6-2008

Operationally Responsive Space (ORS): An Architecture and Enterprise Model for Adaptive Integration, Test and Logistics

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THESIS

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AFIT/GSE/ENV//08-J01DL

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THESIS

Presented to the Faculty

Department of Systems and Engineering Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Systems Engineering

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June 2008

AFIT/GSE/ENV//08-J01DL

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Abstract

The capability to rapidly deploy tactical satellites to meet a Joint Force Commander's immediate battlespace requirements is a well-documented joint capability need. Key U.S. strategic documentation cites the need for the capability to maintain persistent surveillance or an "unblinking eye" over battlespace and to rapidly reconstitute critical space capabilities to preserve situational awareness. Warfighter's require a tactical space-based deployment capability that employs a requested launch and operational deployment window of 90 to 120 days. This master's thesis reports two areas of work: it summarizes (to reinforce) the Operationally Responsive Space (ORS) mission tasks using the Joint Capabilities Integration Development System process, and it analyzes and defines the capability gaps within the ORS adaptive Integration, Test and Logistics (IT&L) process for payload to bus deployment to meet shortened ORS timelines. The ORS adaptive IT&L concept of operations developed as part of this work focuses on the Tactical Satellite Rapid Deployment System, which is an adaptive integration, test and logistics capability that enables rapid and effective payload to bus integration to meet a 90- to 120-day warfighter window. This document recommends engineering solutions and processes for an ORS IT&L "to be" state that meets warfighters' capability needs.

Acknowledgments

We would like to express our sincere appreciation to our faculty chairman Dr. Joseph W. Carl, and to our advisors, Dr. David R. Jacques, Dr. John M. Colombi, Dr. Richard Cobb, and Dr. Brad Ayres, for their guidance and support throughout the course of this thesis effort and program. We would also like to thank all of the other faculty and staff that have supported us in numerous ways to complete this distance learning program at AFIT. This Master's Thesis team would like to thank the Air Force Institute of Technology for allowing us the privilege to participate in this program. We would also like to thank our sponsor, Mr. Timothy G. Lamkin, Group Two Seven - Seven Special Projects, Air Force Research Lab (AFRL), Kirtland Air Force Base, for supporting us in our work and providing us the baseline information to build this Systems Engineering product. In addition, we would like to acknowledge and thank Colonel, USAF (Ret) Robert Rhoades for giving us his perspective from his years of service in the U.S. Air Force. This team also owes special thanks to the extensive effort that Ms. Maryann Glen (Molly) provided in the area of technical editing and document configuration.

We would like to thank our managers at Sandia National Laboratories, Mr. Guillermo Loubriel, and Mr. Wallace T. Wheelis (Ted). They consistently and enthusiastically supported our time, effort, and tuition for this program.

Finally, to our spouses, family and friends (especially our mascots, Pia, Honey, and Kong) who supported our late night study sessions and mood swings after exams, we appreciate you!

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1. Introduction

1.1. General Issue

The Department of Defense (DoD) Office of Transformation (OFT) is leading an initiative that focuses on one of the most complex national security challenges, operationally responsive space (ORS). The National Security Presidential Directive (NSPD-49, 8/31/2006) on National Space Policy makes clear the United States commitment to key principles in the conduct of space activities. Because of the current national security challenges, tactical space technology will be key to the warfighters due to their need for increasing situational awareness (32:6). In support of this new initiative the DoD OFT has defined a new business model that focuses on "standardization" and "modularization" of focused space technology and capability. The ORS business model is focused on several aspects of transformation to include redefining the acquisition process, eroding barriers to competitive entry, and providing flexibility to ensure U.S. space superiority.

1.2. Problem Statement

This thesis focuses on the U.S. need to transform the current "big space" paradigm to one that provides a flexible responsive capability to provide tactical space assets in a timely manner to meet emerging threats. U.S. space capabilities do not respond quickly enough to new threats to the nation and to the information needs of the warfighter. The current and future threats are constantly changing, unpredictable and can be simultaneously dispersed throughout numerous countries. Effective and efficient execution of ORS requires a clear understanding of the required architecture and capabilities. Increased responsiveness must be created across a broad range of time scales in the space lifecycle to meet future warfighting mission, priority and situational requirements.

Payload and bus integration, test and logistics is one segment of current space operations that requires transformation to meet responsive space capabilities. The master's thesis team addressed the question: What are the capabilities that are required to significantly improve operational efficiency at the payload and bus IT&L phase to meet ORS timelines?

The problem statements addressed are the following:

- The capability gap requirements for an ORS adaptive Integration, Test and Logistics (IT&L) process for payload to bus deployment have not been defined.
- Engineering architecture, solutions and standards to fulfill identified ORS IT&L capability gaps have not been specified.

1.3. Background

Operationally Responsive Space has been defined as assured space power focused on timely satisfaction of Joint Force Commander's needs (32). This definition considers ORS as a subset of space activities designed to satisfy immediate Joint Force Commander's (JFC) needs, while maintaining the ability to address other users' needs, for improving the responsiveness of space capabilities to meet all national security requirements (32:10). This transformation is based on the recognition that national security space needs can no longer be defined with the "cold war" focused elements of deterrence strategy and nation-state opponents that are slow to change.

ORS is a course of action that supports the goals and principles of increasing situational awareness and adaptability to the threat by providing a rapid focused tactical space capability. The National Security Space definition also further defines and characterizes ORS as: on demand capability, seamless integration, and affordable lift (30).

As cited in the 2007 Congressional Defense Plan, key attributes of ORS include:

- Custom built for the Operations Commander – Demand driven
- Joint Military Capability versus National Intelligence Capability
- Does not require large Command and Control (C2) organization – Autonomous
- Integrated with space, air, and surface assets
- Centralized Command and Control
- Reduced classification
- Risk tolerant versus risk constrained

1.4. Research Objective and Methodology

The objective is to identify what must be executed to support DoD's ORS mission in the ORS adaptive IT&L domain. Those items that must be executed will include business model changes, process, organization, doctrine, and training. This thesis investigates the areas of transformation to provide a more agile space operation to sustain U.S. preeminence.

1.4.1. Research Methodology

This research methodology will follow three steps (Figure 1-2):

- Apply JCIDS analyses and ORS CONOPS,
- Develop "as is" process / architecture, identifying changes needed to meet ORS IT&L objectives for payload to bus deployment.
- Develop an enterprise improvement strategy that covers the "to be" state and a transition plan

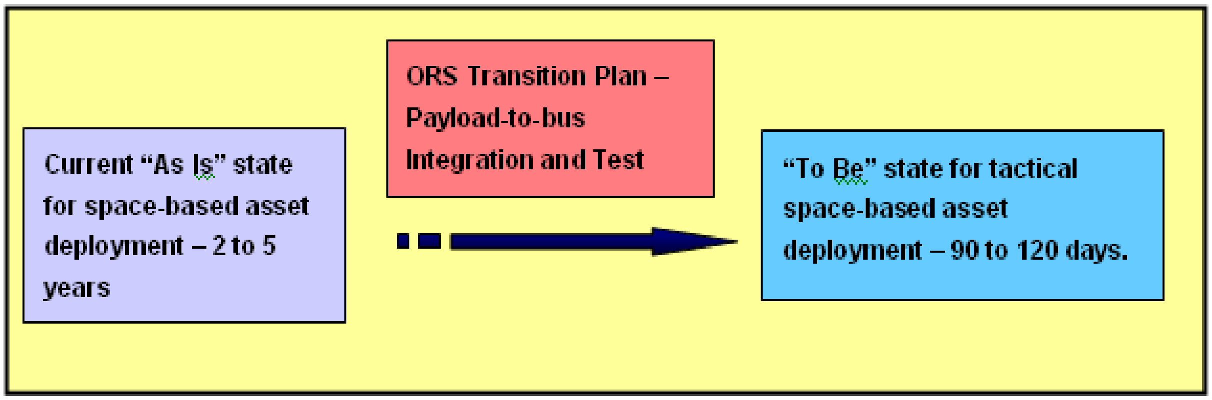


Figure 1-1. ORS IT&L Transformation From "as is" to "to be"

Boundaries include: the moment a warfighter makes a request for a space asset to time of launch of the requested asset. A specific ORS requirement is to reduce the deployment time of the "as is" state of more than 2 to 5 years to a "to be" state of 90 to 120 days.

The JCIDS analysis application covers:

1. ORS Functional Area Analysis (FAA) – Identify ORS operational tasks, conditions, and standards needed to accomplish military objectives.
2. ORS Functional Needs Analysis (FNA) – Identify ORS IT&L capability gaps based on mapping of stated needs.
3. ORS Functional Solutions Analysis (FSA) – Develop ORS IT&L operational based assessment of doctrine, organization, training, materiel, leadership/education, personnel, and facilities (DOTMLPF) approaches to solving capability gaps.

Capabilities are employed to achieve desired effects in support of strategies. New capabilities, such as ORS, must be defined within the "art of the possible" and "grounded within real world constraints of time, technology and affordability"(33).

1.4.2. Assumptions and Their Implications

Adaptive IT&L functions must be optimized to meet ORS mission objectives, which are primarily focused on rapid deployment and high reliability of hardware. In this master's thesis, analysis is based on the following assumptions:

- Adaptive is defined as tailored precise and anticipatory decision support for integration and test. This includes total situation awareness with an emphasis on understanding the warfighter's needs and intent (36:11).
- Integration is defined as the mechanical, electrical, optical assembly and integration of payloads to a designated bus. Completion of the integration process indicates readiness for spacecraft-level testing.
- Test is defined as the system or subsystem evaluation, test and independent review required to fully understand and verify specified function and performance of the item.
- Logistics is defined as the function where detailed resource planning and operational flows have been identified and configured for integration and test functions.

A significant assumption required for a successful execution of ORS attributes is that national and military strategy will generate and accept the core transformation operating environment of rapid, risk-managed and risk-tolerant tactical satellite deployment capability. In addition, the ORS initiative relies heavily on the rapid proactive transformation of the U.S. space industry to support the engineering and technological processes of ORS adaptive IT&L.

The implications of not providing the warfighter with the required tactical space-based capabilities will include limiting intelligence, surveillance and reconnaissance capability in the warfighting zone. This also affects the warfighter's ability to maintain situational awareness in rapidly changing environments and to develop and execute effective warfighter decision-making in the battlefield. It is because of irregular warfighting tactics that rapid deployment of tactical space-based capability has become so critical.

1.5. Preview

ORS directives are not indicative of a current "sustaining strategy," but rather a "disruptive" strategy that forces technological and process innovation resulting in identification of radical technical change (29:4). A new architecture is rooted in defining a joint military function and providing joint military capabilities for operational and tactical-level demand.

This master's thesis provides systems engineering and programmatic direction for establishing an adaptive IT&L payload-to-bus deployment program. Chapter 2 provides a literature overview that links U.S. and military policy to the required ORS capabilities. Chapter 3 contains "as is" architecture based on the current "big space" paradigm. In Chapter 4, the "to be" architecture and transition plan provides the ORS Program Office with direction on capabilities that need to be established. The "to be" architecture is based on FSA output, and then further modeled in this thesis using *System Architect*™. This analysis identified six major ORS task conditions that are the basis of the ORS adaptive IT&L function. The ORS task conditions consist of:

1. ORS IT&L 1: Stock qualified standard spacecraft bus
   - Successful realignment of U.S. Space industry
   - The will of the U.S. to fund a space technology build-up
2. ORS IT&L 2: Develop rapid integration and logistics program
   - Defined robust technology and comprehensive qualification programs
3. ORS IT&L 3: Develop rapid system test program
   - Defined test program
   - Established training
   - Dedicated operations facility
   - Defined environments
   - Defined interfaces
   - Defined mission scope
4. ORS IT&L 4: Utilize qualified dual-use launch system
   - The will of the U.S. to fund a space technology build-up
   - Successful realignment of U.S. Space industry
   - Defined interface, environment and data requirements with bus and payload
   - Defined interface control document requirements system
5. ORS IT&L 5: Develop and stock a suite of payloads
   - The will of the U.S. to fund a space technology build-up

- Successful realignment of U.S. Space industry
- Defined interface control document requirements system
- Defined Test and Evaluation Master Plan (TEMP)

6. ORS IT&L 6: Develop technology management system
   - Defined Interface Control document system
   - Established configuration management
   - Resolve proprietary resistance from vendors

This work provides a strategy to guide architecture investment decisions.

Additional investigative questions that this master's thesis explores include the following:

- What is the basis for re-formulating the IT&L process while continuing to meet system functionality and flight readiness?
- What are the inputs and outputs required for an ORS IT&L capability?
- What are the elements and scope of a transition plan for payload to bus integration and test?

In summary, Figure 1-2 provides an overview of the analysis and documentation that was applied to generate the ORS IT&L solution.

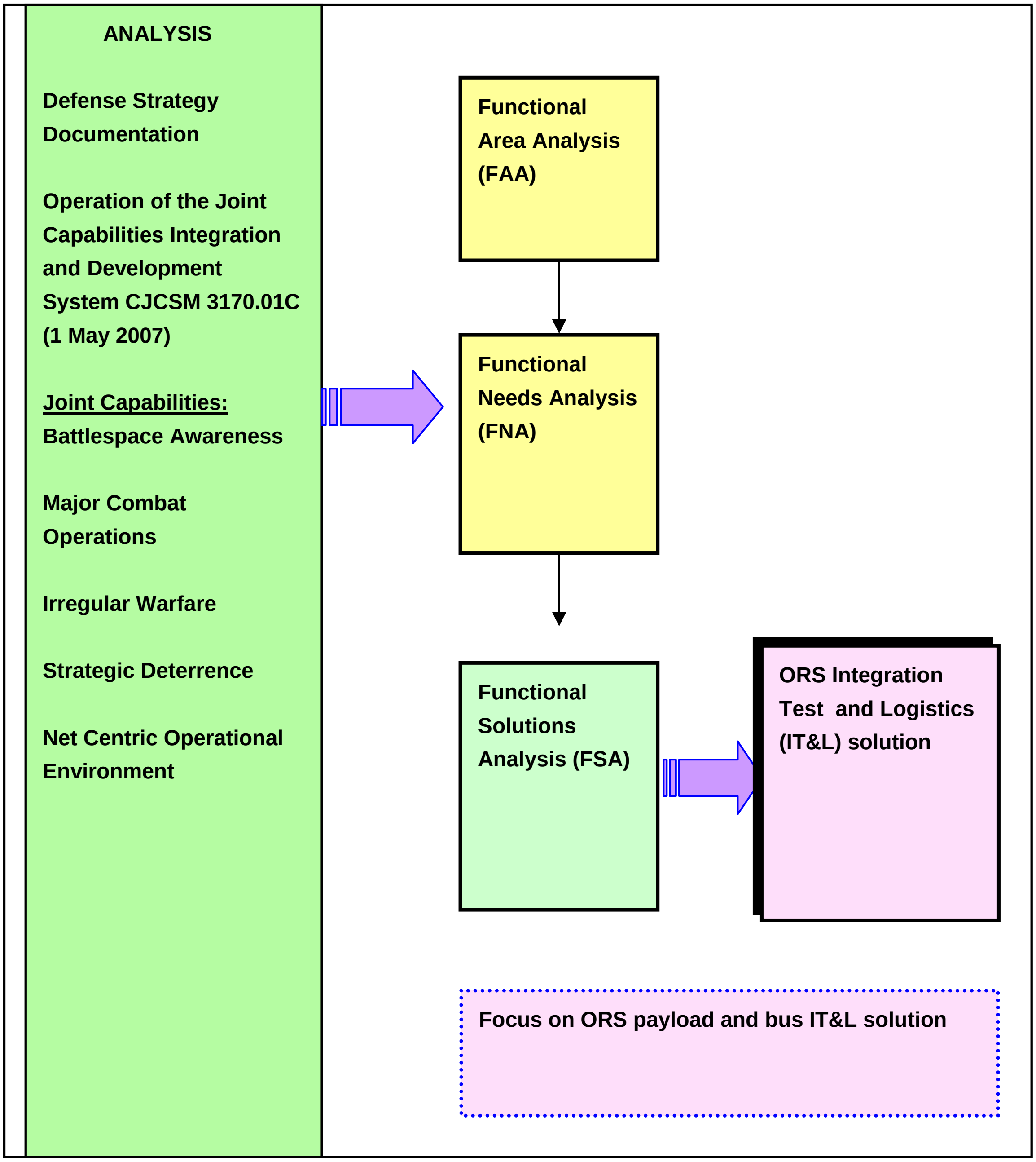


Figure 1-2. JCIDS Applied to an ORS IT&L Solution in Support of the Warfighter

2. Literature Review

This master's thesis Literature Review chapter is structured to provide a logical structured review of how key strategic documents identify the need for an ORS-type capability. This ORS systems analysis is following the Chairman of the Joint Chiefs of Staff Instruction (CJCSM 3170.01C, 1 May 2007), which provides instruction on the Capability-Based Assessment (CBA), which is the analysis part of the JCIDS process (45, 46). The CBA and supporting literature review define the ORS capability needs, capability gaps, capability excesses, and approaches.

This master's thesis team reviewed all available (as of February 2008) Joint Operating Concept (JOC) documents, Joint Functional Concept and Joint Integrating Concept (JIC) documents to specifically determine which subset of combat capabilities would be best supported by ORS attributes. These documents are collectively part of a family of documents called Joint Operations Concepts (JOPsC). Appendix A and Appendix B contain the FAA for both ORS and ORS IT&L, respectively. Appendix C is the ORS FNA; FSA results are discussed in Chapters 2 and 4. These appendices were developed by this team based on the combat data and required capabilities found in the JOPsC. Based on the review, the following documents were used in the CBA.

- *Major Combat Operations, Joint Operating Concept*, Version 2.0, December 2006
- *Battlespace Awareness, Joint Functional Concept*, December 2003
- *Irregular Warfare (IW), Joint Operating Concept*, Version 1.0, September 11, 2007
- *Strategic Deterrence, Joint Operating Concept*, February 2004

- *Net Centric Operational Environment, Joint Integrating Concept*, October 31, 2005

The conduct of future joint force operations requires "the simultaneous development of both incremental and transformational enhancements to combat capabilities." The JOPsC is "the unifying framework" that provides the foundation for the development and acquisition of new capabilities through changes in doctrine, organization, training, materiel, leadership, and education, personnel and facilities (DOTMLPF). The purpose of this work was to specifically link polices and capabilities required by the JFC that can be supported by a space operations initiative (See Figure 2-1).

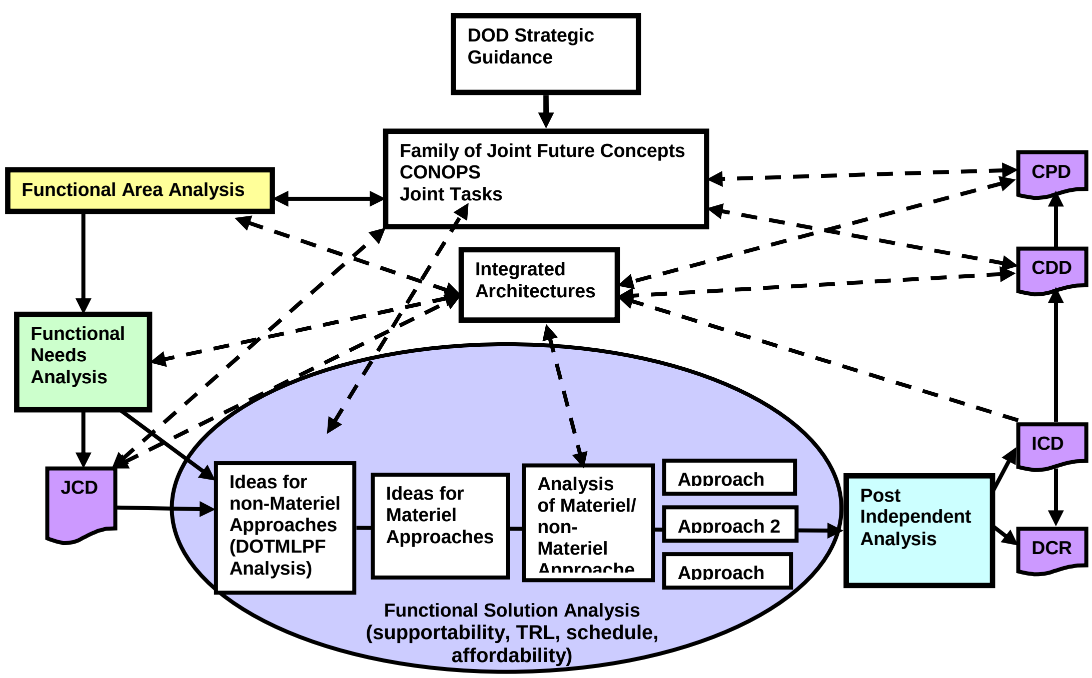


Figure 2-1. JCIDS Process Used by Warfighter to Define Capability

Figure 2-2 provides an overview of the specific analysis path that was conducted. This begins to address the problem statement documented in section 1.2.

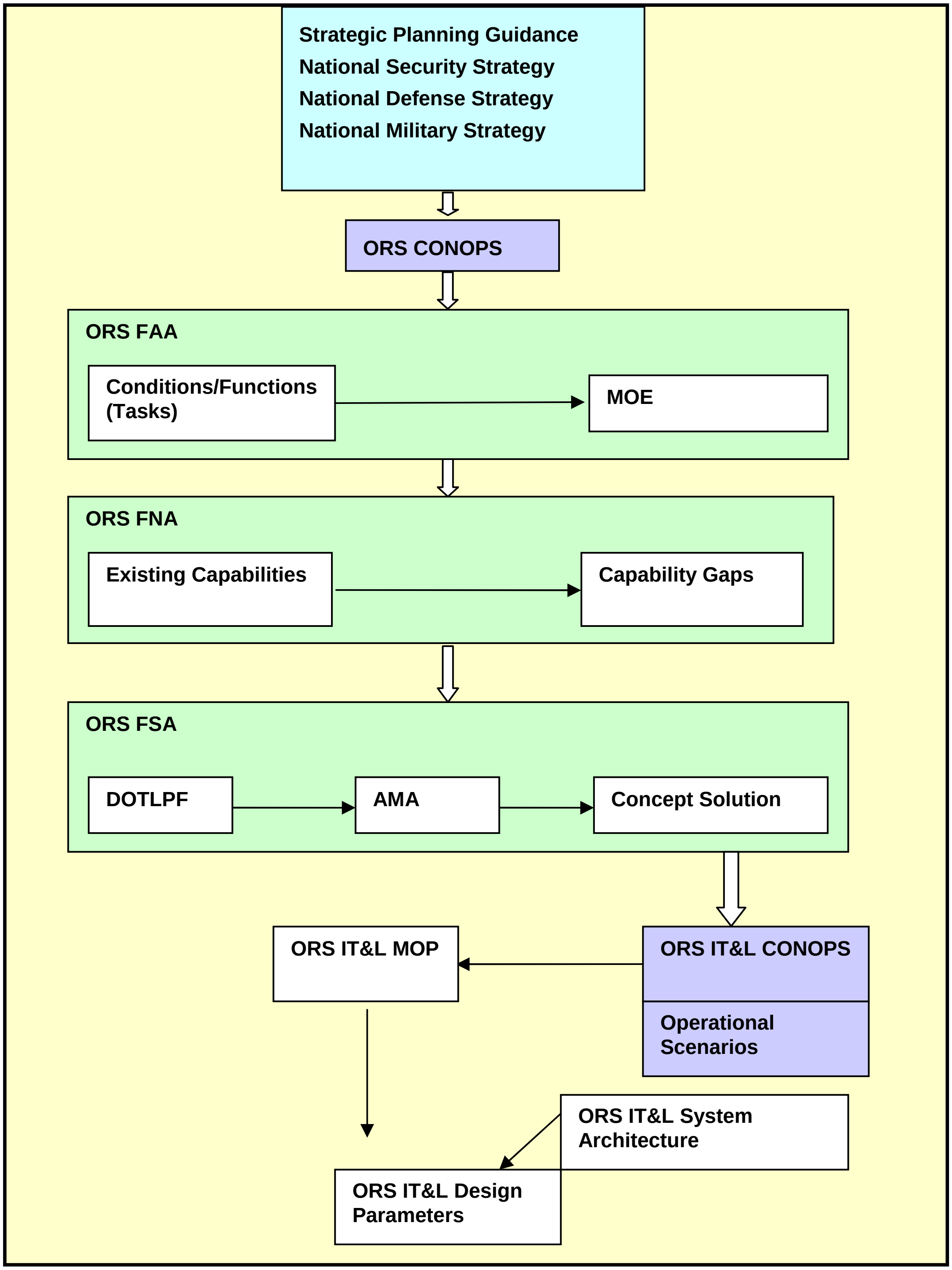


Figure 2-2. Capabilities Based Process for ORS IT&L Solution

2.1. Department of Defense Strategic Guidance

The President of the United States and the Secretary of Defense define and establish strategic guidance that "provides goals and objectives for the Armed Forces of the United States." The applicable National Security Strategies relevant to this ORS literature review are: (53:3):

- Transform America's national security institutions to meet the emerging challenges and opportunities
- Strengthen alliances to defeat global terrorism and work to prevent attacks against allies, friends and the United States
- Prevent enemies from threatening allies, friends and the United States with weapons of mass destruction
- Work with others to defuse regional conflicts
- ORS attributes can be applied to all levels of military defense surveillance requirements in support of situational awareness.

