Identify which sites are specifically to be imported and to what depth and amount of legacy content will be available within the CMS or simply via the Portal infrastructure. On initial analysis it has been found that approximately 170 sites in the nasa.gov domain account for about 80% of NASA's digital assets. Of those sites the Portal Team recommends that initially the following web sites be targeted for full integration into the portal infrastructure.

Center Home Pages and Public Affairs Sites

- ARC www.arc.nasa.gov
- ARC public affairs http://amesnews.arc.nasa.gov
- DFRC www.dfrc.nasa.gov (no PAO site)
- GRC www.grc.nasa.gov
- GRC public affairs www.grc.nasa.gov/Doc/news.htm
- GSFC www.gsfc.nasa.gov (no PAO site)
- HQ www.hq.nasa.gov
- HQ public affairs ftp://hq.nasa.gov/pub/pao (already completed)
- JPL www.jpl.nasa.gov (no PAO site)
- JSC www.jsc.nasa.gov (no PAO site)
- KSC www.ksc.nasa.gov
- KSC public affairs http://www-pao.ksc.nasa.gov and www.ksc.nasa.gov
- LaRC www.larc.nasa.gov
- LaRC public affairs www.larc.nasa.gov/news_and_events/
- MSFC www.msfc.nasa.gov
- MSFC public affairs www.msfc.nasa.gov/news/
- SSC www.ssc.nasa.gov
- SSC public affairs www.ssc.nasa.gov/~pao/news/
- Wallops www.wff.nasa.gov

The effort required for this migration will be borne by the public affairs offices at the respective centers.

Mission Offices/Enterprise Home Pages

- Exploration Systems http://exploration.nasa.gov ; http://spaceresearch.nasa.gov
- Space Operations http://hq.nasa.gov/osf
- Science http://spacescience.nasa.gov ; http://earth.nasa.gov ; http://science.nasa.gov
- Aeronautics http://aero-space.nasa.gov
- Education http://education.nasa.gov is currently in the NASA Portal at http://www.nasa.gov/education. Migration of program specific sites will need to be included into the portal infrastructure.

The resources required for this migration effort will be borne by the respective mission directorates or offices.

Additional analysis will be conducted of the remaining sites identified in Appendix A to determine the migration option most applicable to these sites based on their infrastructure needs and resources available from the content owners to facilitate the migration. A ranking priority will be established to to conduct the analysis.

Management Plan

The technical aspects in this plan will be managed by the Office of the Chief Information Officer, with content direction from the Office of Public Affairs. Implementation of the site

migration, quality check of migrated content, and training will be managed initially by Jet Propulsion Laboratory and later by the portal contract vendor Etouch.

Overall status of the task will be reported at weekly status meetings, at the existing NASA Portal Monthly Management Reviews, and on a web site that shows each of the sites in migration, current, status, and any issues (this will utilize the existing JIRA site for tracking purposes). Each individual site will be managed with a series of meetings and a standard procedure that includes initiation meetings, daily meetings during actual migration activities, and organized training classes.

Best practices from the sites that are being integrated will be included in the overall management plans for the content development, accessibility issues, and technology. The goal of this activity being to learn from these new sites and integrate, as appropriate, procedures and workflows into the overall NASA Portal structure.

NASA HQ shall be responsible for:

- Ensuring that all funds are received by JPL or Etouch in a timely manner to complete the work (regardless of the sources of such funds)
- Working with Center contacts to ensure that they are willing and available to commit to the migration of their sites. Once the names are delivered to JPL of each point(s) of contact and the funds associated with that site migration, the migration process can begin.

JPL or Etouch Systems shall be responsible for:

- Working with the NASA Portal Editorial Board and Office of the CIO to develop a set of four templates that will handle migration of the new sites
- Meeting with site owners and publishers as necessary to keep parties informed and prepared for managing the new site
- Migrating all appropriate content within the site URLs noted above
- Ensuring that content has been migrated accurately (quality check against existing content)
- Establishing redirects, DNS switches, and other aspects to ensure a smooth transition
- Conducting training for all publishers and site managers. There will be one training opportunity scheduled for each site team, with additional training available as space is available for other site team sessions and on a “train the trainer basis” (e.g., materials will be provided to a core team member of each site team to train additional or new team members internally).
- Tracking progress of each site’s migration status and all sites overall
- Providing cost estimates for each site migration for the purposes of NASA HQ allocating charges to individual site owners as necessary
- Providing the list of specific monthly fees applicable for each site for maintenance

Technical Plan

The existing NASA Portal infrastructure is able to handle the import of the sites noted above. Analysis of the additional 139 sites may drive increased storage or license needs and will be noted in the analysis report.