The National Defense Strategy of The United States of America cites continuous transformation as a key objective. Based on adversarial challenges the United States may encounter, it is apparent that certain environmental factors can now take on new meaning and levels of expected performance. These include (53)

- Time window for lifecycle execution
- Technology selection criteria
- Technology design criteria
- Integration methodology of space programs

2.2. National Military Strategy

The National Military Strategy (NMS) of the United States of America provides focus for military activities by defining a set of interrelated military objectives (27). The

National Military Strategy establishes three military objectives that support the National Defense Strategy:

- Protect the United States against external attacks and aggression
- Prevent conflict and surprise attack
- Prevail against adversaries

The National Military Strategy (NMS) of the United States defines specific tasks for the Joint Force that allows commanders to assess military and strategic risk. The team mapped strategic guidance to ORS key attributes based on documentation analyzed (Table 2-1). As demonstrated below ORS is a key enabler in these areas.

Table 2-1. NMS Principles Link to ORS Attributes, Capabilities and Functions

NMS Principles of Joint Force	NMS Desired Attributes of the Joint Force	ORS Attributes	NMS Capabilities and Functions	ORS Capabilities and Functions
Agility	Fully Integrated	X	Applying Force	X
Decisiveness	Expeditionary		Deploying and Sustaining Military Capabilities	X
Integration	Networked	X	Securing Battle Space	X
	Decentralized	X	Achieving Decision Superiority	X
	Adaptable	X		
	Decision Superiority	X		
	Lethality	X		

2.3. Quadrennial Defense Review (QDR)

The *2006 Quadrennial Defense Review* (QDR) represents a "snapshot in time" of the Department's strategy for defense of the nation and the capabilities needed to effectively execute that defense (37). A key tenet of the QDR and military strategy is the development of a capabilities-based approach. The National Defense Strategy makes clear the requirement to increase agility and "synchronize capabilities" to be full spectrum dominant (FSD). FSD emphasizes the importance of decision superiority and adaptability. The attributes of ORS support FSD and the tenants of the QDR.

2.4. U.S. Space Security Policy

The U.S. National Security Strategy approaches space from the position that assets in outer space must be protected and that space is part of the overall strategy to assure the national security of the United States. The U.S. Space Security Policy strategy is linked with the transformation of remote sensing, intelligence and global strike capability. The DoD Space Policy defines space as a medium like land, sea and air; therefore the ability to use space is an important national interest. Space power is a strategic enabler because of its vital role in communications and surveillance. A fully developed ORS program can provide rapid deployment of space assets to meet U.S. Space Security Policy.

2.5. Joint Doctrine for Space Operations

The Joint Doctrine for Space Operations provides guidelines for planning and conducting joint space operations (24). This doctrine also explains the relationships and responsibilities for the employment of space forces and space capabilities. Space capabilities have been proven to be a "significant force multiplier."

Military space is "demand driven." The ability to rapidly and decisively respond to threats and provide the warfighter with technology-based space capability within small timeframes is an important space support operation. For example, the prime advantage of an Intelligence, Surveillance, and Reconnaissance (ISR) space system is the potential capability to provide continuous and focused coverage of areas of interest (AOI). ORS tactical satellites can fulfill this mission because it will be able to respond to demand driven requests.

2.6. ORS CONOPS

Based on documentation reviewed, the team assembled the following ORS concept of operations (CONOPS). Operationally Responsive Space (ORS) represents an expanded portfolio of national space capabilities. ORS is the ability to respond appropriately to changing situations and time critical mission or capability requirements for space-based products and services (29). ORS is broadly defined as "assured space power focused on timely satisfaction of Joint Force Commanders needs." Providing the capability to maintain situational awareness and battlespace control is core to ORS objectives. The scope of an operationally responsive space includes (24:28):

- Spacelift Operations
- Mission Planning and Coordination
- Acquiring Capabilities – payload design and development
- Integration and Test
- Satellite Operations
- Early Orbit Operations

Space services based on payload and spacecraft selection and design will include:

- Intelligence
- Surveillance / Reconnaissance
- Communications
- Position, Navigation and Timing
- Environmental Sensing
- Missile Warning
- Space Control
- Force Application

ORS is in direct alignment with supporting the Joint Force Commanders as indicated in the Joint Doctrine for Space Operations, 3-14, 2006 principles of war. Relevant principles and interfaces are cited below.

Table 2-2. Congruence of Joint Doctrine for Space Operations to ORS CONOPS

Space Operations Principles of War	ORS CONOPS
Space forces and application of their capabilities are best employed when they contribute directly to achieving the commander's objectives	Rapidly respond to the warfighters needs with customized operational capabilities
Commanders must understand the capabilities and limitations of space-support operations to determine how to best support the joint force	Provide rapid dedicated reliable decentralized command and control capability based on specific warfighter needs
Combatant commander's planning includes identifying space-support requirements	Provide and deploy space-based capability to meet combatant commander's timeline.
Integrate and synchronize supporting space forces, so that the concentration of combat power at the proper time and place can be most effective	Provide dedicated customized tactical space-based capability to each warfighter.
Precision navigation capability	Provide dedicated navigation payloads to meet warfighter's needs
Adversary use of similar space-based systems – commercial access to space	Provide warfighter with a dedicated tactical satellite in which payload technology has been protected and optimized

Space Operations Principles of War	ORS CONOPS
Know the adversary and understand the adversary's access to, use of, and dependency on space systems	Use research and development to augment space knowledge and capability through disruptive innovation, continuous development and refinement of operational concepts, processes, and technologies
Surprise	Offer a suite of payloads that will provide various technological capability
Know the environment	Provide the warfighter with a dedicated tactical satellite with payloads customized to battlefield requirements

In addition, ORS is to support the Commander, United States Strategic Command, in three areas (24:38):

1. Rapidly exploit and infuse space technological or operational innovations.
2. Rapidly adapt or augment existing space capabilities when needed to expand operational capability
3. Rapidly reconstitute or replenish critical space capabilities to preserve operational capability.

Therefore, ORS shall have both anticipatory and reactive elements. As part of routine operations, ORS is required to identify likely emergent space needs, make preparations to meet those needs, conduct required operations and experimentation and prepare plans for operational integration and deployment.

2.7. Joint Operating Concepts (JOC), Joint Integrating Concepts (JIC) and Joint Functional Concepts

The following Joint Operating Concepts, Joint Integrating Concepts and Joint Functional Concepts specifically link and cite the need for space operations capability and emphasize the importance of situational awareness. This data will be used in the functional assessments that are part of this thesis (28).

2.7.1. Major Combat Operations (MCO) – Joint Operating Concept

The MCO JOC documents the concept logic that the United States will fight an uncertain and unpredictable enemy (23). The future enemy will present the US military with complex combinations of challenges. ORS capability can support the MCO achieving the operational level objectives listed below :

- Deny enemy battlespace awareness
- Deny enemy freedom of action
- Disrupt enemy ability to command and control his forces
- Disrupt enemy sustainment system
- Selectively degrade enemy critical infrastructure and production capacity

The MCO JOC capability list also states the need to deploy, employ, and sustain a persistent, long endurance, appropriately stealthily and dynamically tailored ISR system. The MCO JOC capability need for persistent situational awareness to gain and maintain dominance in information environments and tailored ISR can be supported and is consistent with the tenants found in the ORS CONOPS.

2.7.2. Strategic Deterrence Joint Operating Concept, February 2004

Strategic Deterrence (SD) is defined as the prevention of adversary aggression or coercion threatening vital interests of the United States and/or our national survival (22). The foundation of strategic deterrence is Global Situational Awareness. Where capability gaps exist in the U.S. space assets to provide the needed ISR for a particular area of interest, ORS can provide a rapid response capability to fill those gaps when the need is urgent. All capabilities supporting SD rely on the existence of robust, reliable, secure, survivable, timely, unambiguous and sustainable DOD-wide command and control. ORS can be a key concept to support command and control (C2) operations by insuring that all the C2 characteristics that are provided by space assets are in place, replaced in a timely manner, and/or enhanced as needed. ORS lessens the importance of adversarial threats such that any attack or attempt to deny U.S. access can be countered quickly.

2.7.3. Irregular Warfare (IW), Joint Operating Concept, September 11, 2007

Irregular warfare (IW) is defined as a violent struggle among state and non-state actors for legitimacy and influence over the relevant populations (18). IW favors indirect and asymmetric approaches, though it may employ the full range of military and other capabilities, in order to erode an adversary's power, influence and will. It is inherently a protracted struggle that will test the resolve of our nation and our strategic partners. Irregular warfare capability conditions document the need for (18):

- The ability to assess operational situations
- The ability to conduct joint force targeting
- The ability to conduct strategic communications in support of campaign objectives
- The ability to exploit information on a situation
- The ability to assess ground operations
- The ability to synchronize joint irregular warfare operations

This JOC also consistently cites the need for rapid information capability that supports situational awareness. ORS can be structured to provide the identified capability as discussed in the ORS CONOPS.

2.7.4. Battlespace Awareness, Joint Functional Concept, December 2003

Battlespace Awareness (BA) is primarily the delivery of accurate and timely information to battle decision makers (19). The capabilities that BA brings to the mission are defined by five attributes.

- *Persistence* is measured by survivability and endurance. ORS can provide timely tactical assets over the battlefield in space where they are currently out of range of most adversaries.
- *Agility* is seen as the speed of action, speed of redirection, and discrimination of effects. ORS is the key to making space assets agile in providing the ability to provide new assets or reconstitute assets in days to months rather than years.
- *Information* is what space assets are all about.
- *Reach* is mobilizing anywhere in the world in a short period of time. Space provides true global reach.
- *Spectrum* represents the number of ways awareness can be accomplished. ORS provides the ability to provide ISR assets across the full spectrum of available technologies.

Battlespace Awareness is also the situational knowledge whereby the Joint Force Commander plans operations and exercises command and control. This includes providing accurate, timely, and high-quality intelligence to decision makers. Battlespace awareness includes the processing, use and communication of information for the operational environment. ORS will provide significant capability support in this area and address several of the operational and technological gaps currently identified for battlespace awareness. The ORS responsive and demand driven capability will be key in this area.

2.7.5. Net-Centric Operational Environment, Joint Integrating Concept, October 31, 2005

The need for the ORS capability is justified by examining the Joint Operations Concepts (JOpsC) family of documents that state the need for future or existing capabilities (21). Specifically, the Net-Centric Operational Environment JIC addresses some specific needs that ORS can satisfy. The physical domains in which the Net-Centric Operational Environment (NCOE) exists spans land, sea, air and space. The operational context upon which NCOE is built is a globally accessible platform of data and information. Benefits to the warfighter with ORS in the NCOE are identified in two specific areas:

- **Decision Superiority**-Use of ORS communication and surveillance payloads allows specific capabilities to be within reach. The speed and accuracy at which this data can be transferred securely will enable a higher level of situational awareness in the battlespace.
- **Rapid Adaptability at the Tactical, Operational and Strategic levels**- Space based technology supports Commanders at multiple levels. For example: vital "lessons learned" will be acquired rapidly, improving the Joint Task Force knowledge base and ensuring that the Force becomes better prepared to address recurring situations."

ORS will be a key capability in the NCOE, which lists "space-based networks" as one of its main capabilities.

2.8. ORS Functional Area Analysis (FAA)

A FAA identifies the mission area or military problem to be assessed, the concepts to be examined, the timeframe in which the problem is being assessed, and the scope of the assessment (13, 45, 46). The ORS FAAs in Appendix A and B describe the relevant space mission objectives and lists effects to be generated if objectives are achieved.

Appendix B FAA provides a more focused analysis of required tasks to meet ORS IT&L mission performance. The Unified Joint Task List (UJTL) tasks identified for the FAA analyses include SN 3.5 Provide Space Capabilities (47). SN 3.5 Provide Space Capabilities consists of the following breakdown which was mapped into the FAA. ORS IT&L tasks were also identified and documented in this analysis. The complete summary list of space operations tasking is shown in Table 2-3.

Table 2-3. UJTL Space Operations Tasking Applicable to ORS

Task	Specification
UJTL 3.5	Provide Space Capabilities
UJTL 3.5.1	Provide Space Support
UJTL 3.5.1.1	Launch and Initialize New Satellites
UJTL 3.5.1.2	Monitor / Upkeep Satellites
UJTL 3.5.1.3	Resolve Satellite Anomalies
UJTL 3.5.1.4	Relocating / Reorienting Satellites
UJTL 3.5.2	Provide Space Control
UJTL 3.5.2.1	Provide Space Surveillance
UJTL 3.5.2.2	Provide Space Protection
UJTL 3.5.2.3	Provide Space Negation
UJTL 3.5.3	Provide Space Force Enhancement
UJTL 3.5.3.1	Provide Navigation Support
UJTL 3.5.3.2	Provide Weather / Environmental Support
UJTL 3.5.3.3	Provide Theater Ballistic Missile Warning Products
UJTL 3.5.3.4	Provide Communications Channels
UJTL 3.5.3.5	Provide Surveillance Recon Support
UJTL 3.5.3.6	Deploy Space Support Teams
UJTL 3.5.3.7	Protect Ground based Assets
ORS IT&L 1	Stock Qualified Standard Spacecraft Bus
ORS IT&L 2	Develop Rapid Integration and Logistics Program
ORS IT&L 3	Develop Rapid System Test Program
ORS IT&L 4	Utilize Qualified Dual Launch System
ORS IT&L 5	Develop and Stock a Suite of Payloads
ORS IT&L 6	Develop a Technology Management System

2.8.1. Capabilities for Mission Performance for Future Space Operations

Provide war fighter information. By rapidly expanding space coverage, the warfighter can access new information and request that information gaps be filled in a timely manner. By adding enhanced capabilities for the warfighter through increased communication bandwidth, increased ISR imagery, and additional GPS signal density over the theater for a limited period, ORS can enhance air, ground and naval missions.

Ability to enhance space based assets. When an existing satellite with an active capability ceases to function, a new satellite can be rapidly deployed, which can be solely outfitted to fill in the lacking capability, or enhanced with newer enhanced assets. Provide "on-demand capability" customized for the warfighter.

Ability to respond to a Space Pearl Harbor. If an adversary were able to conduct a surprise attack on key space assets, the U.S. capabilities could be critically crippled. As the DOD moves toward Net-Centric warfare models, the criticality of the space assets in that model increases. The timeliness of the U.S. ability to respond to reestablishing key space capabilities would be critical.

2.8.2. ORS Tasks

Develop and stock a suite of payloads. Various payloads need to be developed to support key capabilities that are robust, interchangeable and easily deployed. New technologies need to be managed such that when they are ready to be deployed (mature) they are compatible with the ORS systems so they can be rapidly deployed as needed. They payloads need to be built, tested, maintained and stockpiled in sufficient quantity to respond to need capabilities.

Develop and stock spacecraft buses. Bus system or systems need to be developed, built, tested, maintained and stockpiled in sufficient quantity to respond to needed capabilities and support the suite of payloads.

Develop integration and logistics protocols that support rapid deployment of space assets. Integration times to support rapid deployment require careful and, comprehensive management of information and data.

Develop system level test protocols that support rapid deployment of space assets. Testing times to support rapid deployment require careful comprehensive management of information and data.

Develop and stock a reliable launch system. Reliable lift vehicles must be available in sufficient quantity to support the needed capabilities.

Develop a full cradle to grave technology management system. Understanding, documenting and controlling requirements and configurations across the entire system is key to preventing issues which produce delays.

2.9. ORS Functional Needs Analysis (FNA)

The FNA assesses the capabilities of the current programmed force to meet the relevant military objectives of the scenarios chosen in the FAA (25:4). The FNA assesses whether or not an inability to achieve a desired effect exists (capability gap). The FNA analyses produced by this team identified several capability gaps which will be addressed in the FSA and Chapter 4. The conditions that the FNA assumes is that the warfighter has requested a tactical satellite, on a rapid time scale of 90 to 120 days, to support irregular warfare operations. The warfighter has also stated battlespace and situational awareness are of critical importance to the mission. Table 2-4 data was generated by the master's thesis team as a result of extensive research and interviews of our sponsor's staff. These are measures that are derived from IT&L tasks. The primary functions that the tasks are derived from are highlighted in Figure 4-15; they are also previewed in section 1.5. This table is discussed in detail in Chapter 4.

Table 2-4. ORS IT&L Performance Data to Meet Warfighter Capability

Requested Payload/s Available from stock < 5 days
Payload Reliability exceeds .97
Requested Bus/s Available from stock < 5 days
Bus Reliability exceeds .97
Integration of any payload/bus in < 5 days
Assembly information available in < 1 days
Test of any payload/bus in < 62 days
Test Environments defined in < 1 days
Launch Vehicle available from stock in < 60 days
Launch Vehicle Reliability exceeds .75
All project information is available to the full project team in < 2 days
New Satellites launched in 90 to 120 days
New Satellites for Space Surveillance launched < 120 days after request
New Satellites for Space Protection launched < 120 days after request
New Satellites for Space Negation launched < 120 days after request
New Satellites for Navigation Support launched < 120 days after request
New Satellites for Weather/ Environmental Support launched < 120 days after request
New Satellites for Communications Support launched < 120 days after request
New Satellites for ISR Support launched < 120 days after request

2.10. ORS Functional Solutions Analysis (FSA)

It is clear from the ORS level analysis that a more rapid deployment of space systems is an important solution for meeting many of the capabilities identified by national level concepts and policies. Under the current space system development paradigm, systems have operational reliability issues because of one-of-kind cutting edge technology insertions. In order for the new paradigm to function as an agile capability, a system is envisioned which uses a standard spacecraft bus and a suite of interchangeable qualified payloads which can be configured to provide a variety of different capabilities as needed. System reliability will be an important factor for limiting failures of deployed systems. In a statistical study by Weigel in 2000, an overview of all space test programs was evaluated, it was found that on average for commercial spacecraft endeavors that 12.67 person-years of labor was spent on discrepancy investigation at the system integration level. Several of the schedule delays were because of inadequate workmanship, immature technology, poor reliability of tester equipment and cable damage.

The elements of the IT&L portion will be fully discussed in Chapter 4. Items that will be evaluated include the use of a verification/validation exercise which provides a "gold stamp" of approval at the subsystem level. The ORS IT&L focus is to determine how to structure a testing program within the space system life cycle to optimize the schedule, effectively manage discrepancies and deliver a product at the system level that will have a specified performance. Highly reliable subsystems as well as a standardized set of interfaces would appear to be very effective in eliminating most of the discrepancies. The core success of ORS IT&L will be in the ability to manage requirements and define interfaces such that IT&L operates in a known framework.

2.11. Doctrine, Organization, Training, Materiel, Leadership, and Education, Personnel and Facilities (DOTMLPF) Evaluation:

The following is an overview of DOTMLPF information based on the functional analyses conducted. As a result of the further analyses documented in Chapter 4 the DOTMLPF will be also expanded in the Chapter 5 closing information.

2.11.1. Doctrine

Architecture investment decisions require a doctrine and policy that should reflect a desire for all new technology development programs to be managed and integrated by a separate ORS R&D branch. The ORS R&D branch develops and provides the ORS operations branch new capability on a 3 to 4 year cycle. The ORS operations branch should only manage proven qualified space technology.

2.11.2. Organization

ORS program office provides leadership, technical and engineering direction in all space operations DoD procurements. In parallel with the initial ORS program office operations, consider setting up a ORS Skunk Works-like initiative to be executed within a specified timeframe. Skunk Works like output could accelerate ORS Program Office capability. A strong but small project office must be staffed by both military and industry personnel.

2.11.3. Training

A trained, efficient ORS IT&L team that is fully experienced with all aspects of the program is required. A training program is required to be developed to cover all technical, administrative and engineering duties. A training competency and qualification requirements matrix should be developed and executed.

2.11.4. Materiel

Development of requirements and hardware to implement the new paradigm is required. A strategy for payloads, buses, and launch systems on demand or in storage requires definition. Standardization of payloads and buses will result in common tooling and equipment requirements. A dedicated ORS Integration, Test, Staging and Storage facility capability is required to maintain a focused effort.

2.11.5. Leadership

The political will to prepare for the needs and threats that will emerge in the future will be required. Issues associated with proprietary information and other sensitive corporate information will need to be resolved at a legal and policy level. All levels of ORS qualified hardware and information should flow within the secure ORS configuration management and information system. The ORS Leadership should have a focused and targeted understanding of the difference between research and development technology and ORS qualified operations technology. ORS qualified operations technology meets the warfighter capability need window of a 90 to 120 day deployment cycle.

2.11.6. Personnel

A trained, efficient ORS IT&L team that has been cross-trained in ORS protocols, electro-mechanical and optical hardware handling needs to be defined. The team should be part of the ORS verification and qualification program and conduct audits at ORS vendor locations. This team facilitates the execution of standardized processes, executes the integration and test of payload to bus, manages ORS stores, performs logistics duties, conducts technical coordination with the launch site, and generates and evaluates extensive configuration management data.

2.11.7. Facilities

A dedicated ORS IT&L Facility which contains state of the art testing equipment, flight hardware storage capability, integration and staging capability, and logistics interface capability to load directly on to an aircraft will be required. The facility will be required to be capable of handling 2-3 parallel ORS system level requests with the possibility of expanding to more IT&L activity as threats begin to be realized in the future. Staging and storage operations shall also support built-in test data collection, data analysis, inspection, qualification and personnel training.

2.12. Analysis of Materiel Approaches (AMA)

The Responsive Space Operations Architecture terms of reference states that the U.S. must have the ability to respond appropriately across a broad range of time scales to changing situations and time critical mission or capability requirements for space based products and services. Space services that may be enabled by responsive space include: intelligence, surveillance and reconnaissance, position, navigation, communication, space control, environmental sensing and missile warning. For the purpose of this thesis space based payload and bus integration and test is investigated, but the term “responsive” is not limited to a narrow definition. It also covers “acquiring capabilities” to meet customer needs which include the ability to coordinate and disseminate data to the warfighter. Non-space based surveillance assets may be more responsive in terms of development and deployment, but capability trade-offs have to be understood. Non-space based systems do provide tactical assets to the warfighter and are therefore considered as alternatives based on warfighter need. Appendices D and E provide a detailed overview of current space based capabilities and reviews a broad technology platform list. Appendix D provides AMA summary decision matrix data and Appendix E provides an AMA overview. This AMA was completed after the FSA.

3. As-is Integration, Test and Logistics

The current day space mission analysis and design process begins with broad objectives and constraints, and then proceeds to define a space system that will be met within a defined cost (48:458). Current day space surveillance capability that the warfighter has relied upon has mostly come from a strategic capability which implies a long-term design and deployment capability. New warfighting strategies require a more "responsive" customized capability that can be deployed on more narrow time frames and are assigned to specific localized warfighting missions. In the current "as is" space mission design state, cost has often been questioned because cost can be a fundamental constraint. Emerging vulnerabilities and new threats to national security require a reassessment of the old business model in order to recapitalize military space capabilities for the future.

In general, space mission objectives and system concepts have adopted five (5) basic measures: required performance, cost, development and deployment schedule, implicit and explicit constraints and risk. The space industry is risk adverse and high spacecraft and launch costs have been additional incentives to use satellites as long as possible, slowing technology insertion.

As currently documented, the Space Mission Analysis and Design (SMAD) Process summarizes an approach that has evolved over the past 40 years and consists of a process flow as shown in Figure 3-1 SMAD Process (49:39).

The life cycle for an "as is" space mission consists of four major areas which is part of the SMAD process. The lifecycle process documented in SMAD is not unique and is

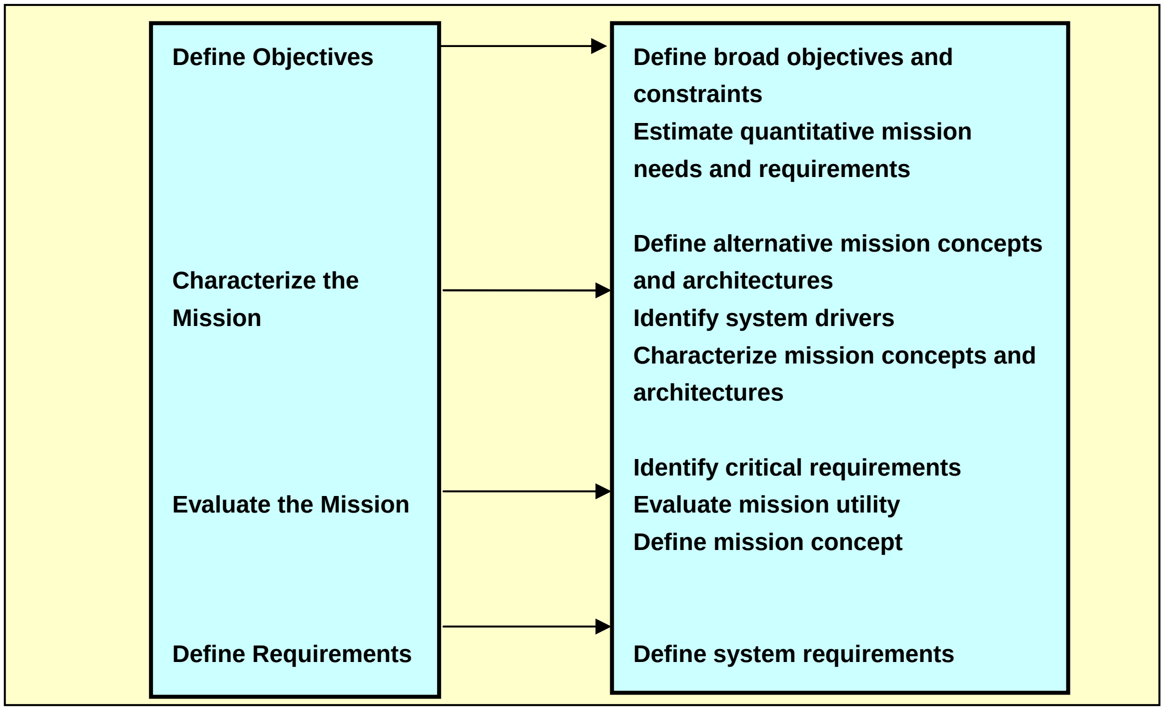


Figure 3-1. Generic mission and requirements steps

therefore very similar to other documented system lifecycle processes. The SMAD cites four (4) major process steps (49:9-39)

- Concept exploration
- Detailed development
- Production and deployment
- Operations and support

It is during the early lifecycle phases that the top-level mission requirements are formulated into operational and functional requirements and mission constraints defined.

Mission payloads can be divided into six (6) broad categories: observation, communications, navigation, in situ-sampling, sample return, and crew life support and transportation. Payload trades involve criteria that include the mission orbit, pointing and tracking functions and spacecraft elements. Payload trades are also affected by when space systems perform more than one mission; thus, with every major decision consideration must be given as to which performance option meets essential requirements. "As is" integration, test and logistics functions are controlled and managed based on the requirements negotiated and specified through interface control documents (48, 71). Interface Control Document complexity will be directly related to mission objectives, expected orbit, and required working life of spacecraft and payloads. Internal to the system, documenting interfaces between segments and or subassemblies is important and key to integration and test activities. The Interface Control Document is developed based on the data listed in the system specification document. System standards, interfaces and plans are also derived from system specification documentation and can specify environments, performance and operational requirements that will be required to be verified as part of integration and test functions. Additional important system documentation includes Test and Evaluation Master Plans (TEMP); these plans address and evaluate measures of effectiveness.

3.1. As-Is Architecture – OV Description

The OV-1 shown in Figure 3-2 demonstrates:

- Integrated Product Teams (IPT) – Large industry teams contracted to provide space operations services. This can include hardware, software, design and engineering support. IPT complies with detailed systems requirements and interface control documentation. Detailed requirements include identification of external interfaces, system standards, drawings and plans. Reports to Special Project Office (SPO) for direction on mission requirements.

- Launch vehicle integration and launch services – Primary output is to launch spacecraft. This activity receives a spacecraft for final integration on to the carrier.

- Integration and test personnel – A group of highly trained personnel that have extensive capability and expertise in hardware integration, test and logistics.

- Integration, test and logistics facilities – Facilities, hardware and tooling required to execute the space operations work. Multiple facilities and logistics interfaces are required. Design and interface issues are a continuous topic because of the numerous vendors and types of sensitive technology.

- Ground Stations–Extensive software and hardware development is conducted. On-Orbit testing and acceptance of new systems can take months before final system sell off.

- Spacecraft program management (SPO) – Provides budget, schedule, resources and customer negotiations.

Figure 3-3 shows the operational node connectivity. The activities that are supported by each node are shown along with the need lines between nodes. The integration and test node is the focus of this thesis and the functional activities will be explored in the OV-5 figures. The primary needs identified in the node connectivity are requirements, component build and test information, and schedule updates from the various space operations sources. Figure 3-4 shows a high level organizational hierarchy and reflects the strategic nature of the current space operations system. Current "cold war" space operations represent very large organizations with numerous payloads of advanced technology. Launch systems are complex because of the size and weight of the satellite. Integration of payloads involves many industry partners, requiring a complex program management structure.

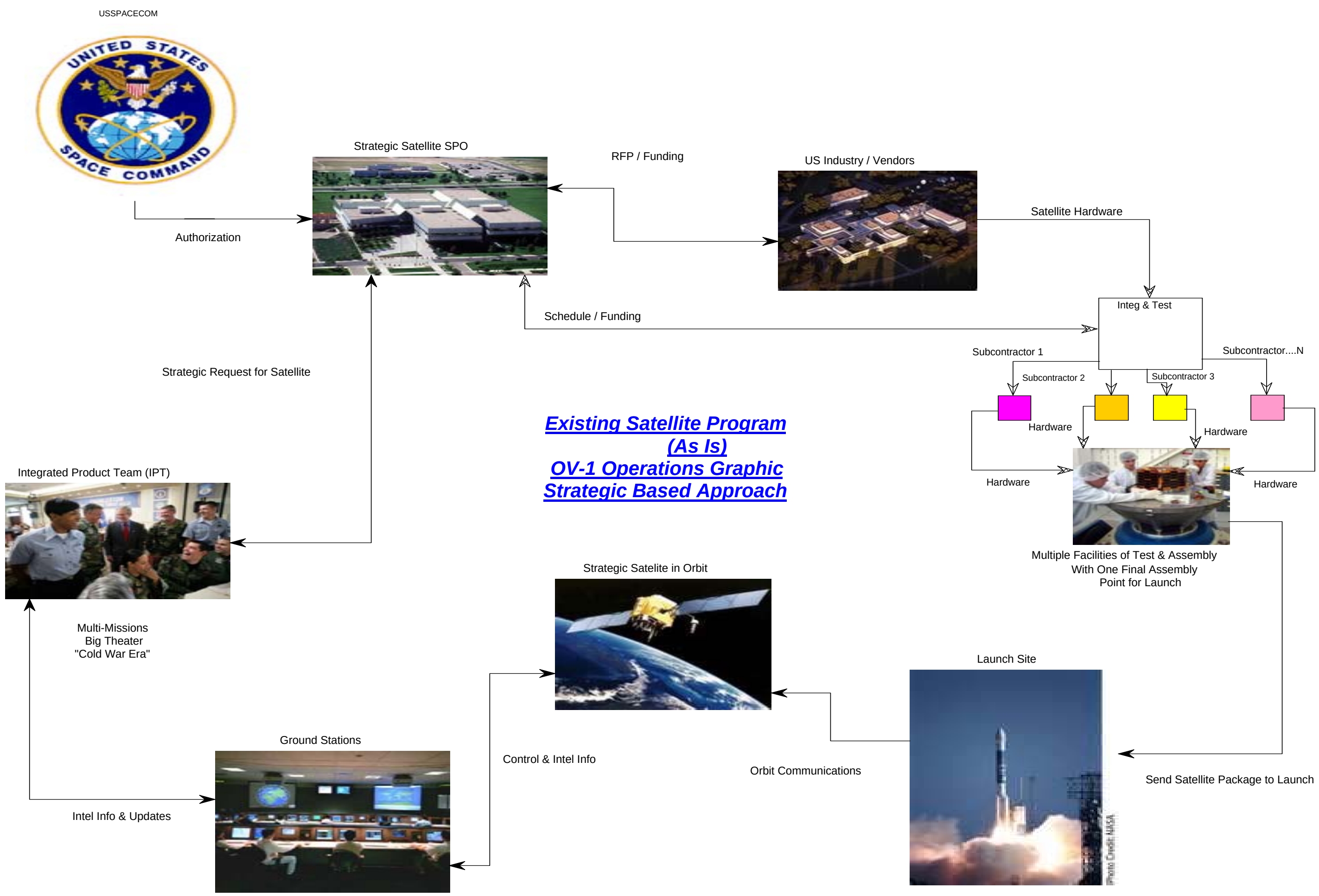


Figure 3-2. OV-1 As-Is “Big Space” Multi-Mission Operations Graphic Information

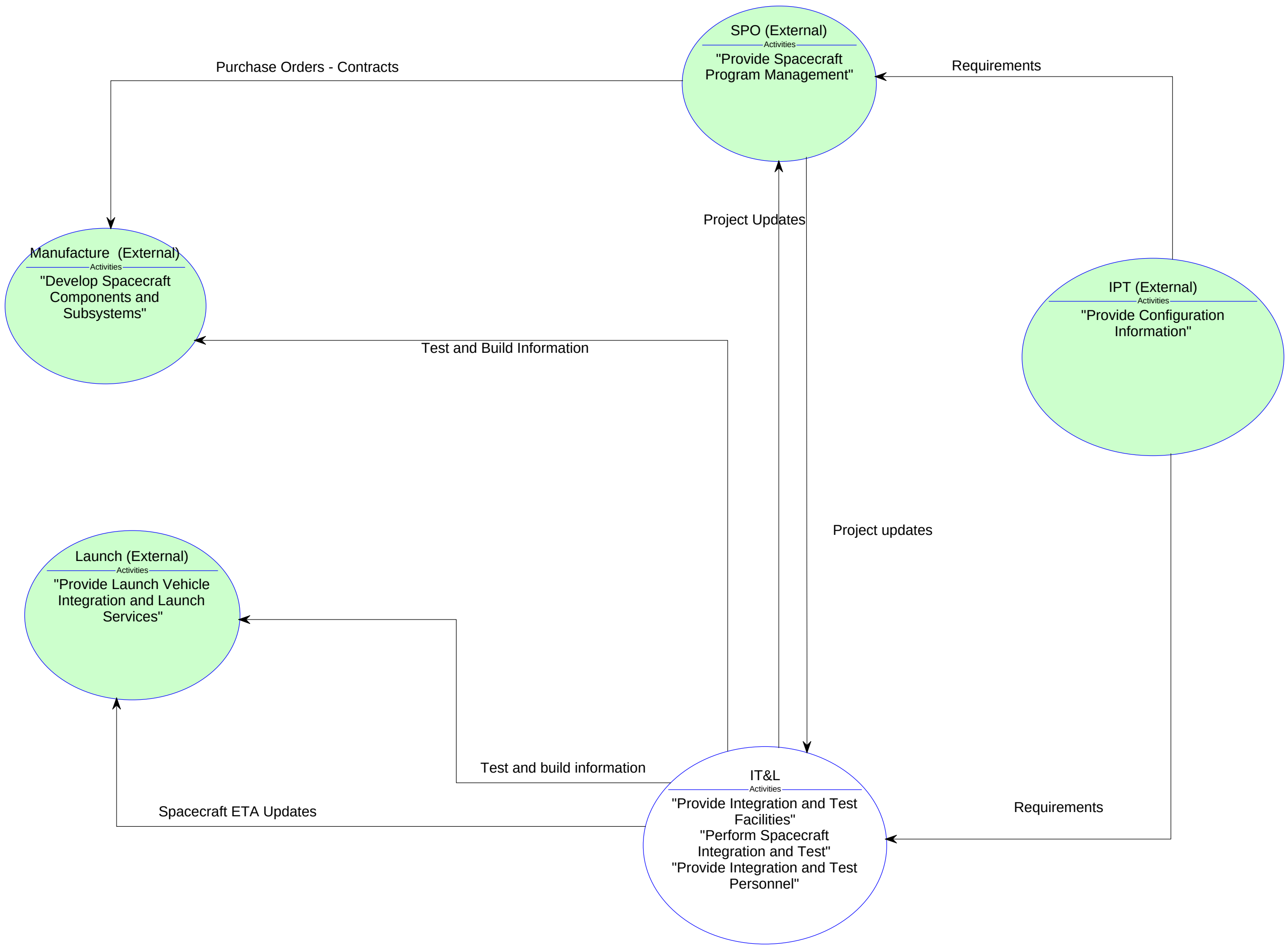


Figure 3-3. “As is” Information Transfer and Communication Node 1 [OV-02]

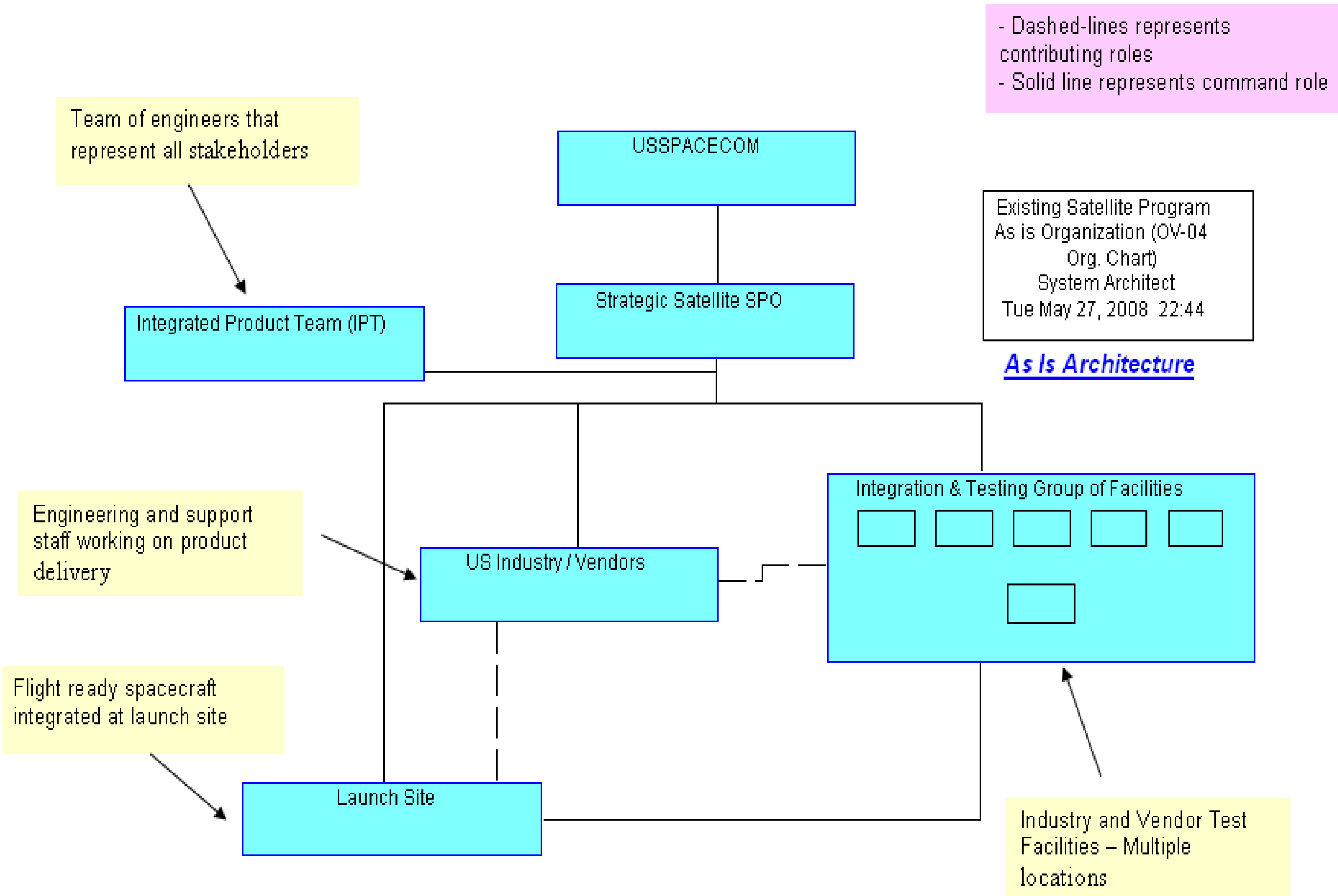


Figure 3-4. Existing Satellite Program "as is" Organization [OV-04 Org. Chart]

As shown in Figure 3-5, the OV-5 Activity Model External Systems Diagram for "as is" IT&L is supported by six (6) major activity areas which result in complex communication pathways that require extensive infrastructure and unique test equipment. The spacecraft integration, test and logistics function (A-0) is the primary activity that all payload vendors flow to once the SPO has provided approval to the (A-1 activity), "consent" to perform spacecraft integration and test (A.0) at the spacecraft level. In order to integrate a payload, at the spacecraft level, the SPO would have approved all test, verification and validation data of the item. As indicated in A-4, the payload vendor is required to comply with detailed design and test requirements provided by the SPO. Each payload industry partner is responsible for extensive testing at the component and subsystem level of the payload. Each industry partner negotiates with the SPO on the test plan scope for each level of assembly. In addition, quality, reliability and mission assurance plans (in the interface control documents) have additional requirements that confirm functional and operational requirement compliance. Extensive logistics and handling issues are required to be managed because of special handling requirements of flight hardware. Safety of flight hardware is required to be assured at each step.

The output (A.0) is integration to the launch carrier with a flight ready spacecraft. This final integration occurs at the launch location.

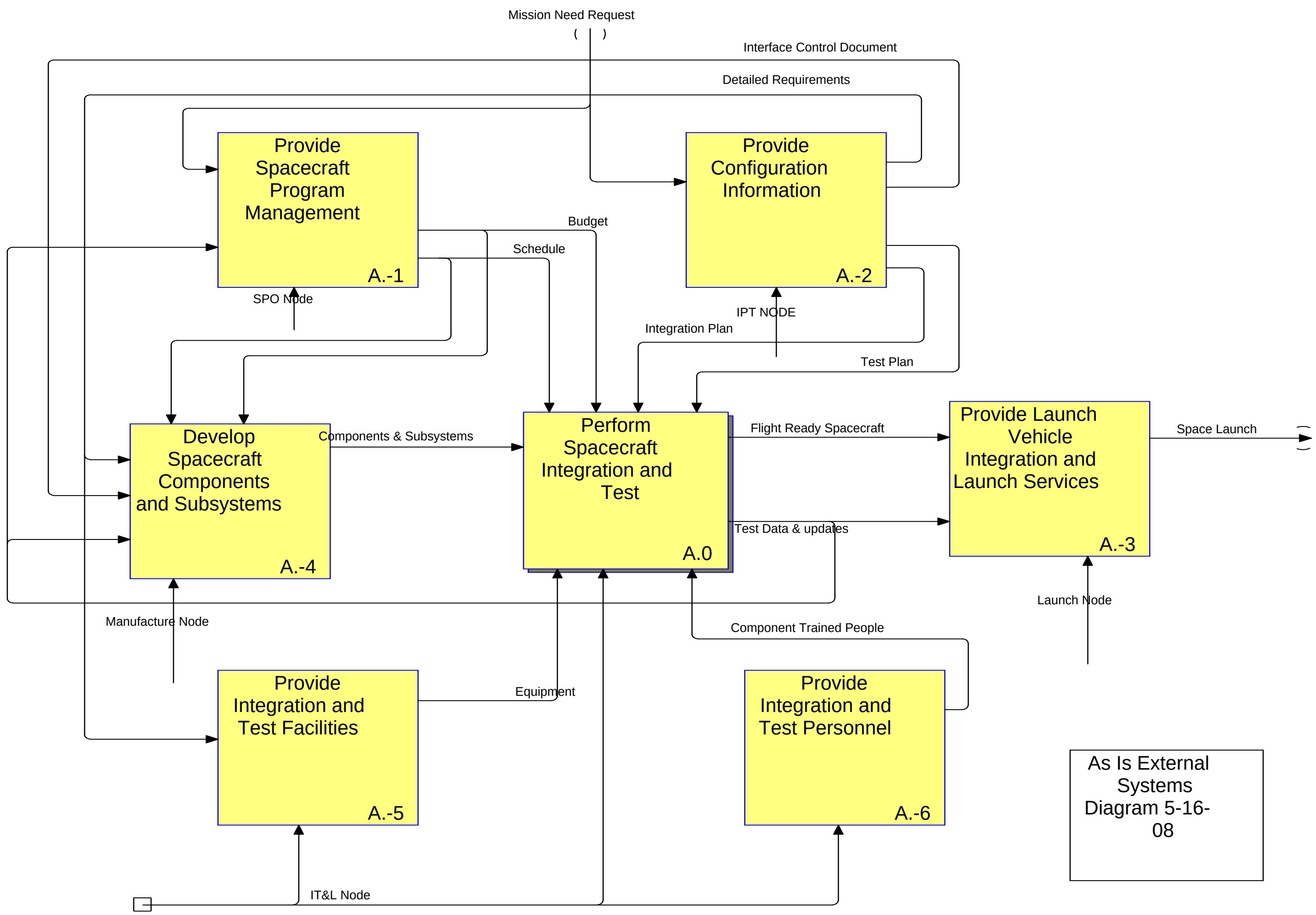


Figure 3-5. Depicts "as is" External Links Important to IT&L [OV-05 Model]

In Figure 3-6, detailed analyses identifying the major Inputs, Constraints, Outputs and Mechanisms (ICOM's) associated with "as is" IT&L is performed. Integration is indicated at four (4) levels which are subsystem, bus, payload and spacecraft. Figure 3-7 shows a comprehensive integration plan with an embedded schedule which covers each phase of integration along with the requirements at each phase. At each level of integration functional testing is performed and a formal consent to break review is conducted which provides the programmatic authority to proceed to the next testing category. It is very common in the "as is" process for there to be issues with integration hardware, component reliability, adequacy of test plans, and mechanical hardware design which cause delays and/or rework. These issues have to be coordinated among several agencies and can be difficult to resolve quickly. Based on this consideration, periodically integration steps have to be repeated before a reliable system exists that can be approved for graduation to the next phase.

In the previous cited study by Weigel, the statistics for failures indicated that failures in the ambient environment were one of the leading causes for delays and rework which supports the notion that integration issues are of prime concern (73:11). Having the correct, calibrated, and functioning testers and handling equipment available for the full spectrum of components, subsystems, and systems is a complicated endeavor and a further cause of delays. Identifying and managing these logistics needs is a key enabler throughout all phases of integration because it provides the infrastructure to conduct the work within the technical requirements and schedule and is contained within the IT&L operational node.

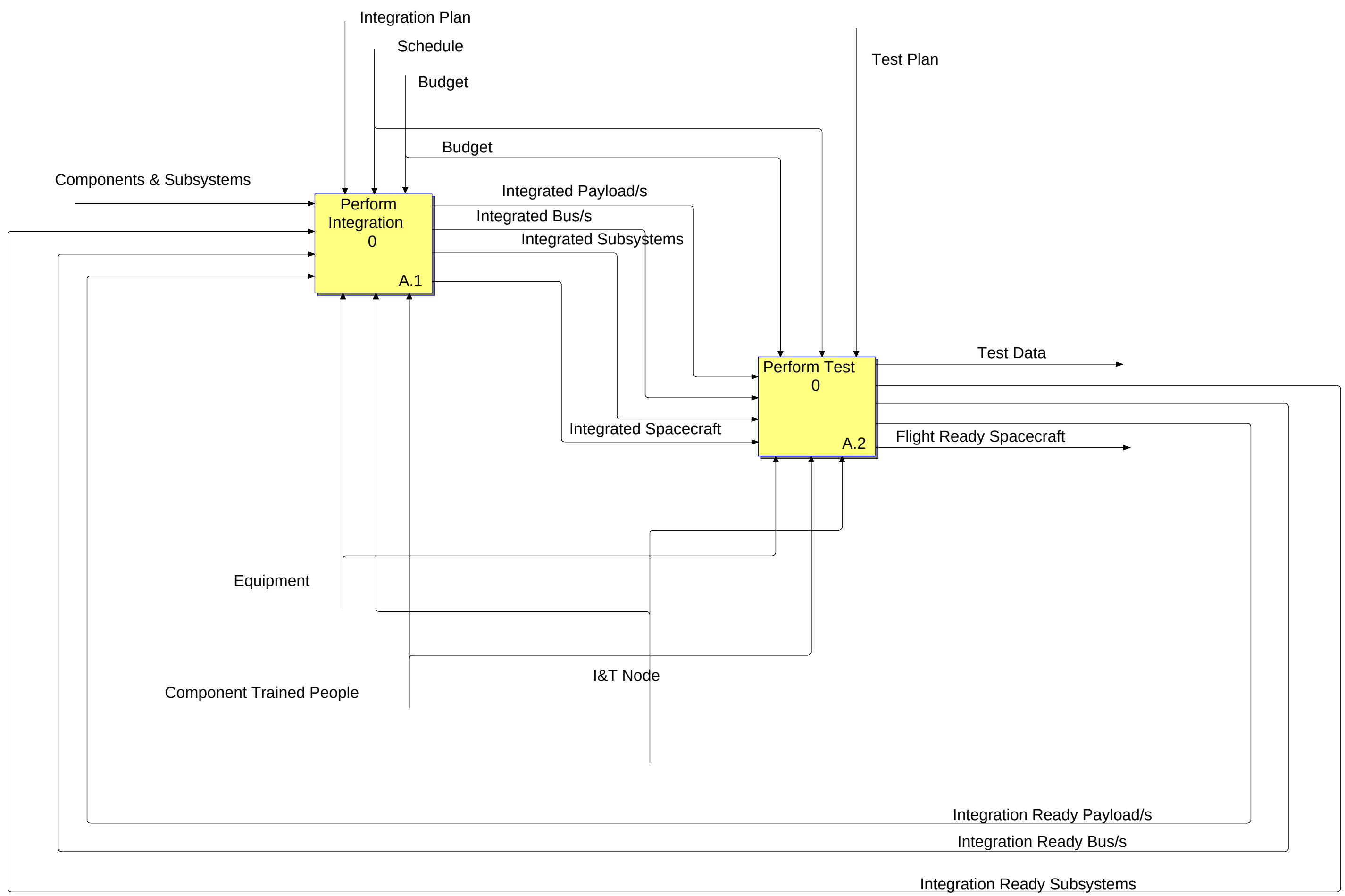


Figure 3-6. Perform Spacecraft Integration and Test "as is" Showing Multiple Iteration Loops [OV-05 Model]

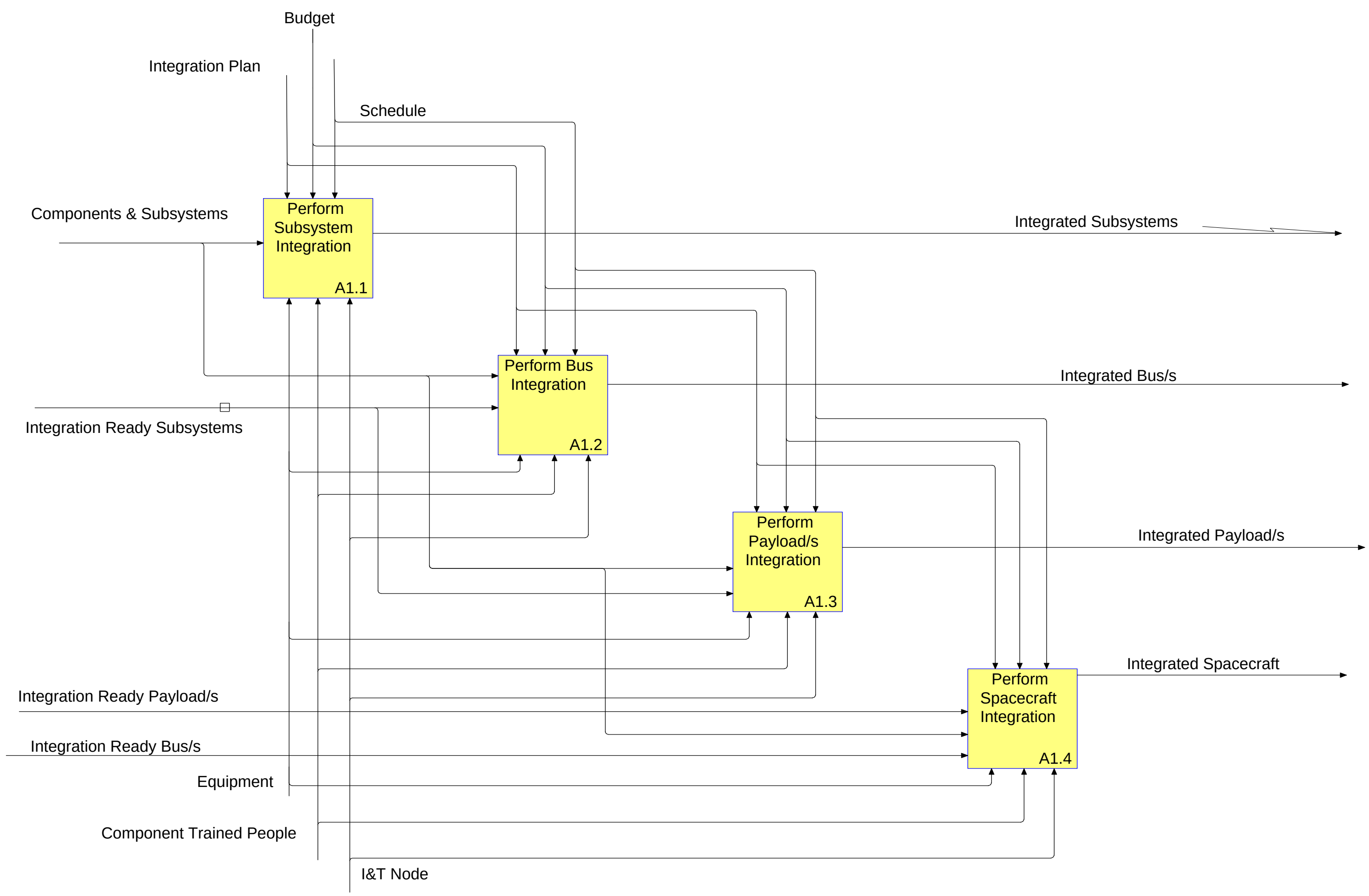


Figure 3-7: Perform Spacecraft Integration and Test "as is" for Flight Hardware [OV-05 Model]

Figures 3-8 and 3-9 provide data on the mechanical, thermal, electromagnetic (EMI) and mass properties testing ICOM's that are required for "as is" testing. This testing represents both functional and performance test requirements that are required to be verified and validated under environments driven by the system Interface Control Document. Integrated System Testing (IST) is performed after each mechanical, thermal, electromagnetic (EMI) and mass properties test. ISTs are also conducted during thermal and EMI cycling to confirm functionality. According to the Weigel study, most of the environmental test failures occur during the thermal vacuum (TVAC) test (73). The cycle times for TVAC can be very long for each transition from hot to cold, and the test requirements can call for several cycles. Based on the environmental standard applied to the system, TVAC testing can take 20 to 30 days depending on the mass of the payload and the chamber capability. Failures during this phase that require retest or repair can quickly add up to costly schedule slippage.