The key components of the technical plan include

1. Creation and deployment of standardized content (e.g., header and footer and links)
2. Creation and deployment of standardized look and feel through the use of templates as noted above
3. Creation and deployment of a naming convention to ensure a consistent URL navigation mechanism. For example,
   - If sites are expected to come in under the www.nasa.gov/XYZ nomenclature, effort will focus on naming structures that will be independent of the NASA organizational structure to ensure long-term stability of site names
   - In addition, potential conflicts of duplicative naming (e.g., science.jpl.nasa.gov, science.arc.nasa.gov, and science.nasa.gov would all be requesting www.nasa.gov/science) will be identified and brought to the NASA Editorial Board for resolution
   - Redirects from existing sites to the new URLs will be created
4. Technical infrastructure implications and future scalability will be identified as the site matures
5. Migration options will be voiced whenever appropriate for full content migration into the CMS vs. a hosting solution, including application hosting. For example, with the spaceflight.nasa.gov site, the ISS monitoring application has been brought into the Portal infrastructure and rehosted in a secure environment to ensure end-to-end functionality with the new site.

Requirements

In addition to normal requirements that follow from the NASA Portal task plan, additional requirements are:

1. Links shall be standardized that appear on Center and Mission Office sites
2. There shall be an affinity look and feel across Center and Mission Office sites, as well as other key public outreach sites
3. There shall be a standard naming convention, such as: grc.nasa.gov becomes www.nasa.gov/grc
4. There shall be a single publishing capability that pushes information out to multiple sites
5. The Web Site Registration System designed by Langley Research Center for the Office of the CIO shall serve as the single database for submission of requests for specific URL names.

Schedule

The overall schedule for this task is scheduled to begin on October 1, 2004. A slip in the start date equates to a slip (day for day) to the overall schedule. Estimated completion of this task would coincide with the end of the primary NASA Portal operations at JPL on November 30, 2004. If this start date were to slip, primary NASA Portal operations could be transitioned to NASA HQ while JPL completed this specific task.

Schedule option 1: The migration of individual sites will occur in parallel. Given that there are 25 sites on this target list, the estimated time to complete from the point of decision to the time the publishers are all using the CMS for publication, based on the experience in previous imports, training, etc., is 16 weeks. Timing for publishing new sites effectively limits the efficiency beyond 16 weeks.

Schedule option 2: Quickly agree on a blended approach that has all Center and Mission Office publishers putting all new content onto the NASA Portal under a single (or small number of) templates. Migration of older content would occur over the following several months (schedule to be negotiated). The initial work of training, "day one" content creation, and initiation would occur over 8 weeks, with the goal of having a first site available within two weeks to provide a benchmark and proof of concept. This approach will substantially reduce the short-term cost or allow diverting budget to more thorough separation of content from presentation.

2. Modify the information architecture of the portal and identify the import scope for the above-mentioned sites. A decision to use information architecture by sites or by site types will need be considered.

3. Templates will be developed for the migration and presentation of content in the following arenas:
   a. Offices
   b. Missions
   c. Centers
   d. Projects and programs

   The NASA Portal Editorial Board will validate the templates and navigation structure for different types of sites.

4. Migrating the content will involve the following steps:
   a. Mark and categorize content for import
   b. Decision to use information architecture by sites or by site types
   c. Depth of import - it will be important to consider how much past or legacy content will need to be migrated into the Portal CMS or Hosting environment.
   d. Import content from the targeted site into the Portal Infrastructure
   e. Conduct quality assurance of imported content
   f. Apply metatags as per Portal and NASA Taxonomy standards
   g. Create collections within the Portal IA
   h. Create index pages
   i. Incorporate into the NASA search engine
   j. Conduct final quality assurance on content

9 Appendix B Examples

9.1 Johnson Space Center Mission Control Center (JSC MCC)

The MCC provides support to the International Space Station and the Space Shuttle Transportation System through the following functions: flight reconfiguration, product generation, mission planning, command and control flight operations, flight controller and crew training, and software development.