3.2. As-is Testing Discrepancies

The Weigel study also indicates that the thermal vacuum environment finds 36% of all the discrepancies discovered at system-level IT&L. The thermal cycling environment finds about 3% of all discrepancies discovered at the system level, and the "shake" environments of acoustic, vibration, acceleration and shock together find about 3% of all discrepancies discovered at the system level. This is consistent with previous studies and discussions with test professionals that have suggested the thermal vacuum environment catches substantially more discrepancies than the other environments (73).

Shock and vibration testing has traditionally been performed one axis at a time. Single axis testing requires extensive handling of the flight hardware, cables and interconnect boxes between each test reconfiguration which can be very time consuming depending on the complexity of the system. System testing is very important and can not be altered to meet schedule constraints. It should be recognized by the program that if major system failures are detected during system testing significant schedule delays will be incurred.

An example of an additional variable that can escalate complexity of final integration is the mechanical interface handling gear. Lifting hardware is used to maneuver the system in a certain orientations required for testing. This hardware design is complex and carries numerous interface requirements. Design inconsistencies occur frequently. Mechanical hardware redesign and re-certification requires extensive time periods which results in the "stop work" of the program. In addition, if separate gear is required for different phases of test handling, this adds to risk to the flight hardware because of the continuous mechanical movement. In Chapter 4 this master's thesis team recommends that ORS requires design and test of all components, subsystems and systems to the revised Mil Std 810G. Mil Std 810G requires multi-axis testing which provides much greater accuracy and fidelity to real world environments. A multi-axis tester set-up would also facilitate the goal of limiting flight hardware movement for mechanical tests. This will be fully explored in Chapter 4.

An additional issue that often exists in "as is" space design and operations is that test plans, at all levels of assembly, are not developed or written until just prior to the actual test. This is a significant problem because it reflects that the design engineer does not have the technical basis by which the design will be verified or validated until very late in the lifecycle. This has caused significant issues in "as is" space because of the high probability of the product not passing the requirements of a rigorous testing program. Further, a design program that is purely dependent on modeling and simulation and does not have the empirical data to substantiate the accuracy of the model will have potentially significant errors. It is the test data at all assembly levels that validates the modeling and simulation used for space operations design.

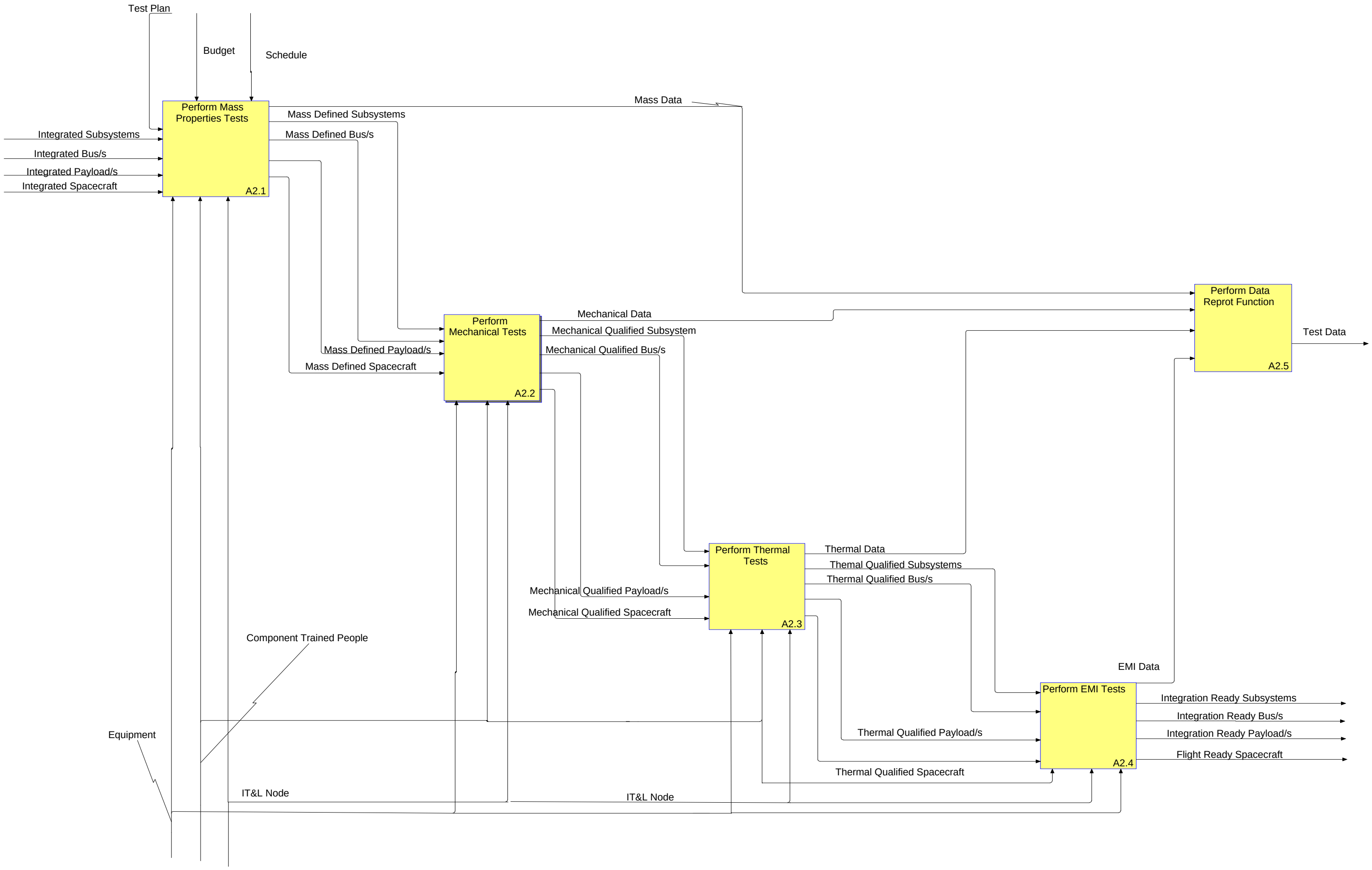


Figure 3-8. Perform Test: Begin Environmental Test with Flight Hardware [OV-05 Model]

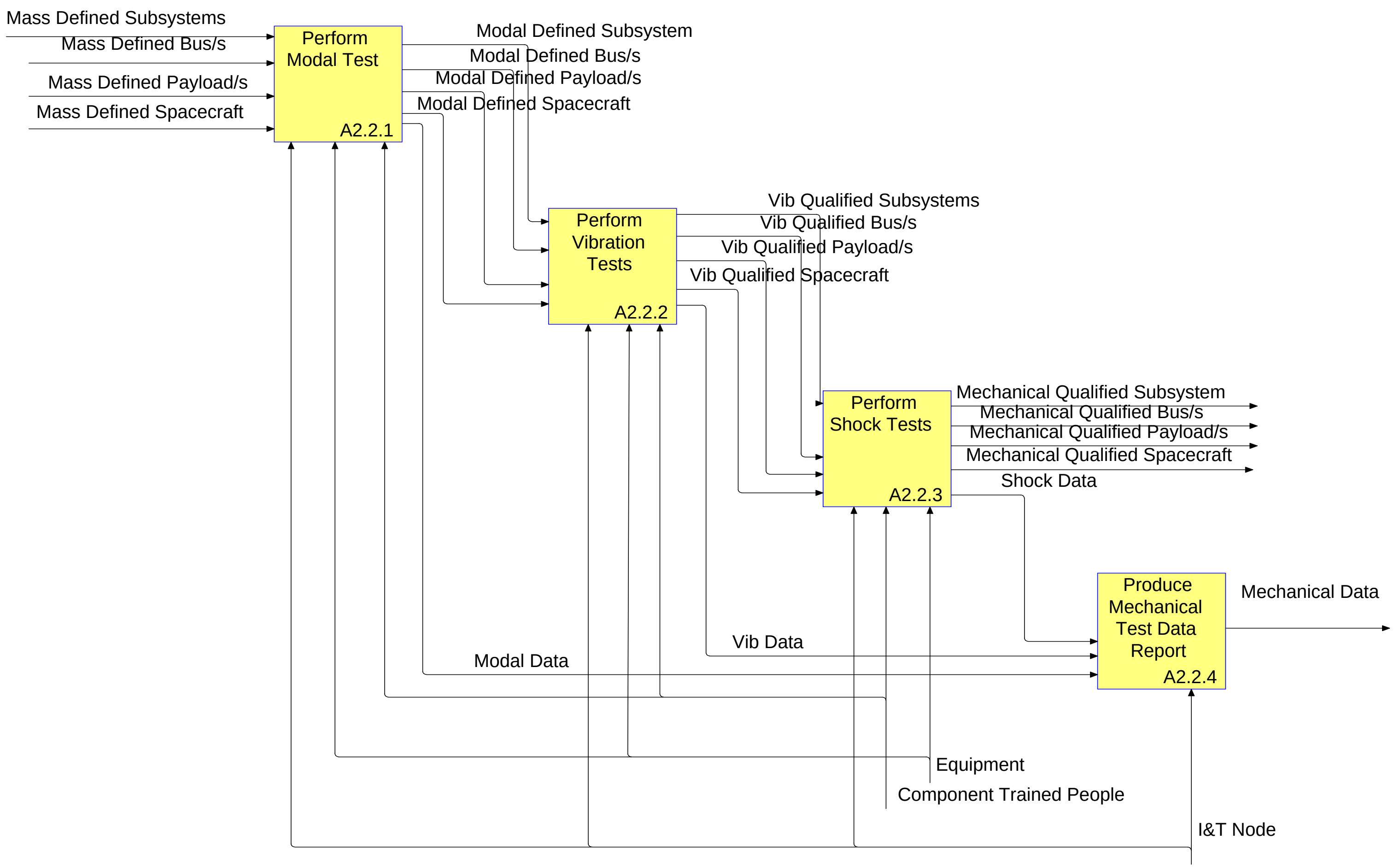


Figure 3-9. Perform Mechanical Tests "as is" Hardware is Qualified [OV-05 Model]

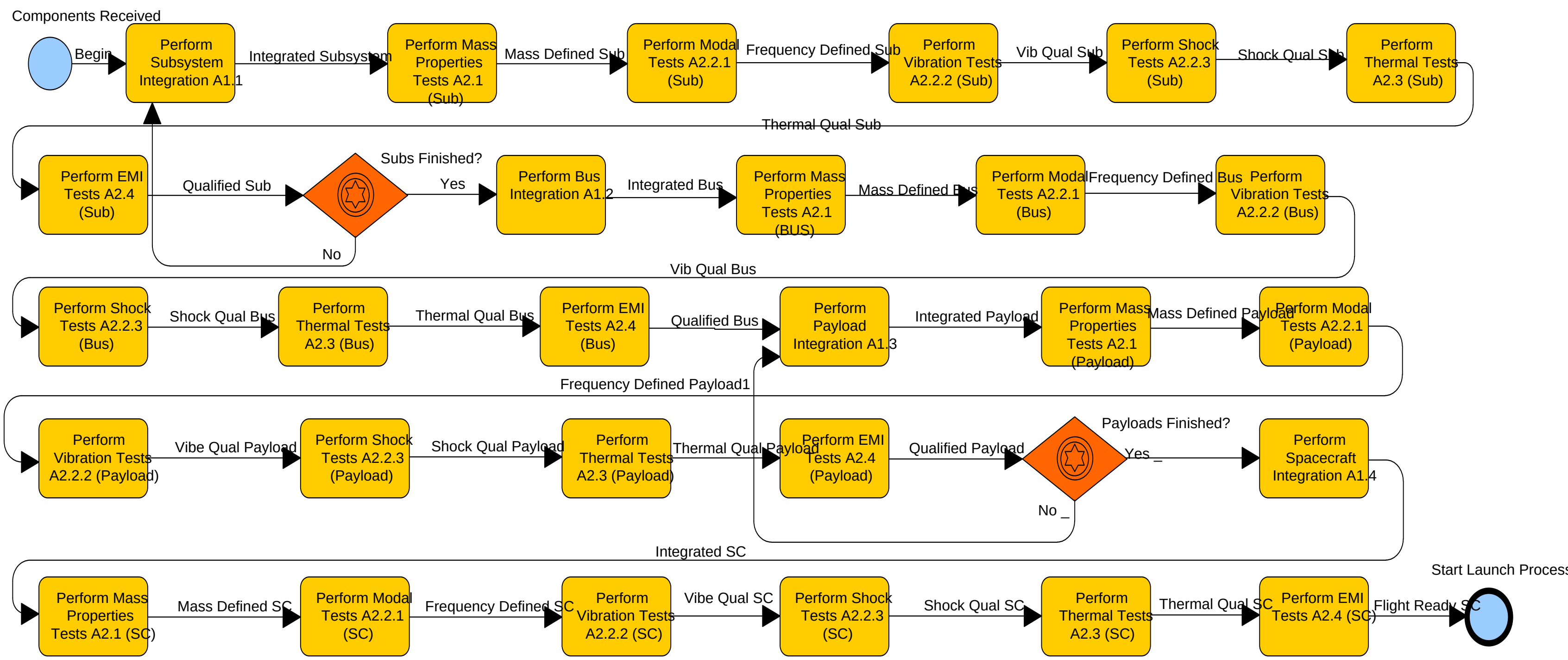
Figure 3-10 shows the process flow through the current "as is" process for a "happy path" scenario. As mentioned before, test failures and integration anomalies will result in extensive flight hardware rework. Figure 3-10 contains approximate time information for various phases of the test and integration process. This data was generated from interviews with space professionals.

3.3. As-Is Summary

The "as is" payload to bus lifecycle documented above is complex and iterative and takes extensive interface management to properly baseline requirements and maintain traceability of all engineering decision-making. Based on mission needs, analyses and validation exercises, the system requirements document should cover every relevant aspect of system function and performance. All of the above listed points directly configure the integration, test and logistics requirements and program at the production phase. For example, Figure 3-11 shows a generic floor plan of the items in a standard IT&L facility.

One of a kind satellites with complex strategic missions and state of the art payloads equate to extensive interface management requirements and numerous iterations of requirements definition. This phase of work requires detailed integration and test planning exercises with numerous operating CONOPS developed for every external interface.

Logistics is also complex because of numerous interface elements that have to be continuously met to be compliant with Interface Control Document technical agreements. These logistical issues include areas like: mechanical handling gear requirements, contamination control, electrostatic discharge (ESD), security, contingency planning, facility configuration management, environmental monitoring and transportation and handling requirements.



Total Duration = 500 working days average

Figure 3-10.“As Is” Process [Business Process] – Working Day Average of Existing Sequence Flow

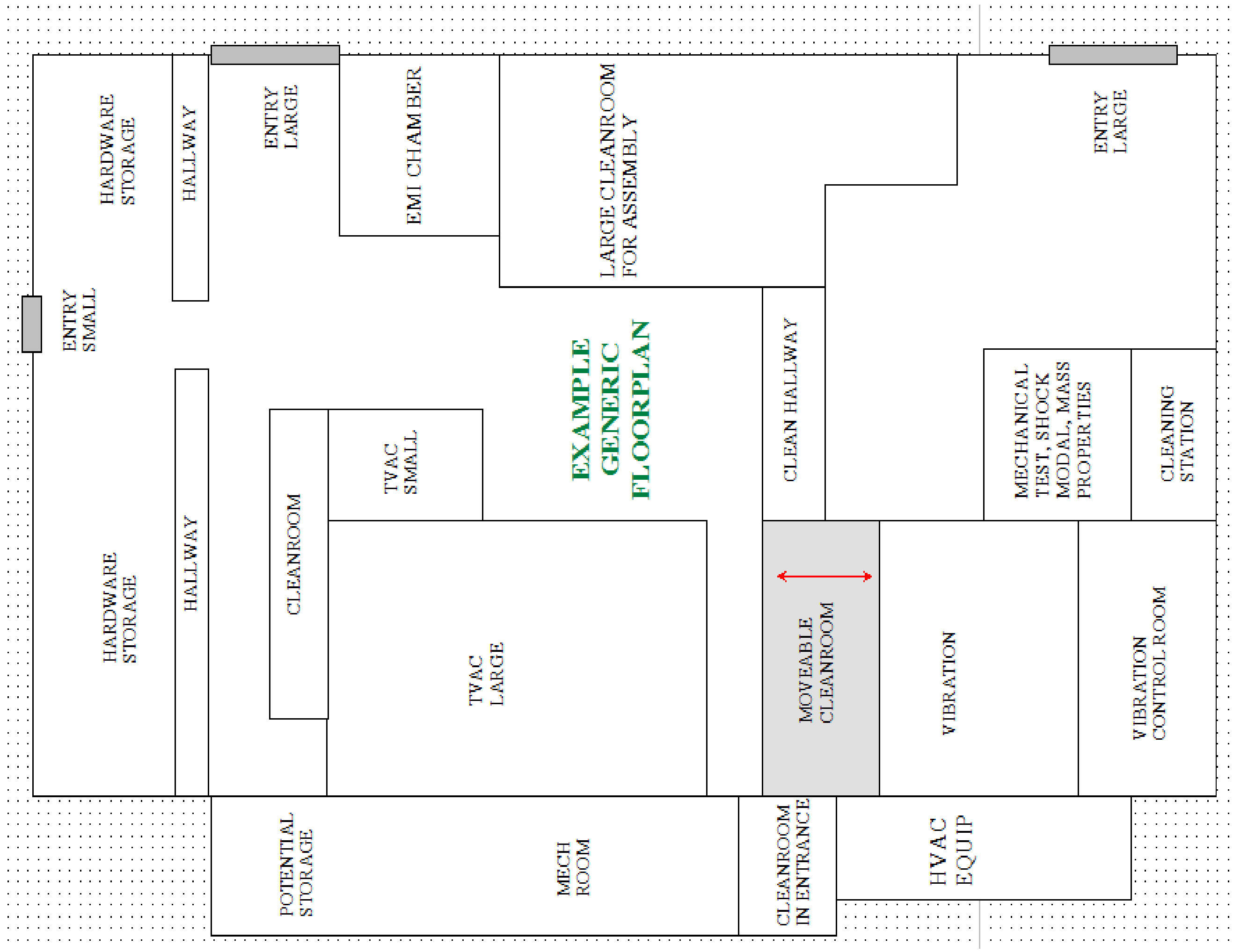


Figure 3-11. Generic "As Is" Floor Plan (Includes Needed Test Stations)

A major problem for aerospace and defense companies serving the US government is the time it takes them to reach production after the technology design is frozen (38:22). Technology continues to advance, but insertion is very slow and does not keep pace with warfighters needs. An agile framework based product design could permit new technology insertion almost up to production time. A product designed this way would permit technology upgrade more quickly and facilitate efficient integration and test process. The “as is” vs. the “to be” does not have many process step differences. What is different is the “as is” structure is populated with many variances that are typically not addressed until production, integration and test activities are initiated. It is very typical in the current “as is” structure that at all levels of integration it is discovered that required equipment was not designed or that a cable connector type is incorrect or environmental test plans are not compliant with the TEMP. These are all unacceptable operating conditions based on the new required warfighter capability timeline. There are numerous issues that arise as a result of the “as is” process that have to be better managed and anticipated. The “to be” process discussed in Chapter 4 proposes operational efficiency insertions to meet the 90 to 120 day warfighter timeline by controlling interface and processing requirements at the system level.

3.3.1. Key As-Is Relevant Points

This thesis documents in Chapter 4 that by modifying the current IT&L approach from: the *components driving* the system to a *standard space operations system driving* the components significant improvement in cycle times will be achieved and will enable ORS tactical space operations. Figure 3-10 demonstrates that the current “as is” space operations model will take a minimum of 500 days total program duration. This “as is” duration assumes that there are: no electrical, mechanical or optical failures, no re-testing, all requirements are executed exactly correctly the first time, communication paths are flawless, industry contracts require no re-negotiation and no integration anomalies exist.

4. To Be IT&L Process/Architecture

4.1. Introduction

The paradigm of the “cold war” has defined deployment of new space systems as being developed over several years with the end product generally being a one of a kind custom system. The key to the ORS IT&L architecture is the build-up or stocking of highly reliable interchangeable payloads and a standardized spacecraft bus or buses. The payloads would consist of proven technology which has met both performance and functional requirements of the warfighter. ORS tactical space systems will be required to have a shorter operating life and will be built for very specific tasks and missions that are identified on short notice. The ORS request for tactical satellite support will be based on a limited list of mature capabilities that can meet established standardization, reliability, qualification and testing requirements. These systems will be in an inventory and capable of being rapidly configured into a multi-payload spacecraft configuration. The capabilities and operational efficiencies developed under ORS can eventually be migrated to larger strategic space operations.

4.2. ORS IT&L Elements

The following technical parameters, organizational parameters, assumptions and risks apply to the success of the ORS Tactical Satellite Rapid Deployment System (TSRDS). The mission of ORS IT&L is to provide on demand rapidly integrated tailored payload and bus systems, test the resulting spacecraft and prepare for integration on to the launch carrier.

The technical elements of ORS IT&L include:

- The engineering focus of the ORS Program as defined by ORS Stockpile to Mission (STM) documents. These documents define the mission characteristics of a ORS payload(s) and bus suite. Each STM would represent the complete set of parameters for an ORS mission.
- Mature technology and broad use of commercial off the shelf technology (COTS)
- Narrow range of capability that is specific to the mission request
- High reliability of system components to meet technical requirements, mission request and schedule
- Extensive technology qualification program

Organizational Parameters:

- Program Office effectively translates mission requirements to technical requirements
- Doctrine, tactics, techniques and procedures, along with organizational structures will be reexamined and modified
- Standardization of technology and interfaces – for example cables, harnesses, use of Jet propulsion Laboratory (JPL) contamination control practices, ESD mitigation, lubricants, cable connector procedures, standards, etc.
- DoD investments in infrastructure that supports ORS Program (ground, flight, manufacturing) execution
- DoD investment in funding a qualified payload and bus development program would be required. DoD would then stockpile ORS payloads and buses to meet a rapid response request.

Assumptions Parameters:

- Recognition that ORS is a disruptive innovation which will result in improved performance along a warfighting trajectory. Because ORS is disruptive its execution will require different organizational capabilities.
- The ORS Program office will be the “product champion” for ORS technology, thus therefore, refining the engineering process as lessons are learned.
- Shorter mission duration – tactical mission specific to an immediate need

Risks parameters:

- Maintaining national and political will to fund start-up costs for ORS
- Overcoming the existing big space program/ industry paradigm of being risk adverse
- Overcoming Space industry lobby and influence on national security policy
- Eliminating echelons – Decision-making and top-down command structure
- ORS system could become overwhelmed in a national emergency – risk of overwhelming initial infrastructure
- High level of reliance on civilian support personnel / infrastructure – Components at all levels will be provided and qualified at the vendor level
- Risk of scope creep – must manage to keep ORS operations separate from ORS research and development.

4.3. ORS Adaptive Integration, Test and Logistics – CONOPS – Payload to Bus

Figure 4-2 depicts the ORS operational view. Operational re-design is needed to ensure affordable, rapid access to the space based capabilities that are critical to fulfilling the full range of U.S. diplomatic, information, military and economic needs. An ORS IT&L initiative can

- Transform the Space Test Program – Increase number of payloads making it into space
- Strengthen the tie between qualified payloads and combatant commander capability needs
- Serve as a unifying body to focus on modular capabilities and standardization
- Enable earlier acquisition and deployment of an operational system and increase production opportunities

An ORS Program Office was established in 2007 to manage the process, generate an implementation plan and execute a business model that will meet the goals warfighter's needs. The ORS Program Office consists of the top five (5) functions (32:10) as shown in Figure 4-1. The COCOM/User Support function will identify, advocate and plan for desired ORS capabilities. This function supports COCOM user needs and provides a direct interface to the war fighter. The Conceptual Solutions Function links ORS needs and Science and Technology (S&T) through applied research and advanced concept development. S&T functions define and pursue payloads, buses, ground infrastructure and launch systems to meet the ORS needs. The Acquisition Function executes timely acquisition of ORS capabilities and manages inventory support. The Operations Support Function provides operational capabilities to support delivery of space effects to the users. This function provides the program office support to ORS IT&L. The S&T, Acquisition and Operations support functions are directly tied in to the adaptive IT&L activities.

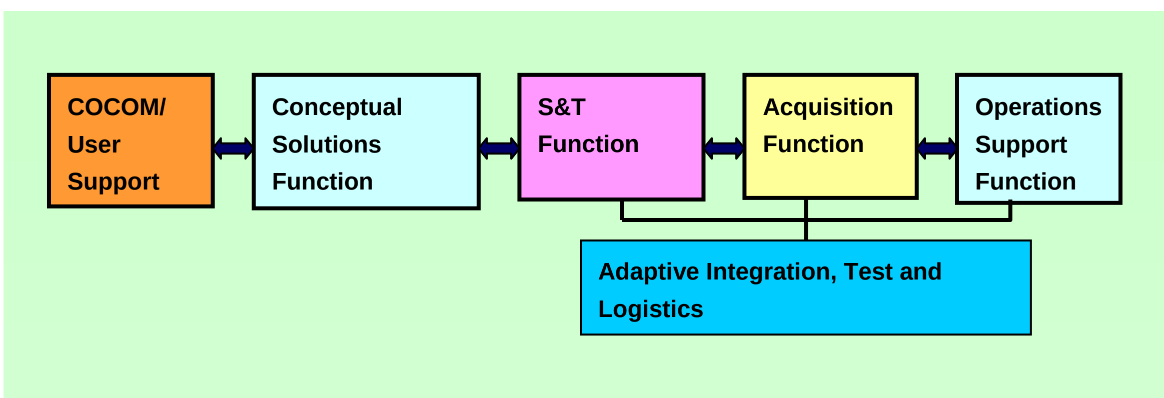


Figure 4-1. Three ORS Program Office Functions that are Linked to IT&L

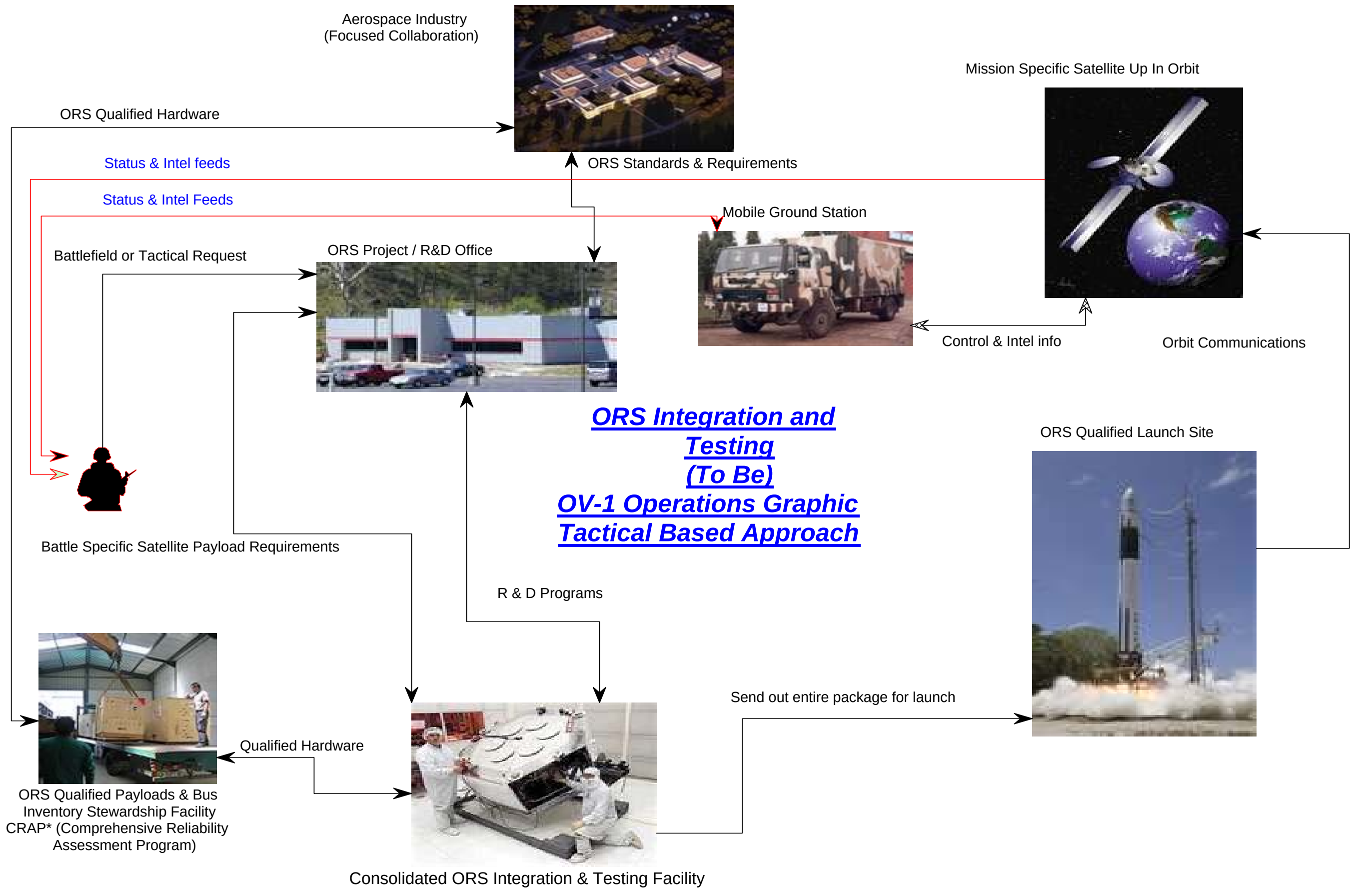


Figure 4-2: ORS Links to Tactical Warfare

ORS communication pathways will be required to be direct, rapid and accurate to the capture the customer‘s request. Figure 4-3 shows the Operational Node Connectivity Diagram which defines the information needs between nodes. The ORS Program Office will be required to be skilled in converting mission requirements to technical and payload requirements within a 24 to 48 hour time interval upon receipt. The key attribute of the ORS business model is that the field commanders drive demand. That demand is that the joint military capability meets operational and tactical levels of needs. The operational commander requires an in theater capability that is available during joint warfighting planning timelines. The time function for responsiveness is then driven by adaptive contingency planning cycles rather than predictive futures or high scripted acquisition periods. Therefore the objective is communication, agility and dynamic fitness, not the pursuit of immature technologies that are not necessary for the current warfighter's needs.

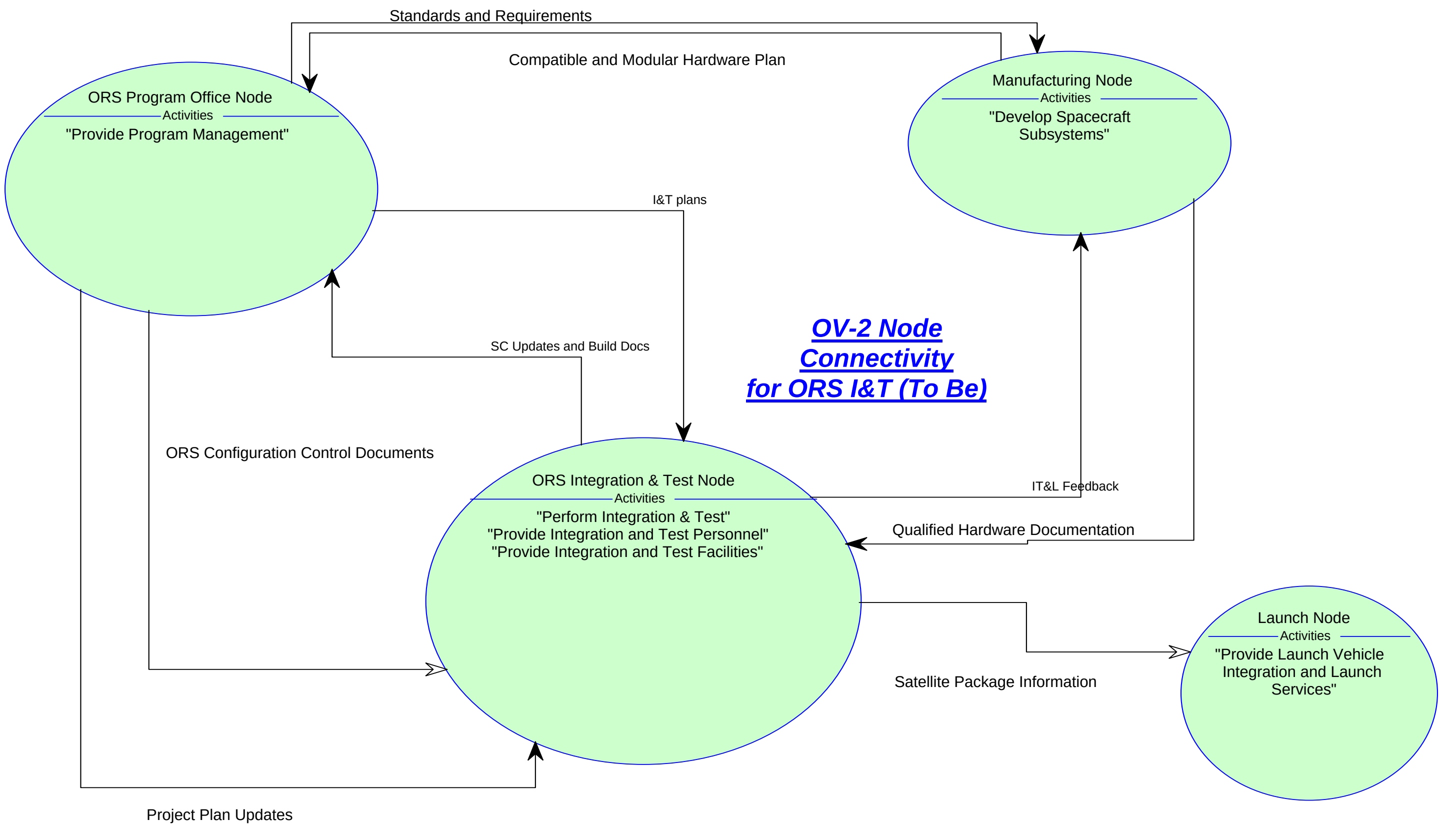


Figure 4-3. Node Connectivity: ORS IT&L Information Needs [OV-02]

ORS adaptive Integration, Test and Logistics mission space is defined as that capability to integrate qualified ORS payloads to a qualified ORS TacSat bus in a prescribed window of time. Qualification and Test of ORS Program assets will follow a strict verification and qualification process to support a defined integration process for the efficient assembly of a Tactical Satellite Rapid Deployment System (TSRDS) and are discussed in detail in section 4-6 and 4-8. The ORS adaptive integration, test and logistics capability will serve the rapid deployment of tactical space systems at the war-fighter's request because technology staging, selection, compatibility and design will be completed. All early stages of the design and development lifecycle will be completed, documented and in stores awaiting request. The ORS IT&L function will maintain a store of qualified payloads and buses, handling equipment and all required resources to complete the assigned tasks in a cycle time defined in days.

This capability will also serve to execute the entry and exit qualification and performance requirements for ORS. The required parameters for effective ORS Integration, Test and Logistics (IT&L) team will be rooted in the creation and definition of the embedded capability named ORS Tactical Satellite Rapid Deployment System (TSRDS) which provides at a minimum:

1. Payload Verification and Qualification requirements
2. Sub system interfaces - Components, Cabling and Fittings Acceptance and Qualification requirements
3. Launch System Acceptance and Qualification Process and Program requirements
4. Payload to bus Integration, Test and Logistics process
5. Rapid testing and analysis protocols
6. Operationally efficient integration of hardware

One of the important points in the Figure 4-4 is the clear and distinct need for a separate ORS research and development (R&D) function coupled with a *strict management of technology process* which serves as the path and gatekeeper between R&D and mature technology capable of ORS deployment. The ORS program office must have concise protocols that support comprehensive qualification in order for technology to be listed as "ORS deployable". Executing a strict management of technology process will provide a level of risk mitigation for meeting the ORS objectives. New technology should not be allowed into the right side processes of Figure 4-4 unless there is documented and reviewed system architecture for the technology that demonstrates it can meet operational, performance and timeline expectations of the warfighter mission as specified by ORS. Research and development is very important for the program and major upgrades of capability should be targeted for cycles of 3 to 4 years. ORS R&D can also serve as a test-bed for "big" space transferring technology and new space operations architecture that has proven success. The right side of Figure 4-4 also depicts the high level functions that will be performed by adaptive IT&L. The Tactical Satellite Rapid Deployment System (TSRDS) is a "to be" capability in which facility, equipment, and personnel will execute detailed flight hardware procedures, execute handling operations, and implement all hands-on operations to deliver a qualified ORS satellite to the launch location.

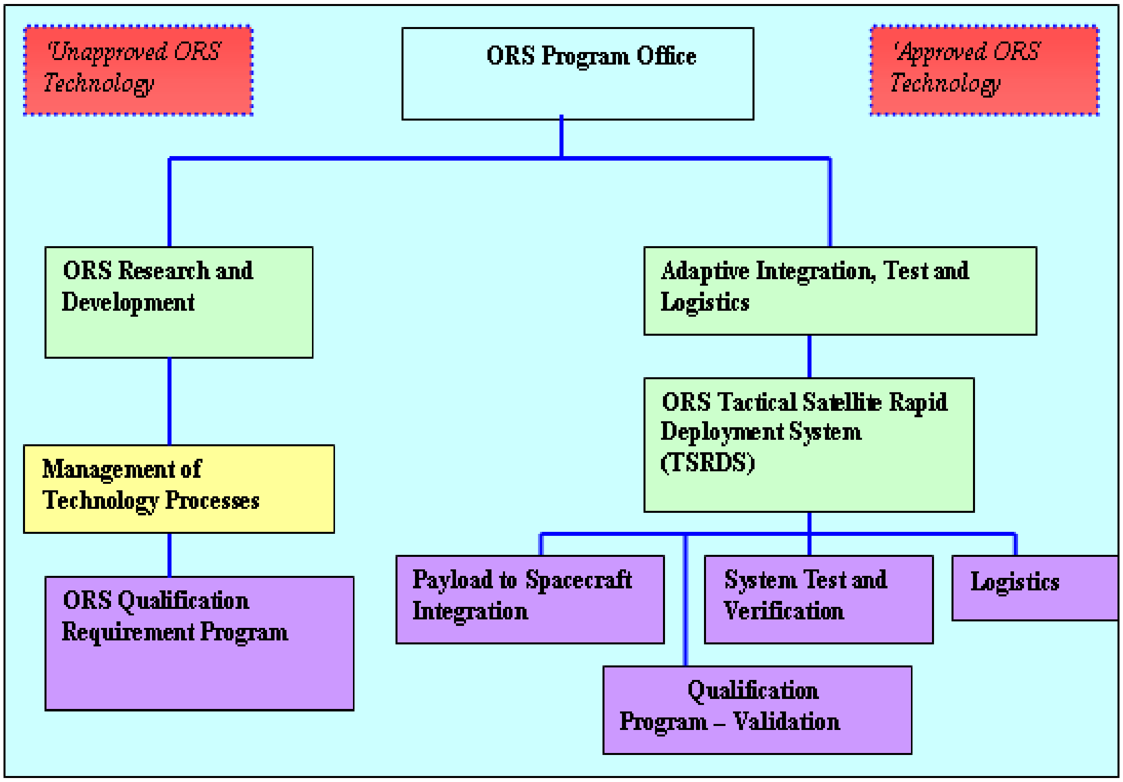


Figure 4-4. Separation between ORS Research and Integration, Test & Logistics

In Figure 4-5 the integration and test relationships are depicted. There is a close relationship with ORS Project / R&D Office and launch site with a contributing relationship with industry. The relationship with industry plays a key role in having a qualified unit ready for integration.

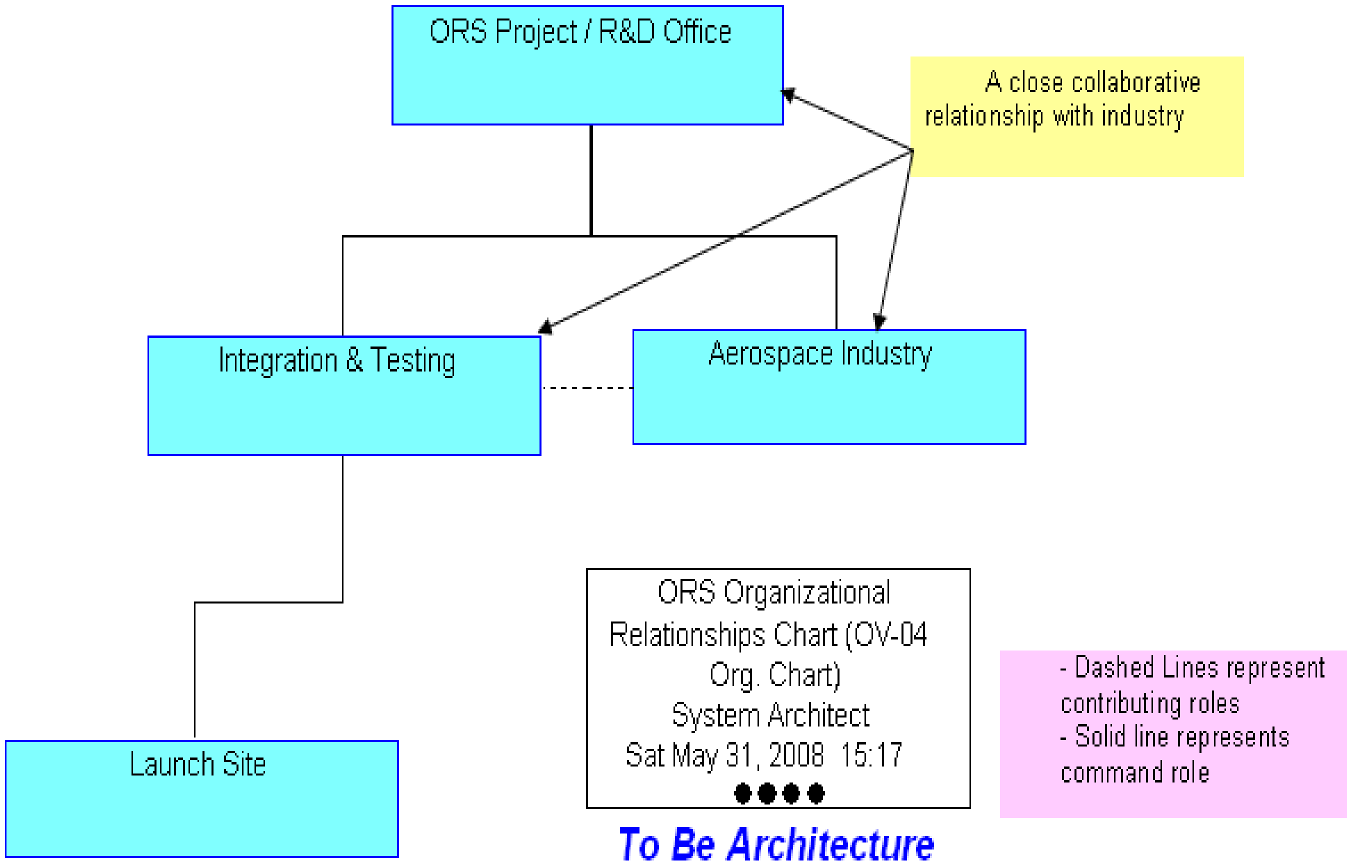


Figure 4-5. Identification of Command and Contributing Roles Chart [OV-04 Org. Chart]

4.4. Architecture

The external systems level *ORS IT&L Function* is very similar to the external systems view of the "as is" IT&L function and is shown in Figure 4-6. One of the key differences is that mission need requests come directly to the ORS Project Office operational node and are acted upon immediately based on predefined capability sets which are defined in the various Stockpile to Mission (STM) definition documents. The Stockpile-to–Mission (STM) sequence document contains information that maps specific mission warfighter parameters to the identification of specific space operation technology capability to achieve an expected level operational and performance capability. The STM also documents expected handling, storage and operating environments expected throughout the payload and bus lifetime. The ORS Program Office controls the IT&L function and effectively replaces the SPO and consolidates the layers of management to lower the number of stakeholders providing oversight. Within Figure 4-6 it is shown that ORS IT&L only deals with qualified payloads, buses, and integration components. The testing, integration, verification and validation of these subsystems has not been eliminated but pushed down to the vendor level. Testing at all assembly levels will be important to the ORS program. Modeling and simulation of components, subsystems and systems can not be validated unless extensive test data is collected and applied to these engineering tools. Strict requirements concerning what is needed to be "diamond stamped" an ORS qualified subsystem is key to ORS IT&L success. Figure 4-7 evaluates the next level of functions associated testing of qualified hardware.