The MCC is providing a mission specific delivery of service that is very specialized and is difficult to leverage outside Space Operations. The SRM does not really lend itself to a complete, detailed analysis of the MCC application. MCC functions map into the SRM into the following Key Service Domain/Service Type/Components classifications:

- Process Automation Services (Domain) - Tracking and Workflow (Type) - Process Tracking (Component)
- Business Management Services (Domain) - Management of Process (Type) - Change Management, Configuration Management, Requirements Management, Quality Management, and Risk Management (Components)
- Digital Asset Services (Domain) - Document Management (Type) - Document Imaging and OCR, Document Referencing, Document Revisions, Library / Storage, Document Review and Approval, Document Conversion, Indexing, and Classification (Components)
- Digital Asset Services (Domain) - Knowledge Management (Type) - Information Sharing, Knowledge Capture, and Knowledge Distribution and Delivery (Components).
- Business Analytical Services (Domain) - Analysis and Statistics (Type) - Modeling, Predictive, Simulation, Mathematical, and Structural / Thermal (Components)
- Business Analytical Services (Domain) - Visualization (Type) - Graphing / Charting, Imagery, Multimedia, and CAD (Components)
- Business Analytical Services (Domain) - Reporting (Type) - Ad Hoc and Standardized / Canned (Components)
- Back Office Services (Domain) - Data Management (Type) - Data Exchange, Data Mart, Data Warehouse, Meta Data Management, Data Cleansing, Extraction and Transformation, Loading and Archiving, Data Recovery, and Data Classification (Components)
- Back Office Services (Domain) - Assets / Materials Management (Type) -Facilities Management, and Computers / Automation Management (Components)
- Back Office Services (Domain) - Development and Integration (Type) - Legacy Integration, Data Integration, Instrumentation and Testing, and Software Development (Components)
- Support Services (Domain) - Security Management (Type) - Identification and Authentication, Access Control, Encryption, Intrusion Detection, Verification, Digital Signature, User Management, Role / Privilege Management, and Audit Trail Capture and Analysis (Components)
- Support Services (Domain) - Communication (Type) - Audio Conferencing and Video Conferencing (Components)

- Support Services (Domain) - Systems Management (Type) - License Management, Remote Systems Control, System Resource Monitoring, and Software Distribution (Components)

The overall approach to providing both mission control functions and general purpose functions in the control rooms is to have two networks of two sets of workstations providing two sets of services. The mission control workstations and network are predominantly UNIX based and perform the mission control functions. The planning lifecycle for these workstations is on a seven year obsolescence cycle. The general purpose workstations and network are ODIN seats, is Windows based, and serves to support the room staff in general purpose functions. These workstations are planned for a 3-4 year cycle, based on the NASA standards 2804 and 2805. The two networks and workstations are isolated from each other. There is no need to either develop complex application to conduct both functions on the same platform or to develop complex integration of function interfaces across multiple platforms. Information and data from the mission control functions that are required externally is replicated and posted to external repositories, avoiding security vulnerabilities. This arrangement works well, as it allows the UNIX platforms to target the high reliability and security required for mission control functions, while allowing for leveraging the lower cost and centralized support of the commodity ODIN seats for general purpose functions.

The mission control operations support investment and implementation is included in the JSC MCC Multi Program/Project investment portfolio. The MCC general purpose support investment and implementation is included in the JSC OAIT investment portfolio.

A team has been formed, the MCCS Architecture Team, to develop a Distributed Collaborative Joint Space Operations capability including all the Mission Control Center Systems. There is recognition that in the future the duration and scope of missions will grow substantially, the participant base will be more distributed, and there will be an increased requirement to provide remote access to some mission control room type functions and information for certain external partners. This will require a re-evaluation of the operational paradigms where control functions currently are isolated from external connectivity. In addition, greater leverage and integration of OAIT initiatives will be closely examined.

9.2 Integrated Financial Management Program

The IFM Program consists of functional module projects that effect business process changes and that acquire and implement appropriate information technology tools to substantially improve the Agency's performance.