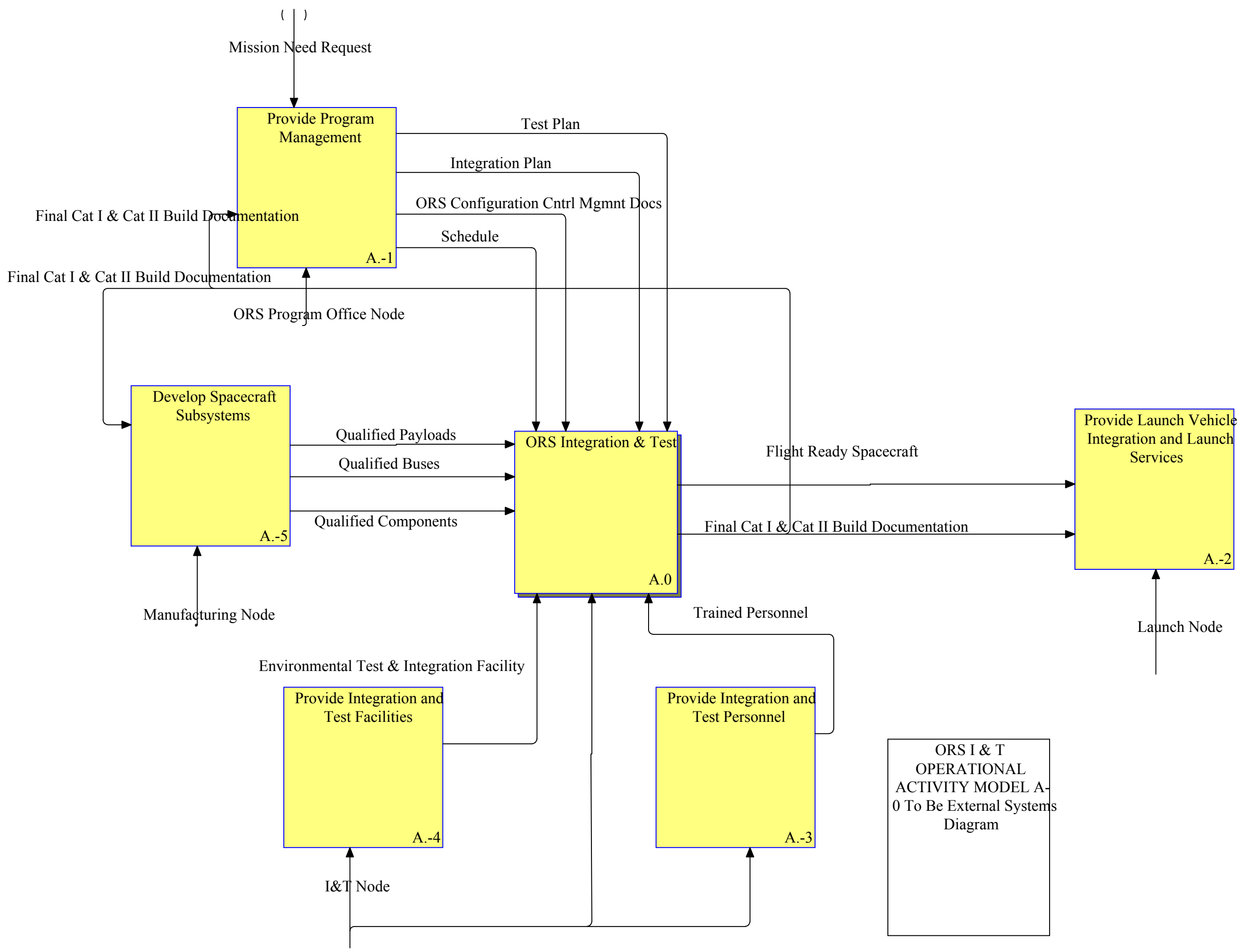


Figure 4-6. A-0 IDEFO [OV-05 Model] – Major Elements defining ORS IT&L

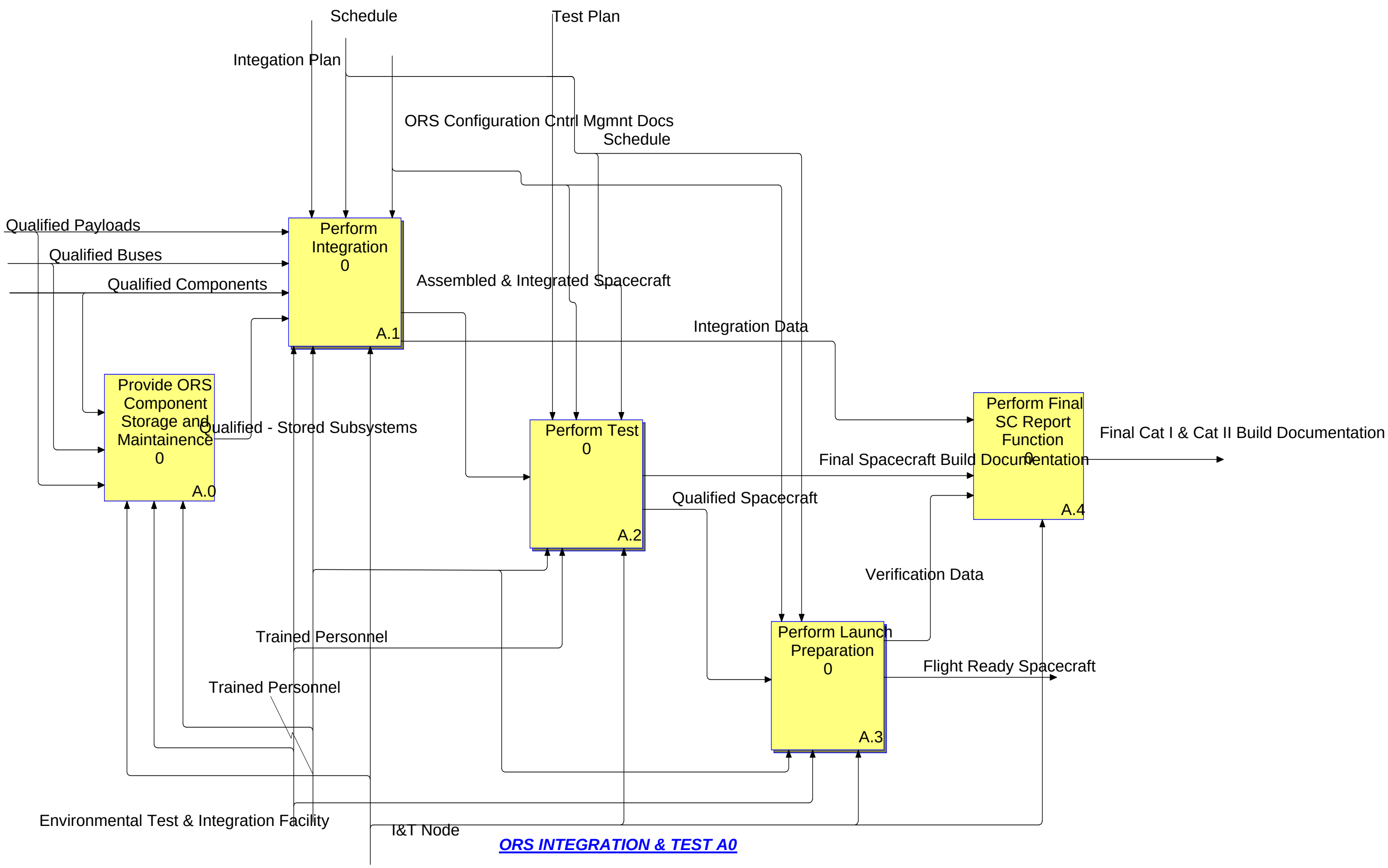


Figure 4-7. ORS Integration & Test [OV-05 Model] – Qualified Hardware for ORS Integration

The IT&L high level functions in Figure 4-7 identifies the ICOMs elements of testing of qualified hardware. Qualified hardware which meets program specifications is the first step toward accomplishing the goal of having the space operation process drive the program rather than having hardware that is poorly defined, tested and characterized drive the program. ORS IT&L is about performance and predictability with respect to the technology it is managing and the skills that the personnel will bring to the product. ORS IT&L will operate under a high tempo because of the interfaces to the product during integration and test, interface to the launch site and interface for the continuous surveillance and assessment of the stockpile.

In the current "as is" mode, the mission need request starts the early planning stages (i.e. requirements and design) of building a new system to meet the newly defined need. In the "as is" process, this historically takes several years on average. The ORS IT&L function supports only the integration and testing of spacecraft with pre-qualified payloads from inventory. Therefore, the inputs to the function are only pre-qualified payloads, buses, and assembly components. At the IT&L level (Figure 4-7), the primary difference is that a storage and maintenance function is needed for ORS to handle the stockpile to comply with the required timely flexible response.

Typically the "as is" system integrates and tests from the component, subassembly and up to the system level. The subsystem testing is not eliminated from ORS, but is moved into the vendor external system. The ORS IT&L node cannot become functional for business until the entire external system has been built up to a qualified stockpile. The ORS IT&L function can support the early definition of the qualified stockpile of components by developing with the ORS Program Office detailed requirements documents that each payload design is required to meet. ORS IT&L personnel can work closely with vendors in meeting the standardized payload interface requirements. This experience would result in a set of derived requirements and needs that can be configured into the ORS IT&L facility function.

4.5. Product Acceptance for ORS Payload to Bus Reliability

ORS hardware, components, payloads and buses will meet a specification definition that will include identification of environments under storage and normal mission conditions. The Stockpile-to–Mission (STM) sequence represents the environments throughout the payload and bus lifetime. As indicated in the above definition, this probability must be estimated across all required normal environments and for the entire stockpile life of the payloads and bus systems. Concerns with system performance at end of life and in conjunction with normal environmental extremes arise from these considerations (71). The ORS reliability engineer evaluates test conditions and test data according to whether they can be used to support this estimate. Thus, the basic question for the reliability engineer is how to relate test data and performance measurements to the expected performance of the payload and bus over the mission target. Environmental (E-) and Destructive (D-) tests performed during design and production are an important source of data that can be used to indicate whether or not the component or subsystem will function properly during and after experiencing normal STM environments (41:10). Another type of test is Built-in Test. Built-in-Test capability and data will be a major contributor to this analysis structure and this is discussed in detail in section 4.13. E-tests and D-tests are intended to support assessment of the product's ability to meet design, process, and manufacturing requirements. These two types of tests have the following objectives:

1. Provide an opportunity to test over the normal environment and usage state space,
2. Detect defects early in production so that they can be fixed, and
3. Provide data on representative hardware for reliability estimation.

Hence, the focus behind these tests is both on proving inherent reliability and obtaining data necessary for providing a reliability estimate for the component and, if necessary, identifying issues that may require production or design changes to improve the inherent reliability. E-testing and D-testing allow identification of design and production process issues that are apparent only when the subsystem or component is exposed to STM environments.

Environmental (or E-) tests are non-degrading tests that evaluate the functionality of a component either during or after the application of one or more normal environments (defined below). The normal environments defined for E-testing represent the range of those (normal) environments that may be encountered during ORS payload and bus stockpile life, as opposed to ambient conditions only. A STM normal environment is an expected logistical storage and operational environment, in which the item will not experience degradation in operational reliability. E-tests are performed to monitor the quality and reliability of a component during production without incurring the cost of scrapping tested units. Selected units that undergo and successfully pass the E-tests can be yielded to either the next assembly or placed in ORS qualified monitored stores.

D-tests are ***destructive*** or ***degrading*** tests (i.e., resulting in either destroying the component / subsystem or losing design margin) that evaluate the functionality of a component either during or after the application of one or more ***normal*** environments. D-tests are performed to monitor the quality and reliability of a component or subsystem during the course of ORS design and production. The normal environments defined for D-testing represent the ***range*** of those (normal) environments that may be encountered during stockpile life, as opposed to ambient conditions only (41). The units that undergo D-testing cannot yield to the next assembly or to ORS qualified monitored stores. After testing, D-test units should be periodically disassembled to assess potential degradation. D-tests are sometimes designed to represent all environments that a unit could be exposed to during the normal life of the component. D-test environment levels must not exceed normal environment levels, so there is no question of over-test-induced failures. Thus, D-testing not only provides a demonstration of product life, but also provides a check on the manufacturing process (57).

An additional approach that can be taken to assure "on demand operational readiness" is to establish reliability for the system. If an ORS payload or bus (and its associated system components) were to meet a .98 system reliability (failure probability of .02), what would be the result with respect to testing the design and determining sufficient data requirements?

Sufficient data are generally taken to be that number of tests such that if the true reliability were any worse than the prediction, then there would be at least a 50% chance of having seen one or more failures, that is, the 50% confidence bound. Because of the discrete nature of the binomial distribution, this value is called the 50% upper confidence limit (UCL) (41:5).

The number of samples needed to demonstrate the required reliability failure probability, without failures, at the 50% upper one-sided binomial confidence limit, is derived as follows: The one-sided upper binomial confidence limit on the failure probability, p, is the value that satisfies the following equation:

$$1-\gamma = \sum_{x=0}^{c} \binom{n}{x} p^x q^{n-x} \tag{1}$$

where γ = confidence level, p = failure probability, c= no. of failures, n = no. of samples, and q = 1-p

.

The 50% upper confidence limit on the failure probability, for zero failures is therefore, using the above equation, where γ = 0.5, c =0:

$$1-0.5 = \sum_{x=0}^{0} \binom{n}{x} p^x q^{n-x} \tag{2}$$

which reduces to:

$$0.5 = \binom{n}{0} p^0 q^{n-0} = (1)(1)q^n = (1-p)^n \tag{3}$$

The value for p that satisfies the above equation is the 50% UCL for p. Now take the natural log on both sides:

$$\ln(0.5) = \ln(1-p)^n = n[\ln(1-p)] \tag{4}$$

For small values of p, ln(1-p) ≈ -p. Also, ln(0.5) = -0.693 ≈ -0.7.

Substituting yields:

$\ln(0.5) \approx -0.7 = n(-p)$ (5)

Then $n = 0.7/p$

This last equation provides the required number of both E- and D-test samples to demonstrate p (or q) at the 50% upper confidence limit, assuming zero failures. Thus, for a reliability requirement of 0.98, this means that p = 0.02 and therefore n = 0.7/0.02 ≈ 35 units are needed to demonstrate a reliability of 0.98 at the 50% upper confidence limit, assuming zero failures. Note that $(0.98)^{35} = 0.493 \approx 0.5$.

The exact solution would be ln(0.5) = n[ln(q)] = n[ln(.98)].

Then n = [ln(0.5)]/[ln(.98)] = -0.693/-0.02 = 34.3. (6)

Note that $(.98)^{34.3} = 0.49955 \approx 0.5$.

It should be pointed out that, although the Binomial distribution is truly correct when the sample is drawn randomly from an infinite population, it provides a useful approximation in most cases. When there are sufficient test data to show that the assessed reliability is better than that of the prediction, the assessed value is then reported. Furthermore, if there are no failures in the test data, then the 50% upper confidence limit for the failure probability is usually reported if it is better than the predicted value.

This standardized reliability framework will be applied to ORS products. ORS IT&L personnel will qualify against vendor reliability and design data. This data will be maintained in the ORS configuration management system and IT&L personnel will annotate data as it becomes available based on floor operations and built-in test monitoring. ORS IT&L will also serve as independent monitors and evaluators of ORS products.

4.6. ORS Qualification Program Elements to Expedite IT&L Functions

Integration Test and Logistics (IT&L) of aerospace payloads and buses transition from the “as is” of “Conventional Space” to the “to be state” of ORS will involve several steps. Performance, schedule and cost are the driving factors. Performance is defined as the ability to respond to the war fighter in a timely manner in a span of days to months. Development testing consists of generating design concept data, demonstration, and breadboard testing. Qualification testing should be performed above the maximum predicted flight environments to provide margins for design acceptance, hardware variations and acceptance system level testing at maximum flight environments. STM documentation will have documented storage and fight environments. It is imperative for the new Operationally Responsive Space model that all development tests and qualification be done on payload and bus assemblies before they enter the IT&L facility. This shift of having only qualified parts reduces the failure probability to the integration procedure and process. The ORS Program Office will be working collaboratively with both the US aerospace industry, and the ORS IT&L.

A prequalified component test program includes physical test levels, acceptance tests, parts materiel, special category testing, unit test selection and performance. Physical test levels have to be driven to lowest assembly level configuration. Acceptance testing is used to screen defects early, lower repair cost and minimize retesting. Parts materiel testing is used to identify design defects, qualification of new or revised parts, screening of parts and quality conformance inspection. Special category testing includes destructive physical analysis, failure analysis trouble shooting and radiation hardness verification.

Specifically, the ORS Qualification Program will consist of 3 tiers of requirements which will have to be met by each ORS vendor partner.

Tier 1:

1. Technology item (i.e.: cables, payload, fasteners, connectors) meets the requirements of an STM and system Interface Control Document
2. Technology can meet reliability requirements specified in Interface Control Document.
3. Technology Readiness Level (TRL) is mature and its behavior in space is understood based on the mission it has been selected.
4. Built-in test methodology integrated into subsystem design
5. Manufacturing capability and assembly process can be established and monitored
6. Ability to build and deliver multiple units within a designated schedule is possible
7. Provide a methodology to validate through testing modeling and simulation tools.

Tier 2:

1. Vendor will provide and maintain all payload drawings, bill of materials, assembly tree, system interface documentation, test data package, and reliability data into ORS configuration management system intranet
2. Compliance with standardization of cabling and connectors
3. Payload to bus electrical and mechanical interfaces standardized and labeled with specification for any required mechanical handling gear
4. Subsystem and component test plan defined and executed with system designed to Mil-Std 810 G – test plans are developed in parallel with the design.
5. Vendor kits and labels all fasteners, cabling, items peripheral to the main payload assembly is kitted
6. Perform audits and conduct reviews of production, test and product data

7. ORS IT&L and Quality function approves production “buy” from the vendor manufacturing line

Tier 3:

1. Vendor and ORS IT&L develop integration procedures and process, conduct dry runs, and verify tooling and assembly drawings.

2. Vendor and ORS IT&L initiate ORS payload storage protocols and activate built-in test data collection. Any external test capability such as a “simulator / tester” is provided.

3. Vendor is to respond within specified time interval upon detection of any anomaly and participates in anomaly resolution process.

4.7. Design for Testability and Built-In Test

The use of BIT (Built in Testing), a complete end to end and go / no-go functionality, can enable the system to be verified more easily, thus reducing the timeline to launch. A well designed BIT system can allow the engineer on the floor to be more efficient in locating failures, and replacing suspect hardware items, thereby returning the system to operational status on a more effective manner.

One type of automatic testing methodology is Built – In Test (BIT) combined with Built – In Test Equipment (BITE). This test technique places the burden of test on the designer who designs the test hardware and software as part of the unit’s functionality. The advantages of BIT and BITEs are: the tester is always available, performance monitoring is possible, fault diagnostics can be preformed by the user, and there is improved design testability. Disadvantages include: additional costs due to high volume, fault diagnostics intended for fault detection not fault isolation, the designer becomes a test engineer, fault coverage determination, and BIT can not be implemented after design completion (8, 67:5-12).

Built – In Test definitions per MIL-STD 1309C is an integral capability of the mission equipment which provides an on board automated test capability to detect, diagnosis or isolate system failure. BIT is used to describe the general case. BITE is defined as the availability of test equipment that was housed in the chassis of the system under test. It implies fault isolation is also performed by BITE. Built – In Self Test (BIST) is used in connection with integrated circuits (ICs) that have capabilities built in to test themselves. This methodology is coming to mean a test that is performed without the need for any external test equipment. In summary, one is performing BIT using BITE and or BIST.

The purpose of built in test function is to improve and enhance maintainability, availability, testability, operational readiness, and production test by predicting detectability of critical failures. BIT also lowers maintenance activity and cost by forecasting the ability of equipment to complete a task or mission, and repair by module replacement. In addition, Built-in Test protocols can be designed to keep pace with system complexity. There are many forms of built in test, three of the most common ones are: Continuous Monitoring (CM), Initiated bit (I-Bit), and Operational Readiness Test (ORT). ORT specializations include: running automatically after power on command providing assurance that all systems are "go". ORT provides more diagnostics and test comprehension than CM, while preempting all operating modes during the actual hardware test (67:35-42).

This methodology is strongly recommended for ORS. Specific design specifications can be developed to assure consistency of application and technique. BIT libraries would have to be available to ORS IT&L and be fully documented in the ORS configuration management system. Active continuous down loading and analysis of BIT data would be conducted while ORS hardware is in flight storage.

4.8. Integration and Test Preparation

The above sections on reliability, qualification, and Built In Test are all key issues that enable rapid and trouble free integration. ORS integration operations will be (See Figure 4-8) conducted based on the following process steps once a demand for an asset has been requested. The pilot ORS integration, test and logistics facility operational readiness review is completed and the facility is activated for operations. The facility has a general layout as depicted in Figure 4-14. Facility readiness includes all technical infrastructure programs: contamination control, electrostatic discharge, flight hardware handling, calibration, and special tooling use, etc.

The facility will have a unique set of capabilities because the ORS storage facility location (bonded for flight hardware) is stocked with payloads and buses.   The storage facility is monitored and all facility environmental parameters are continually downloaded into the ORS configuration data management system. Figure 4-8 shows the activity diagram for the Integration Function. Payload and bus built in test data (state of health) is continuously collected during the storage cycle duration. Anomalies are managed, immediately investigated and documented by the ORS IT&L team. Quality provides oversight to all ORS IT&L functions.

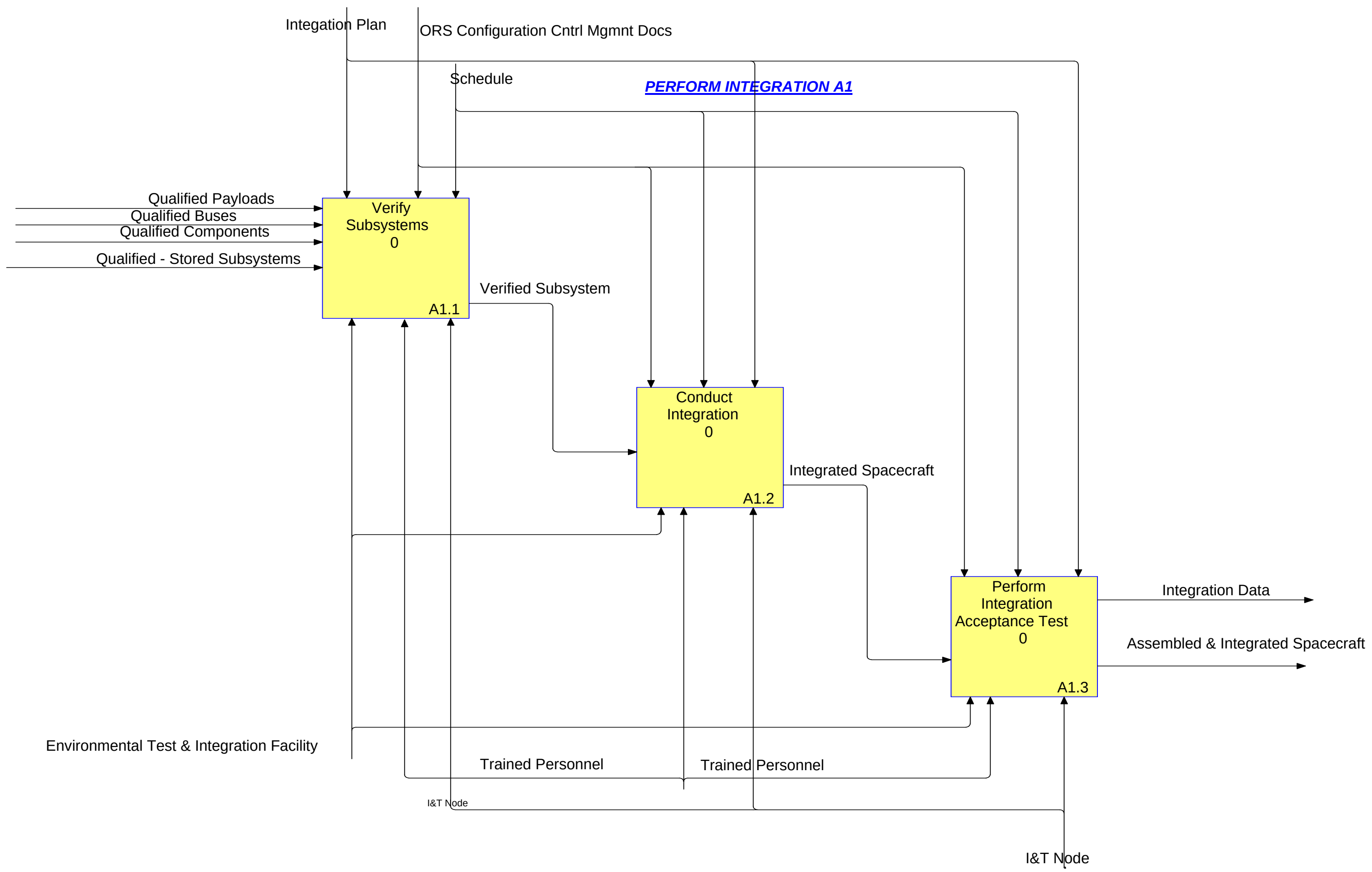


Figure 4-8. Perform Integration [OV-05 Model] – Focused Facility and Personnel Capability Integrating Qualified Hardware

Once an ORS asset is requested, the IT&L team will draw from storage a bus and payload suite that meet the STM and system requirements. All items are prepared for integration and are located in the assembly/integration clean room. ORS auxiliary flight hardware will be required to be kitted, labeled, inventoried and in stores. Built in test routines and integration inspection will verify functionality of the integrated payload suite and bus in the clean room. Multilayer insulation (MLI) is also installed based on thermal modeling data found in the ORS configuration management system.

The integrated bus/payload will then be prepared for removal from the clean room. Standardized flight certified mechanical handling gear will manipulate the integrated bus/payload to the mechanical, thermal and EMI test stations. Environmental testing will include modal, vibration, shock, thermal vacuum and electromagnetic interference (EMI). The asset is moved to each test station through the use of the facility crane and / or asset mechanical handling cart. The ORS system (TEMP) is used to configure and manage each test station. Built in test functions are used to test functionality after each test. Test data is immediately downloaded and processed to the asset data file. Mass Properties data can also be collected as required by the system. Anomalies detected during integration will be handled under the Immediate Anomaly Review (IAR) process. This is described in section 4.8.

In the current "as is" state integrated environmental sensors are units that are installed during final integration prior to testing. These sensors can be thermocouples or three (3) axis accelerometers which are used to collect data during testing. In the "as is" state, installation of these sensors (depending on the size and complexity of the asset) can take at least 3 to 4 days. Testing can not begin until all sensors are installed and cabling is routed and verified for functionality. Sensor locations are determined based on mechanical and thermal modeling of the complete system. In addition, in the "as is" state the cable routing and handling is often ad hoc and has to be repeated 2 to 3 times before a manageable configuration is achieved. This "as is" step is an impact to the testing schedule.

The ORS "to be" state will require all payloads and buses to have environmental sensors built in to the engineered locations of the units. Vendors will be required to install these sensors prior to delivery and acceptance by ORS. Sensor locations will be pre-determined because of comprehensive mechanical and thermal modeling which has been completed for each ORS system level asset configuration. Cable routing will be very specific and performed by a structured procedure. Modeling will provide the optimum cable routing and handling process for the testing sequence. The ORS system level asset thermal model will also serve to define MLI requirements based on STM and ICD requirements. ORS MLI patterns can be produced from this data and custom MLI blankets maintained in inventory. The "to be" sensor operations should be rapid (cable connection) and testing can immediately begin. This operation should begin and end in approximately <4 hours.

It is important to note that ORS will be monitoring and integrating multiple payload and bus combinations of qualified technology. Test data, reliability data, quality data, anomaly reports, and IT&L lessons learned will be used to refine mechanical, thermal, electrical, radiation and optical models for ORS technology. It is through this data refinement of the standardized payloads and buses that testing may be able to be reduced or modified. This type of decision-making will have to be carefully evaluated as the program matures.

4.9. ORS IT&L Testing

Initial qualification tests of all hardware and software that will comprise the ORS satellite will have already been performed at the vendor's site. These tests certify that the hardware and software will work as specified and that the hardware can survive and operate in the desired space environment. All ORS hardware will have a linkage to an ORS STM. It is this particular attribute that differentiates the ORS program from the conventional existing satellite test and integration program, thus labeling the items as "ORS Qualified" before they can be admitted both on the ORS menu suite, or in to the storage, integration and test facility. See Figure 4-14 for a generic ORS IT&L facility depiction. The time to flight 'clock' will begin when the items arrive or are retrieved from the storage facility, and it is in the ORS facility that the functional and environmental testing of selected assemblies or subsystems will be conducted. ORS IT&L will perform system level testing (payload to bus). Subsystem (payload) testing will be performed at the vendor location and state-of health testing status will be continually collected using Built-in test protocols. Based on the comprehensiveness of the qualification program, vendor environmental testing and built-in test, ORS IT&L will justify an abbreviated system level environmental test protocol. Figure 4-7 shows the activity diagrams for the high level test functions. Mechanical tests will be discussed later in the chapter.

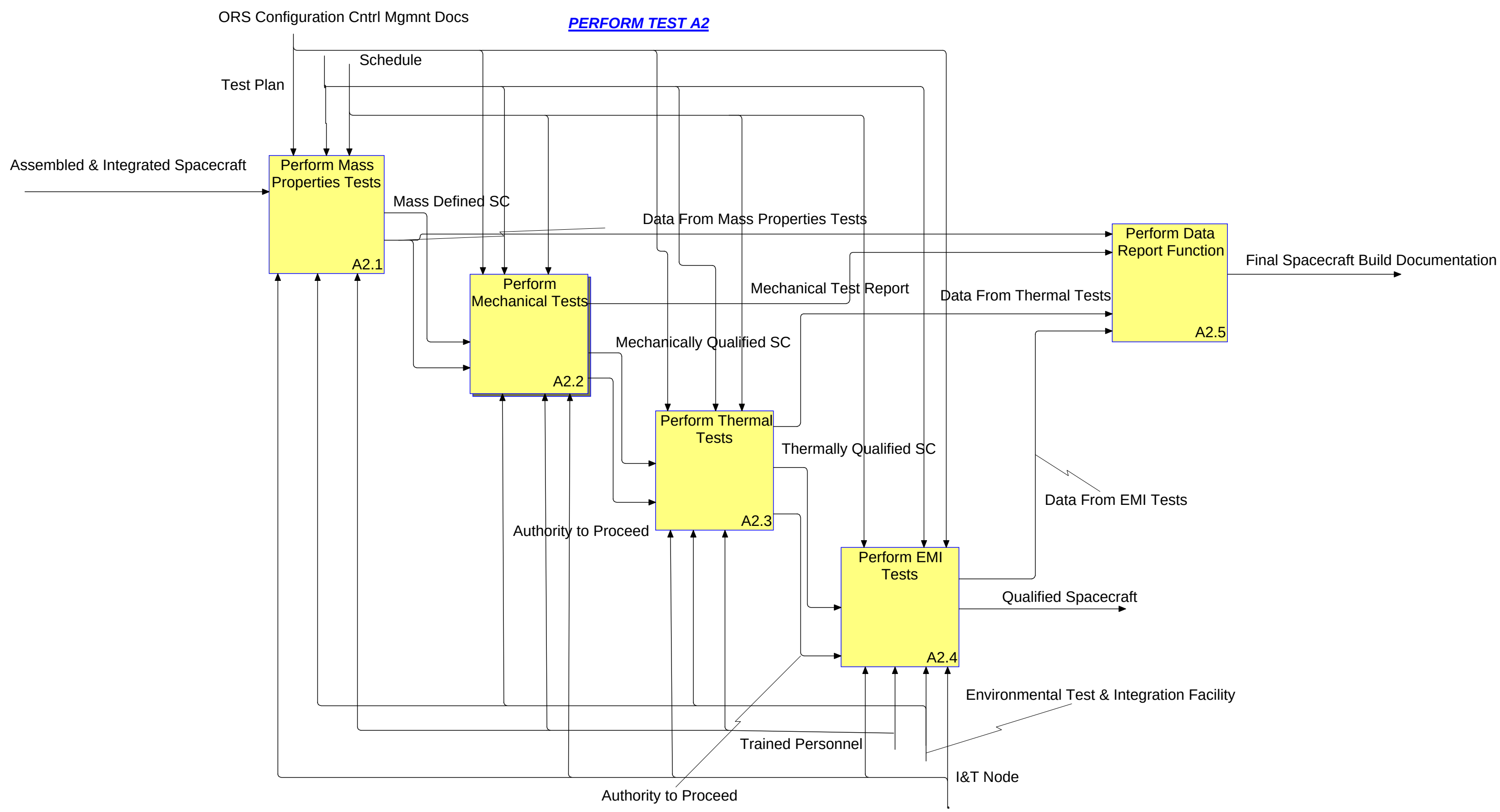


Figure 4-9. Perform Environmental Tests [OV-05 Model] – Rapid Test Data Analysis Augmented by Built-in Test

In addition, as the ORS program matures and libraries of test information are collected and analyzed, “qualify by similarity” per MIL-STD-1540D, section 5.4 and use of the criteria provided in MIL-HDBK-340A, VOL ll, paragraph 4.4. will be employed as a means to reduce the testing timeline for repeated hardware / software configurations.

Once in the ORS facility the assemblies (i.e., payloads) will be taken through the series of tests and integration, with the bus and payload subsystems being worked in parallel until their final integration to the flight configuration. The ORS IT&L team will conduct this work and vendors will only be queried if an anomaly results. In general, because of schedule constraints if a payload were to fail testing after integration the ORS team would conduct an Immediate Anomaly Review (IAR). The IAR would be an expedited process consisting of 2 steps.

- Step 1 – ORS IT&L inspect cable connections, interfaces, compliance of procedures. (1 hour) – If it is resolved then move forward with testing.
- Step 2 – ORS IT&L does not resolve anomaly in 1 hour – payload is removed and replaced; after delivery is made conduct investigation with vendor.

In addition, MIL-STD-1540D tables T-3, and T-4 are valuable in sourcing highly probable sources of failure. Combine that with availability of ORS qualified hardware, the timeline for completion and launch in 120 days can be achieved.

Employing reduced decision to proceed junctures by empowering the assembly team to make decisions with reduced managerial contribution will enable the rest of the testing to proceed more quickly than conventional satellite programs. (See Figure 4-13) This methodology will be used during the Modal, Vibration, Shock Low, Shock High, Thermal Vacuum (TVAC) and EMI tests. These tests will be done in accordance with MIL-STD-810G (in draft), which covers 29 different conditions and specific tests that be performed as potential mitigations to anticipated environments the ORS satellite will encounter. Also, more recent advancements on test bed capabilities, such as multi-axis vibration tables will be incorporated to further reduce the testing timeline.

As the ORS program progresses, the payloads, buses and other assorted hardware of the "menu driven satellites" will not fall into the "Prototype or Protoflight" categories due to the time tested reliability and consistent performance they render to the program. With that established, the hardware will not fall under the NASA-STD-7002A for payload test requirements, thus easing the requirements listed in Table 1 for Mechanical, Thermal, EMI and Functional tests. Evidently, tests will still need to be performed, but those can be rendered as a function of risk mitigation, and can be developed by the ORS IT&L personnel, in agreement with the ORS Program office. The tests still can be conducted along the 7002A methodology in the category of what combination of assemblies could be tested together, but that would ultimately depend on what type of testing equipment and available ORS facility space is available. The desire is to allow the parallel conduction of tests in order not to create a stop point in the timeline process.

Upon examining the Business Process (timelines) of the "as is" versus the "to be" programs, the main difference visible is the consolidation of the tests performed on the hardware (See Figures 3-10, 4-13). Some of these processes are "Perform Subsystem Integration", "Modal Tests", "Perform Bus Integration" and "EMI Tests". Within the consolidation of some of the processes, activities involving the Bus, Payload, and Spacecraft were combined to streamline the overall process. An example of this is the Vibration test. Instead of testing the spacecraft and payload components separately, they are tested as a completed unit. The functional tests are also performed on the whole unit.

Verification of the functionality is performed, recorded, and reviewed. The assembled spacecraft is then sent to the next test, i.e. Shock Low. In the “as is” process, the two decision points labeled “Subs Finished” and “Payloads Finished” typically are an iterative process that sends the hardware back repeated until they finished. This is the largest allocation of time in the “as is” model, which is evidenced by the total duration working days reduction (500 vs. 100). All verification activities will be performed in accordance with MIL-STD-1540D, section 4.2.

4.10. ORS Payload to Bus Environmental Testing

Environmental testing required for final integration activities will include mechanical, thermal, thermal vacuum and electromagnetic. Mass properties will often also be completed at this level. Environmental testing will be completed per System and Interface Control Document requirements for ORS tactical satellites. The ORS system test plan will cover all levels of testing at the time the payload is selected as an ORS candidate (acceptance, development, functional, environment). The ORS Program Office will also have to choose a strategy for the software testing of the system. The testing that will be completed at the ORS IT&L facility will be significantly abbreviated because of the required pedigree of ORS hardware and built in test.

As part of the IT&L facility readiness capabilities, comprehensive mechanical modeling of ORS STM and system Interface Control Document data can be developed and validated. Since ORS will build repeatable tactical satellites, characterization through modeling is possible. Mechanical models can be validated as part of the ORS readiness activities in which the ORS standardized bus will be integrated and tested with the various combinations of ORS payloads. This readiness activity would serve to train personnel, refine procedures, exercise test equipment, exercise facility infrastructure, verify processes, confirm the usability of mechanical handling gear, confirm communication and data interfaces, confirm logistical transfer of the system and update mechanical models.

4.11. Mechanical Environmental Test Mil-STD 810G

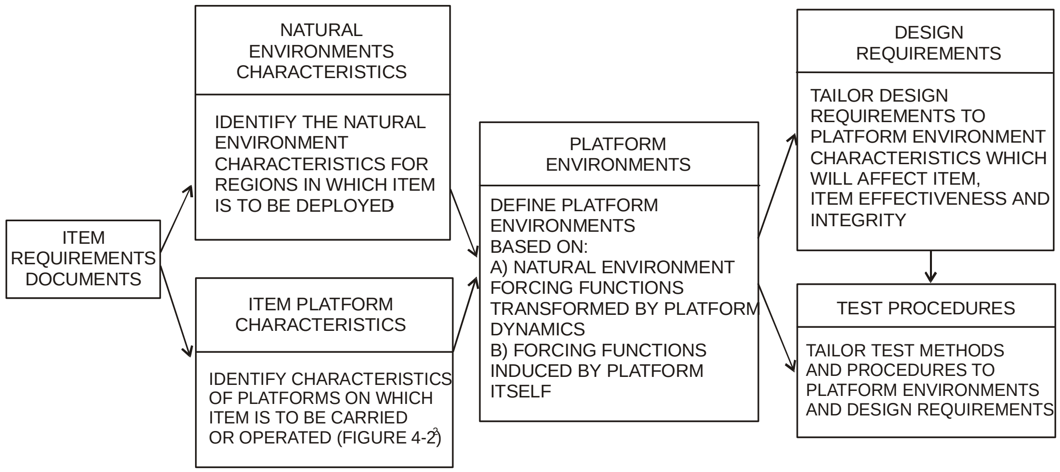
Historically, mechanical testing has been done in the single-axis-at-a-time method. Three tests are conducted shaking the hardware first in the X-axis, then in the Y axis and finally in the Z axis are not realistic for today's complex hardware. These single axis tests were performed up to 500 Hertz for the automotive industry. Airborne applications needed to be tested in 3 axis and up to 2000 Hertz.   It is also commonly known that real-world vibrations exist simultaneously in multiple axes. MIL-STD 810 recognizes this and in the G revision scheduled for release in May 2008 has attempted to remedy this situation. Revision G will include the new Multiexciter Test Method 527 (MEMA). MIL-STD 810 G describes an environmental tailoring process that results in realistic materiel designs and test methods based on materiel system performance requirements (35, 2).

As cited in this standard, the purpose of multi-exciter-test methodology is to provide a degree of confidence that the hardware can structurally and functionally withstand a specific mechanical environment that is defined in more than a single degree of freedom motion (e.g., modal, vibration and shock.) The use of MIL STD 810 G testing during the design and acceptance phase can access reliability. For example, it is well documented that variable repetition rate hammering induces failures by simultaneously exciting all test article resonances. These test techniques are being used to find design and production weaknesses in electronic assemblies. MIL-STD 810G recognizes there are many issues regarding standardization of Multi-Exciter Testing (MET). Revision G is the initial version of the MET test method. The intent of this version is to introduce the basic definition and structures of a laboratory based MET test. The Multi-Exciter Testing (MET) method is used for all types of components and systems at the design phase and can be used for the determination of dynamic test levels, test durations, data reduction and test procedure details. It can be used for various test purposes including development, reliability, and qualification (35).

The guidance and test methods of this standard are intended to:

- Define environmental stress sequences, durations and levels of materiel life cycles.
- Be used to develop analysis and test criteria tailored to the materiel and its environmental life cycle.
- Evaluate materiel performance when exposed to a life cycle of environmental stresses.
- Identify deficiencies, shortcomings, and defects in materiel design, materiel manufacturing processes, packaging techniques, and maintenance methods.
- Demonstrate compliance with contractual requirements.

The standard tailoring process is depicted as the following and is recommended for use by ORS.



1. CONVENTIONAL METEOROLOGICAL DATA ARE NOT COLLECTED WITH MILITARY HARDWARE IN MIND. GREAT CARE MUST BE TAKEN TO ENSURE THAT THE METEOROLOGICAL DATA USED ARE RELEVANT TO THE SPECIFIC MATERIEL BEING TESTED.

2. IN THIS CONTEXT, A PLATFORM IS ANY VEHICLE, SURFACE, OR MEDIUM THAT CARRIES THE MATERIEL. FOR EXAMPLE, AN AIRCRAFT IS THE CARRYING PLATFORM FOR AN AVIONICS POD, THE LAND ITSELF FOR A GROUND RADAR, AND A MAN FOR A MAN-PORTABLE RADIO.

Figure 4-10. Environmental Test Program Tailoring Process (35)

The proposed Multi-Exciter Testing (MET) and environmental test tailoring will reduce the design and test cycle time for ORS IT&L while increasing the fidelity of the result. The reduced cycle time will support the 90 to 120 day response time needed by the war fighter. The reduced number of times the spacecraft will be handled will decrease the threat of failure to the unit. The multi exciter testing more closely simulates the aerospace environment, thereby increasing the fidelity of the result. Figure 4-12 shows the activity diagram for the mechanical test function.

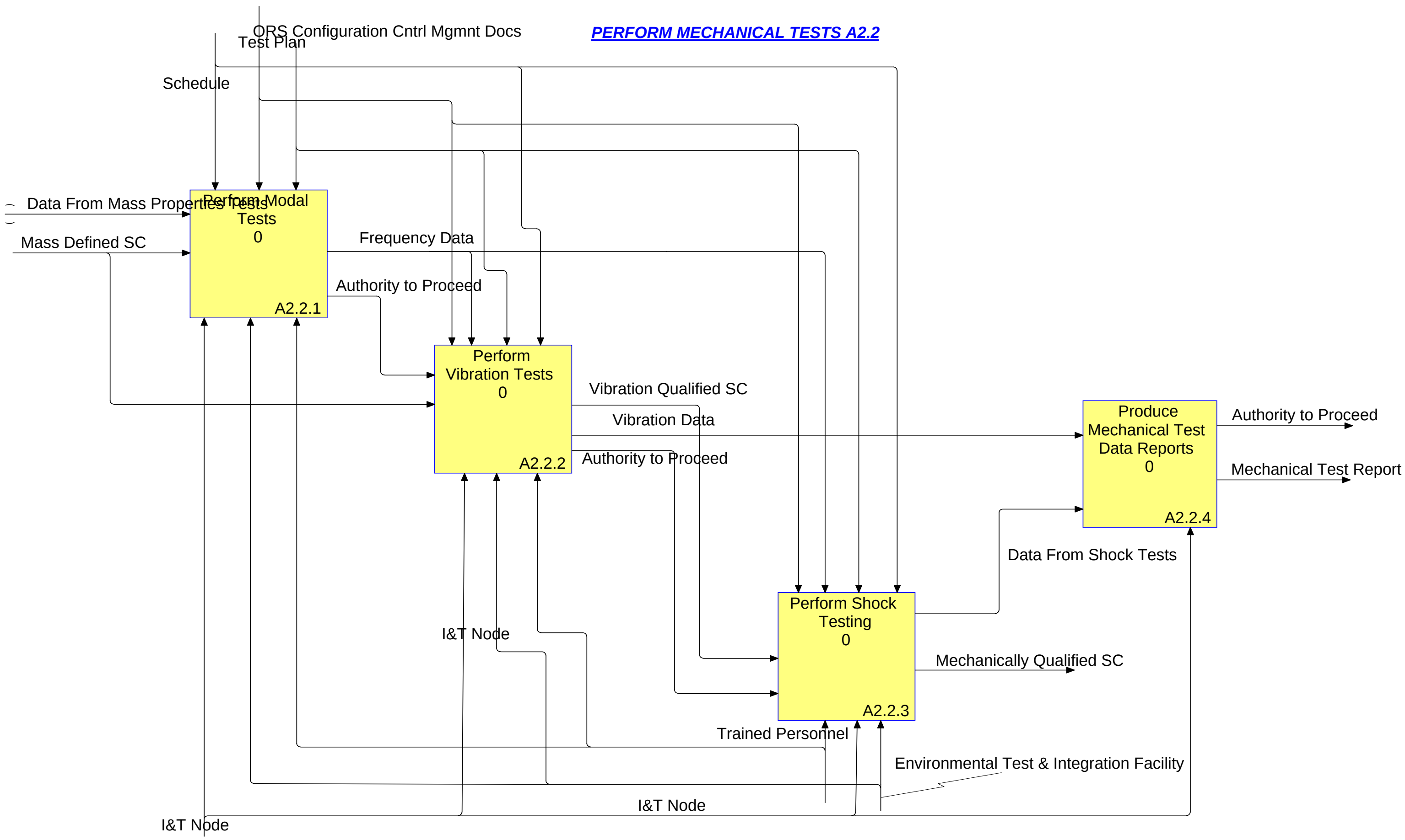


Figure 4-11. Perform Mechanical Tests All Hardware Qualified [OV-05 Model]

4.12. ORS Verification Program

The ORS payload and bus verification program will be required to comply with a standard set of processes to consistently ensure and verify the completeness of work. The current Space System Verification Management (VM) Program methodology process which is used and accepted for U.S. government aerospace projects consists of the following structure (64:10, 58).

- VM Process 1: Requirement Flow-Down and Verification Cross Reference Matrix – includes assignment of verification method at each specification level, rationale for verification choice and method of documented traceability.

  Ownership: ORS Program Office based on analysis of data from warfighters and current off the shelf technology that is defined as fully operational. Full operational technology is defined as technology that complies with the operational technical boundary condition of the customer, can be designed to meet built in test requirements, meets a reliability of .98, is retrofitted with standardized connectors and cables, complies with prescribed environments and meets system interface specifications.

- VM Process 2: Requirement Verification by Analysis, Test, Inspection and Demonstration – includes documented methods and approaches, environmental and operational conditions of the system are stated with detailed insight provided as to how it will be verified.

  Ownership: ORS Program Office and ORS IT&L – define requirements and work collaboratively with vendors. ORS IT&L can conduct audits and inspections and facilitate the qualification process.

- VM Process 3: Integration and Test (I&T) – includes testing methodology to verify the integrity of designed and manufactured system under identified environments.

  Ownership: ORS IT&L and vendors are responsible for integration and test. Vendors perform lower assembly integration and test to establish reliability performance. IT&L conducts system (payload to bus) integrations and test. Data supplied by the BIT will provide almost instant verification as the spacecraft moves through IT&L.

- VM Process 4: Individual Specification Dedicated – Verification Ledger – includes a summary set of key information that demonstrates actions and proof of traceability and verification.

Ownership: ORS IT&L and Vendor – Based on the lifecycle step either entity documents data.

- VM Process 5: Sell-Off/Consent of Ship – includes the entry and exit criteria in addition to engineering review data packages which are at an acceptable level to sell-off / consent to ship the item.

  Ownership: ORS Program Office, ORS IT&L and vendor – Because of STM's and standardized payloads and buses this should be a streamlined process.

- VM Process 6: Verification- related Risk Management – includes the risk management program that is used to proactively resolve verification issues. A risk management plan should exist for defined subsystem/system levels of a program.

  Ownership: ORS Program Office defines the issues to be managed based on data generated.

ORS verification and qualification structure will be important in the facilitation of meeting short time scales. An ORS verification methodology plan would have the same elements identified above but with operational efficiencies to assure an operationally ready integrated reliable payload or bus. The development of STM's will significantly facilitate this aspect. Qualified ORS payload and bus will have the following standardized high level engineering infrastructure (operational efficiencies) that will be designated by the ORS Program Office:

1. ORS Program Office develops several STM's for a likely JFC request. Normal storage and operating environments are defined for payloads and bus. All stockpile to mission requirements (STM) and military characteristics are defined. As required, payloads and buses will be qualified for categories or scenarios of missions.

2. The ORS reliability and verification process is established in that ORS qualified payloads and buses will have a system reliability of .98. This will be validated through testing and design.

3. ORS payload technology suites will be selected and optimized for pre-identified orbits and mission life.

4. ORS payload and buses will use standardized cables and interface sets.

5. An ORS configuration management system will be defined and established. The ORS configuration management system should be an online resource in which all ORS qualified partners are required to deposit, store and access data. The system includes all payload and bus drawings, bill of material's, assembly procedures, engineering drawing trees, engineering requirements documents, Interface Control Document, verification and test data, anomaly reports, quality and audit data.
6. IT&L functions also include storage and monitoring of payloads and buses. Built in Test libraries can provide both functional and performance data. Data from items in storage also serve as a test bed for next generation technology and validation of reliability and design program assumptions.

4.13. Logistics

ORS IT&L logistics includes all flight hardware handling, flight hardware transportation to the launch site, interface with the launch site on technical, test and engineering data packages, security, staging operations, coordination with ORS vendors for hardware management, definition and development of contingency plans and responding to changes in process flows.

"As is" and "to be" transportation functions are similar. Based on discussions with our sponsor and other space user customers for the "as is" business model, logistics functions are often not planned and required resources and hardware needed are not obtained. ORS IT&L transportation will be scripted and standardized. Transportation containers, environmental shock monitoring techniques and equipment handling will be defined for the ORS integrated payload/bus suites. These logistical resources will reside in the facility and a formal ORS logistics program will be developed. ORS logistics can be anticipated and planned because of defined and documented transportation and handling environments which are associated with standardized payloads and buses. Figure 4-12 shows the launch prep activity diagram where many logistics functions are performed.

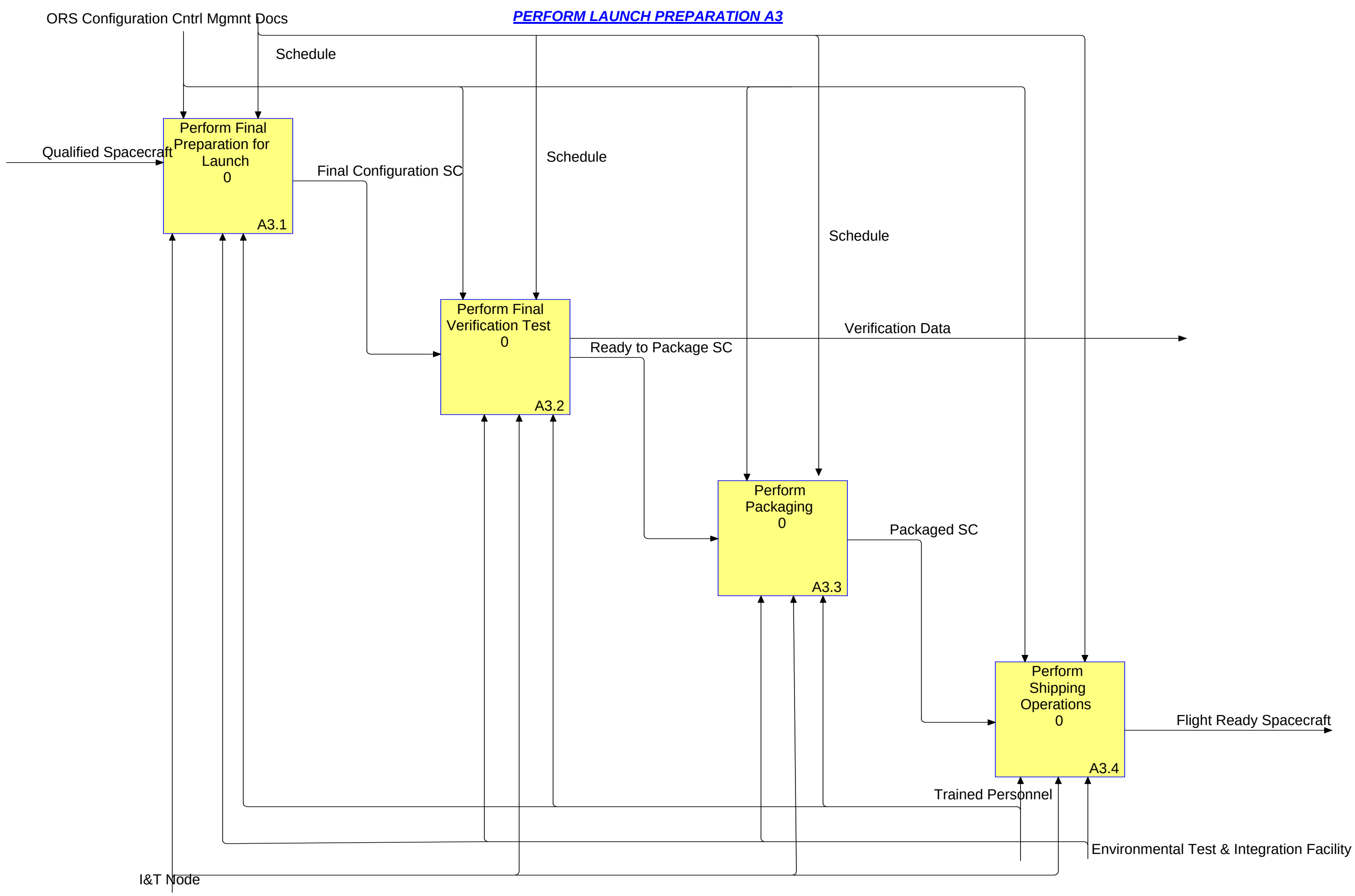


Figure 4-12. Perform Launch Preparation – Interface with Launch site, Logistics and Transportation

4.14. Process Flow

The timeline differences between the "as is" process and the "to be" process can be seen in the respective Business Process Sequence diagram (Figure 4-13). The first major difference is that the ORS IT&L function does not open its doors for business without Qualified Payload, Buses, and Integration Components in inventory. The second major difference is provided by having environmental sensors designed into the components and subassemblies. The third major difference is found in the operational efficiency provided by built in test and reliability. A rigorous and documented test program is required at all levels of development and integration. The process flow operational efficiency is based on a framework of knowledge in which design, manufacturing and operations assurance are linked and consistently executed. In the "as is" different hardware and software elements of complex systems are usually developed by various provider organizations and then integrated by yet another separate organization before final delivery to the customer or user. As such, a uniform set of assurance practices and disciplines needs to be applied at all levels of integration to obtain the needed confidence in the end product. The "to be" architecture is focused on uniformity as a necessary condition.