The Program was reformulated in March 2000 and will complete implementation of all modules within the CPIC process by the end of FY 2006. IFMP is composed of the 8 integrated projects listed below of which 1-4 are fully implemented, 5 and 6 are in formulation/development phases, and 7 and 8 are scheduled to begin in FY04/05 and be completed by the end of FY06.

Project, Completion Date

1. Resume Management, FY02
2. Position Description, FY02
3. Travel Management, FY03
4. Core Financials, FY03
5. Budget Formulation, FY04
6. Integrated Asset Management, FY06
7. Contract Management, FY06
8. Human Resources, FY06

NASA's Integrated Financial Management Program consists of multiple projects, as part of a phased approach to an ERP implementation, which is aligned to the Back Office Services Domain and Support Services Domain in the Service Component Reference Model Section of the Federal Enterprise Architecture. There is a strong correlation between several of the service types and the completed and future projects in IFMP.

Six different service types that are classified under the Back Office Services Domain have been identified as aligned to IFMP. The service types are the following:
Data Management, Human Resources, Financial Management, Assets/Materials Management, Development and Integration, and Human Capital/Workforce Management.

For each of the service types, a number of components that can trace back to the functionality of the various IFMP projects were identified.

1. Data Management components were identified as the following:
    a. data exchange, data mart, data warehouse, meta data management, data cleansing, extraction and transformation, loading and archiving, data recovery, and data classification.
2. Human Resources components were identified as the following:
    a. recruiting, resume management, career development and retention, time reporting, awards management, benefits management, personnel administration, education/training, health and safety, and travel management.
3. Financial Management components were identified as the following:
    a. billing and accounting, credit/charge, expense management, payroll, payment/settlement, debt collection, revenue management, auditing, activity-based management, and financial reporting.
4. Assets/Materials Management components were identified as the following:
    a. property/asset management, asset cataloging/identification, asset transfer, allocation and maintenance, facilities management, and computers/automation management.
5. Development and Integration components were identified as the following:
    a. legacy integration, enterprise application integration, data integration, instrumentation and testing, and software development.
6. Human Capital/Workforce Management (6) components were identified as the following:
    a. resource planning and allocation, skills management, team/org structure, contingent workforce management, workforce acquisition/optimization.

Security Management was identified as the service type within the Support Services Domain that aligns with IFMP. The nine components to the Security Management service type are the following: identification and authentication, access control, encryption, intrusion detection, verification, digital signature, user management, role/privilege management, and audit trail capture and analysis.

Data Management, Human Resources, Financial Management, Assets/Materials Management, Development and Integration, and Human Capital/Workforce Management: For each of these service types, a number of components that can trace back to the functionality of the various IFMP projects were identified.

- Data Management (1) components were identified as the following: data exchange, data mart, data warehouse, meta data management, data cleansing, extraction and transformation, loading and archiving, data recovery, and data classification.
- Human Resources (2) components were identified as the following: recruiting, resume management, career development and retention, time reporting, awards management, benefits management, personnel administration, education/training, health and safety, and travel management.
- Financial Management (3) components were identified as the following: billing and accounting, credit/charge, expense management, payroll, payment/settlement, debt collection, revenue management, auditing, activity-based management, and financial reporting.
- Assets/Materials Management (4) components were identified as the following: property/asset management, asset cataloging/identification, asset transfer, allocation and maintenance, facilities management, and computers/automation management.
- Development and Integration (5) components were identified as the following: legacy integration, enterprise application integration, data integration, instrumentation and testing, and software development.
- Human Capital/Workforce Management (6) components were identified as the following: resource planning and allocation, skills management, team/org structure, contingent workforce management, workforce acquisition/optimization.

Security Management was identified as the service type within the Support Services Domain that aligns with IFMP. The nine components to the Security Management service type are the following: identification and authentication, access control, encryption, intrusion detection, verification, digital signature, user management, role/privilege management, and audit trail capture and analysis.

The IFMP portfolio is intended to capture the bulk of the general purpose Back Office Services of the Agency. In some cases, some service domains are also appropriately contained in the Multi Program/Project portfolio if they are sufficiently integrated with other mission support functions or otherwise have special requirements.