This process is shown in Figure 4-13. The estimated time required under this paradigm is 100 days based on discussions with IT&L experts.

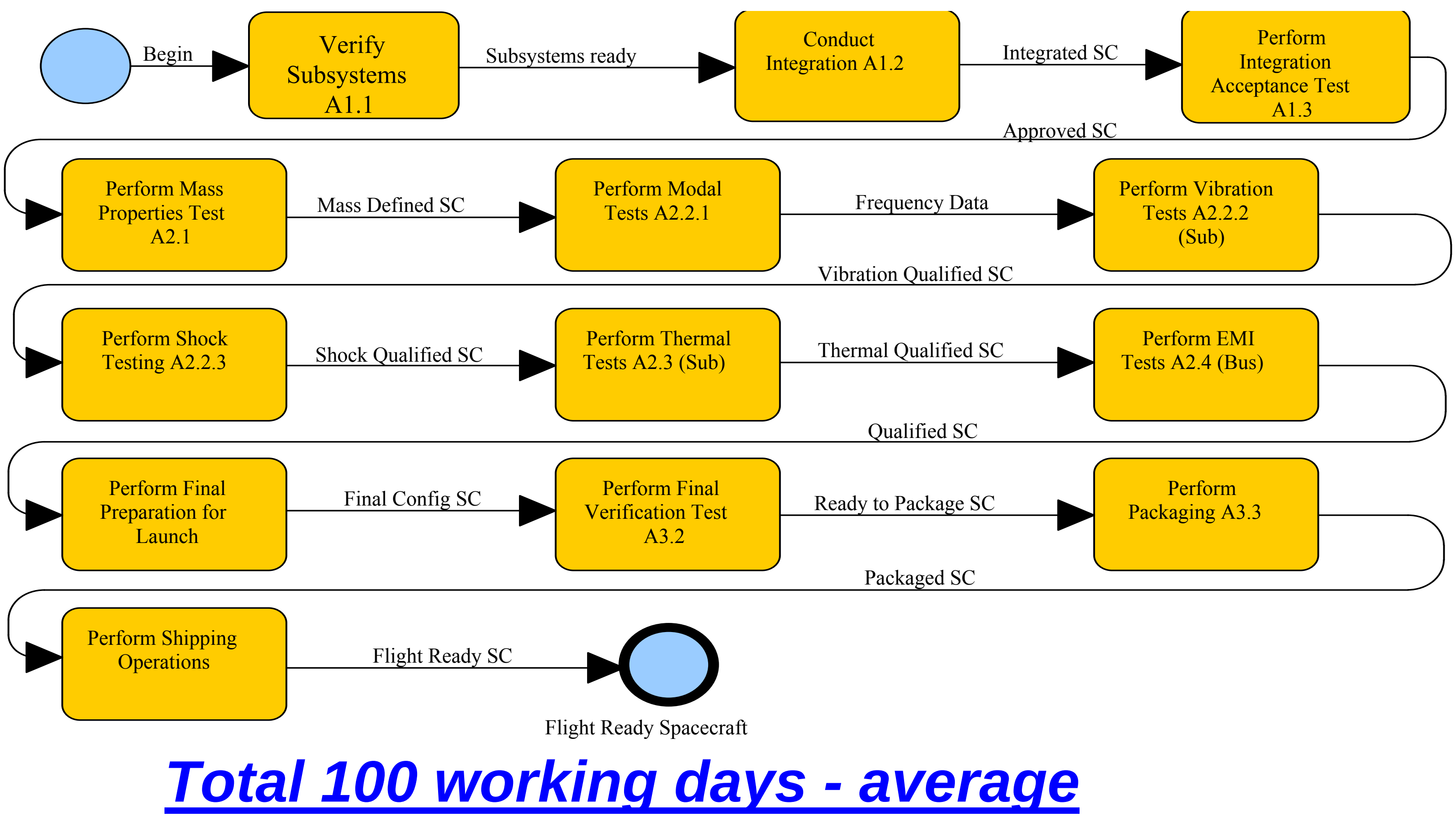


Figure 4-13. "To be" Process [Business Process] – Major Process Sequence Elements Streamlined

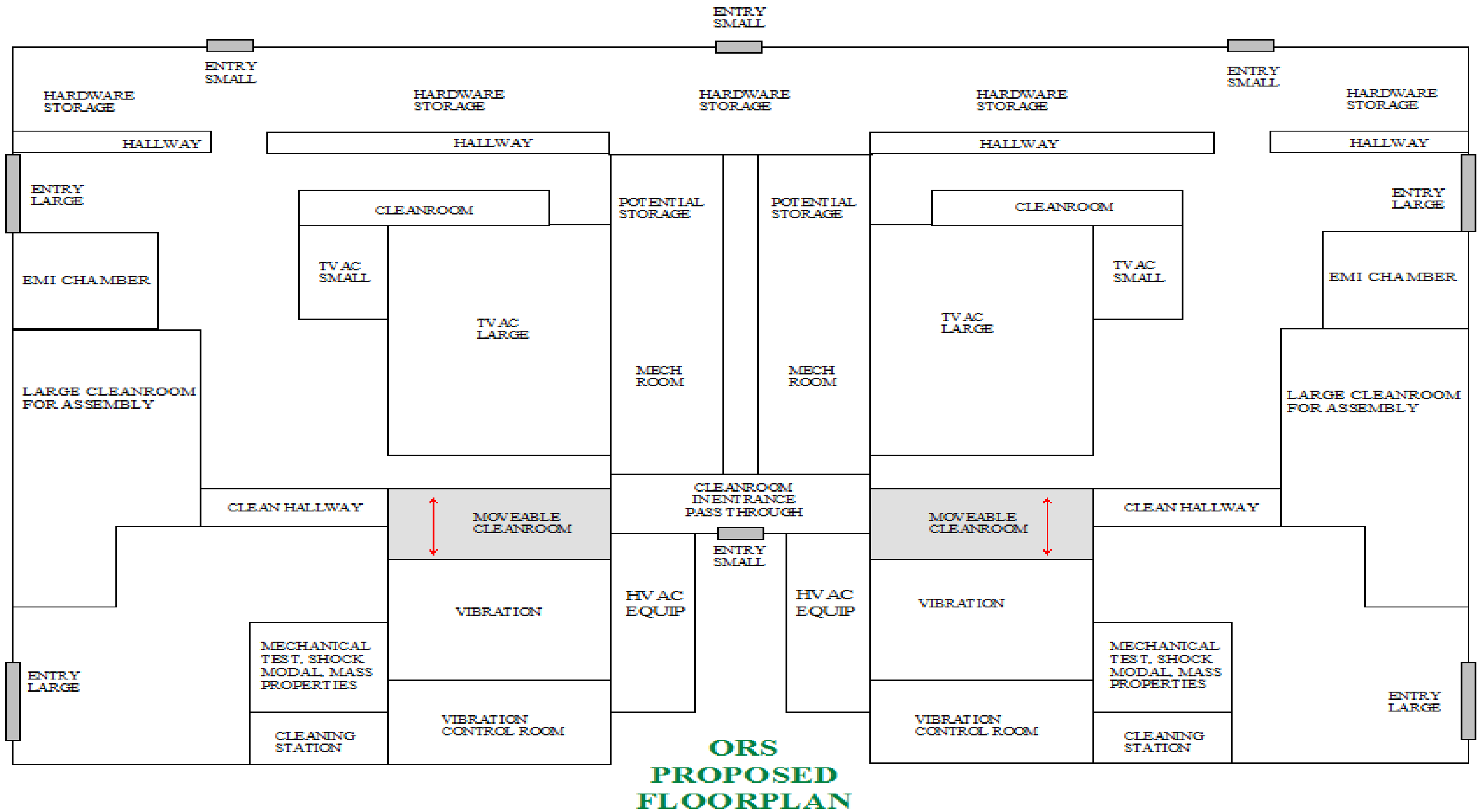


Figure 4-14. "To be" Hypothetical ORS IT&L Facility Floor Plan –Consolidated Storage, Integration and Test

4.15. Alternatives

An alternative to stocking qualified payloads and buses would be to stock fully integrated spacecraft(s) of various capabilities. This would not be desirable due to initial cost and the probability the system may out date itself. The decision to integrate the payload and bus after the mission need request is received is based on the desire to provide a tailored capability that is flexible while minimizing the investment in buses and launch systems. With the proposed process, new qualified payload systems can be added to the capability matrix without further investment in bus hardware. This option gives the best flexibility and lowest stockpile cost. A tailored spacecraft can then be selected with multiple payload options which maximize the current best capability to address the specific tactical need of the warfighter.

4.16. Transition and Implementation Plan

The transition to ORS needs to be done with a blend of control and autonomy. ORS is a complex assignment in which a framework of common values and direction need to be established for personnel to follow. The ORS organization must structure itself to be an "agile" organization, meaning it must have the ability to manage and apply knowledge effectively. Agility is also defined as (38:26-34):

- Knowledge management + Response ability = Agility; this expresses the ability to create and change knowledge effectively such that change can be executed in unpredictable environments. "Being agile means being proficient at change".

In documentation published to date the term "Plug and Play" is often used to describe an attribute of payload design. Plug compatibility is an attribute of an adaptable structure and is defined as a "component of a response-able system which has a shared defined interaction, interface standards and can easily be inserted or removed". Plug compatibility means more than a physical interface its use results in a system with higher and enhanced capability for the user.

The ORS Program Office should solicit industry partners with the following stated framework (in addition to the requirements stated in sections of Chapter 4). ORS Program Office requires:

- Industry and laboratory partners to develop new technologies and processes for rapid deployment of space assets to the DoD warfighter. Advanced System Engineering processes will be used and applied to the ORS structure.

- Industry and laboratory partners to work in an environment directed to establish an agile and responsive space-based operations capability which will revolutionize deployment of space assets.

- Industry and laboratory partners to engage in the definition of a disruptive process. Extensive technology development and knowledge management capability will be required.

- Once an initial ORS payload suite and standardized bus is defined, delivered and operational the resulting agile ORS system will cycle upgrades of qualified ORS payload technologies on a 3 to 4 year bases.

The ORS Program office needs to set a clear framework of common values, practices, relationships and expectations in addition to the broad technical requirements (i.e. STM, System Interface Control Document requirements, etc) stated throughout Chapter 4. DoD may consider an additional parallel avenue for rapid execution of ORS in addition to the standard ORS Program Office path. This parallel avenue would be to establish a Skunk Works type (pilot) operation with the goal of meeting specific ORS parameters. The data collected from this parallel operation would then be transferred into the ORS Program.

Review of Figure 4-13 is important because the projected duration calculated for ORS tactical asset deployment is 100 days. This is a feasible task when qualified, mature technology is on hand and standardization of processes and a frame work of common values have been instituted. In this situation the process and architecture drives the space operation and a common foundation of practices and relationships is set for all vendors against which to benchmark proposed technology.

5. Recommendations

5.1. Introduction

The need to develop a U.S. Operationally Responsive Space (ORS) capability is well documented both in the literature review of doctrine and supported by the JCIDS analysis. Full spectrum dominance of Battlespace Awareness (BA) requires the ability to deploy tactical space assets over the theater of interest. The key paradigm shift required to make a rapid tactical deployment of space assets for BA and other concepts that ORS supports is a build up of a space asset stockpile. In order for ORS to meet the warfighter needs, it must be agile and net centric.

The new ORS program will meet customer's needs by addressing the inefficiencies of the existing space program by shortening the ORS IT&L function. The existing space system program designs, integrates and launches in years. Their large projects (big space) are multi platforms that serve many functions mostly derived from cold war adversaries and requirements. They have high reliability achieved through a long and intensive test program built on a custom chassis or one of a kind payloads and buses.

The ORS system requires a standardized bus to support a suite of micro to mini satellites that are stockpiled and can be selected from to provide a tailored capability to best meet the warfighter needs. The ORS IT&L function would then provide a storage and stewardship capability for the stockpile and would draw from the stockpile to integrate a needed spacecraft based on the mission need request. The following recommendations are the elements required to configure the stockpile in such a way that 90 – 120 days cycle times are feasible. In addition a pilot / test bed facility should be established where ORS IT&L processes can begin to be institutionalized and the hands-on learning process can begin. It is through conducting numerous dry runs, prototype projects, drafting procedures, evaluating tooling, and story boarding work flows that new innovative approaches are realized. ORS IT&L will require several facility, technology and hardware prototype projects. These prototype projects are important mechanisms in this process because they are used to assess the military utility of ORS capabilities, accelerate maturation of advanced technologies, and provide insight into non-materiel implications. The prototype projects and dry runs need to be on a scale large enough to demonstrate operational utility and end-to-end system integrity.

ORS must establish a rigorous and effective process of technology assessment (38:45-56). Technology assessment typically consists of 4 steps (Scoping, Searching, Evaluating, and Committing). The functional analysis documented in the Appendix and in Chapter 2 covers the first 2 steps of the technology assessment. The functional analysis established the technical basis, strategic intent and the target of capability required. Step 3 is evaluating how the IT&L concept facility becomes a key asset to ORS development. In this type of work situation, technology streams can be evaluated against compliance to the framework specified in Chapter 4 with parallel IT&L process structure development. Step 4 addresses how to pursue a particular technology. ORS IT&L expertise in early program development can be a key part of defining how a strategic technology commitment is formulated. This information can then be flowed back into modifying IT&L facility processes and understanding the scope and depth of ORS configuration and data management, including characterizing the behavior of technologies in the testing process.

Management of organizational risks is important for ORS IT&L. The speed of the change and managing the technology fit with the capability need are specific organizational risks that will require monitoring. ORS IT&L will be instituting new standards and organizational focus with respect to space technology supply, and use of these points is also part of the ORS risk profile that needs to be understood.

In order to achieve this new function of transforming the space industry, changes are required across the full DOTMLPF spectrum.

5.2. Doctrine

Architecture investment decisions require a doctrine and policy that should reflect a desire for all space technology development programs to be managed and integrated by a separate ORS R&D branch. The ORS R&D branch develops and provides the ORS operations branch new capability on a 3 to 4 year cycle. The ORS operations branch provides the on-demand warfighter space-based support and should only manage proven qualified space technology.

Issues associated with proprietary information and other sensitive corporate information will be resolved. All levels of ORS qualified hardware and information will seamlessly flow within the secure ORS configuration and information system. An ORS configuration and information management system provides the infrastructure and flexibility that manages the day to day operations.

A robust configuration management program is key to allowing for common interfaces to be maintained such that all vendor designs are compatible. Availability and transparency of all ORS information including but not limited to items like drawings, Interface Control Documents, test data, and anomaly reports need to be maintained for all ORS partners.

5.3. Organization

ORS program office provides leadership, technical and engineering direction in all space operations DoD procurements. In parallel with the initial ORS program office operations, consider setting up an ORS “Skunk Works like” initiative to be executed within a specified timeframe. The output from the “Skunk Works like” initiative could accelerate ORS IT&L capability. It is recommended that a strong but small project office must be staffed by both military and industry personnel to promote acceptance of ORS philosophy. The transition to ORS needs to be done with a blend of control for the Program Office and autonomy for IT&L. ORS is a complex assignment in which a framework of common values and direction needs to be established for personnel to follow. The ORS organization must structure itself to be an “agile” organization, having the ability to manage and apply knowledge effectively.

5.4. Training

A team of trained personnel who are familiar with all of the assets in the stockpile needs to be developed and maintained. A training program is developed through extensive testing at the subsystem and system level while standing up the ORS capability. The personnel are vendor independent and allow for a government or independent capability to ensure continuity of the IT&L program as well as vendor oversight. These personnel need to be funded such that they can perform maintenance and monitoring activities in absence of an actual mission request in order to remain qualified to efficiently respond when actual missions do arise.

5.5. Materiel

An aggressive requirements, design activity, and configuration management program needs to be undertaken that anticipates the range of warfighter needs well into the future. A set of compatible space assets (payloads and bus) needs to be developed that covers the range of capabilities achieving full spectrum dominance and can be configured into multi-payload spacecraft on a common bus to meet changing mission needs. Payloads, buses, and launch systems block buys need to be completed to populate the stockpile. ORS IT&L materiel solutions require components, payloads and buses' having the following attributes:

- Prequalification testing, staging and documentation
- Testability
- Built in Test
- Environmental Test Sensors integration
- Standardization
- Reliability
- Hardware Kits

The use of robust technologies rather than immature cutting edge technologies for the main payload and bus systems is required. The insertion of new technologies can be accomplished by designing to the standard interfaces and ORS bus. These advanced technologies should not be stockpiled until matured to the required ORS reliability.

5.6. Leadership

The U.S. will need the political will to invest in the solutions that meet the needs and threats that will emerge in the future. The ORS Leadership has a focused and targeted understanding of the difference between research and development technology and ORS qualified technology. Uniformity and clear mission assurance principles are adopted.

5.7. Personnel

A trained, efficient ORS integration, test and logistics team should be cross-trained in ORS protocols and electro-mechanical and optical hardware handling. The team should be part of the ORS verification and qualification program and conduct audits at ORS vendor locations. This team facilitates the execution of standardized processes, the integration and test of payload to bus, manages ORS stores, and generates extensive configuration management.

ORS applicable agile system principles include: flat interactions, distributed control and information, and self contained units. Flat interactions refer to components and personnel who communicate directly on a peer to peer relationship, where parallel rather than sequential relationships are favored. It is recommended that the IT&L personnel communications direction and management be flat vs. stovepipe / multilayered. Another agile personnel parameter is distributed control and information. They are directed by objective rather than method; decisions are made at point of maximum knowledge then used, and very well documented to assure repeatability. Information is associated, locally accessible, globally and freely disseminated in this agile personnel parameter.

5.8. Facilities

A dedicated staging, storing, testing and integration facility capable of handling 2-3 parallel ORS system level requests with the possibility of expanding to more IT&L activity. Staging and storage operations should also support built-in test data collection, data analysis, inspection, qualification and personnel training. In the "as-is" model, resources and facilities are numerous and spread across the country. This adds extensive time to the IT&L process due to shipping and handling logistics.

5.9. Additional Considerations

Failures during IT&L processes will need to be very rare as the aggressive time line does not allow for rework or repair. In the current "as is" process, failures during IT&L processes almost always result in schedule overruns.

5.10. Transition Plan

The ORS Program Office should solicit industry partners with the following stated framework (in addition to the requirements stated in sections of Chapter 4). ORS Program Office requires:

- Industry and laboratory partners to develop new technologies and processes for rapid deployment of space assets to the DoD warfighter in a collaborative environment. Advanced System Engineering processes will be used and applied to the ORS structure.

- Industry and laboratory partners to work in an environment directed to establish an agile and responsive space-based operations capability which will revolutionize deployment of space assets.

- Industry and laboratory partners to engage in the definition of a disruptive process. Extensive technology development and knowledge management capability will be required.

- Once an initial ORS payload suite and standardized is defined, delivered and operational the resulting agile ORS system will cycle qualified ORS payload technologies on a 3 to 4 year basis.

The ORS Program office needs to set a clear framework of common values, practices, relationships and expectations in addition to the broad technical requirements (i.e. STM, System requirements, etc.) stated throughout Chapter 4. DoD may consider an additional parallel avenue for rapid execution of ORS in addition to the standard ORS Program Office path. This parallel avenue would be to establish a Skunk Works type (pilot) operation with the goal of meeting specific ORS IT&L parameters.

In addition the Transition plan should take the following actions:

- Take the current TacSat program efforts and begin the standardization process on any new hardware builds.
- Begin implementing built in test and integrated environmental sensor concepts into new hardware. Establish and implement reliability metrics for all assembly levels.
- Initiate a payload capability study to define what payload requirements are needed for the stockpile suite and use data cited in Chapter 4 to assure a common basis.
- Use payload initial requirements to define bus and launch systems.
- Begin to develop STM documents to define operational menu. Start working on the IT&L facility requirements and plans.

5.11. Conclusion

ORS is a needed capability. The concept of stockpiling payloads and standard buses that can be rapidly integrated into multi-payload spacecraft provides the best alternative to develop a flexible, rapid response for tactical satellite needs. The concept of stocking complete spacecraft limits the flexibility of unless all combinations of multi-payload systems are stocked. If the U.S. will build a stockpile based on the recommendations in this thesis, the warfighter will utilize the resource to competitive advantage.

Appendix A. Functional Area Analysis for Operationally Responsive Space

Appendix A: Functional Area Analysis for Operationally Responsive Space

Task	Specification
UJTL 3.5	Provide Space Capabilities
UJTL 3.5.1	Provide Space Support
UJTL 3.5.1.1	Launch and Initialize new satellites
UJTL 3.5.1.2	Monitor / Upkeep Satellites
UJTL 3.5.1.3	Resolve Satellite Anomalies
UJTL 3.5.1.4	Relocating / Reorienting Satellites
UJTL 3.5.2	Provide Space Control
UJTL 3.5.2.1	Provide Space Surveillance
UJTL 3.5.2.2	Provide Space Protection
UJTL 3.5.2.3	Provide Space Negation
UJTL 3.5.3	Provide Space Force Enhancement
UJTL 3.5.3.1	Provide Navigation Support
UJTL 3.5.3.2	Provide Weather / Environmental Support
UJTL 3.5.3.3	Provide Theater Ballistic Missile Warning Products
UJTL 3.5.3.4	Provide Communications Channels
UJTL 3.5.3.5	Provide Surveillance Recon Support
UJTL 3.5.3.6	Deploy Space Support Teams
UJTL 3.5.3.7	Protect Ground based Assets
ORS IT&L 1	Stock qualified standard spacecraft bus
ORS IT&L 2	Develop rapid integration and logistics program
ORS IT&L 3	Develop rapid system test program
ORS IT&L 4	Utilize qualified dual launch system
ORS IT&L 5	Develop and stock a suite of payloads
ORS IT&L 6	Develop a technology management system

ORS IT&L 1: Stock qualified standard spacecraft bus –

- Successful realignment of U.S. Space industry
- The will of the U.S. to fund a space technology build-up

ORS IT&L 2: Develop rapid integration and logistics program

- Defined robust technology and comprehensive qualification programs
- Defined handling, processing, equipment and facility infrastructure

ORS IT&L 3: Develop rapid system test program

- Defined test program,
- Established training,
- Dedicated facility,
- Defined environments,
- Defined interfaces,
- Defined mission scope

ORS IT&L 4: Utilize qualified dual use launch system

- The will of the U.S. to fund a space technology build-up
- Successful realignment of U.S. Space industry
- Defined interface, environment and data requirements with bus and payload
- Defined interface control document requirements (ICD) system

ORS IT&L 5: Develop and stock a suite of payloads

- The will of the U.S. to fund a space technology build-up
- Successful realignment of U.S. Space industry
- Defined interface control document (ICD) system
- Defined Test and Evaluation Master Plan (TEMP)

ORS IT&L 6: Develop technology management system

- Defined interface control document requirements (ICD) system
- Established configuration management
- Proprietary resistance from vendors resolved

FAA Data Based on JCIDS Application

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
1	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy, and dynamically tailored ISR system.	Friendly forces have the information to gain situational awareness, strategic advantage, and the ability for a quick response.	Joint BA	Observation & Collection; Processing & Exploitation	SN 3.5.3.5 SN 3.5.1.1 SN 3.5.1.2	The BA JCA fails to emphasize the need for persistent ISR. To attack the enemy at the time and place of our choosing we must understand what the enemy is doing at all times.
2	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy, and dynamically tailored ISR system.	Friendly forces have the information to gain situational awareness, strategic advantage, and the ability for a quick response.	Joint C2	Monitor Execution, Assess Effects, and Adapt Operations	SN 3.5.3.4	These JCAs adequately cover the requirements.
3	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy, and dynamically tailored ISR system.	Friendly forces have the information to gain situational awareness, strategic advantage, and the ability for a quick response.	Joint Net-Centric Operations	Information Transport; Applications	SN 3.5.3.4	These JCAs adequately cover the requirements.

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
4	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy, and dynamically tailored ISR system.	Friendly forces have the information to gain situational awareness, strategic advantage, and the ability for a quick response.	Joint Logistics	Joint Deployment/Rapid Distribution; Agile Sustainment; Logistics Information Fusion	SN 3.5.3.1	These JCAs do not adequately reflect the future ISR system's projection and sustainment requirements
5	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	"Overcoming an adversary's attempts to negate friendly exploitation of space or minimize adverse affects if negation is attempted". (IV-7 Joint Space Doctrine)	Joint Protection	All Tier 2 JCAs	SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.3	These JCAs adequately cover the requirements.
6	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	"Overcoming an adversary's attempts to negate friendly exploitation of space or minimize adverse affects if negation is attempted". (IV-7 Joint Space Doctrine)	Joint BA	All Tier 2 JCAs	SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.5 SN 3.5.3.5	These JCAs adequately cover the requirements.

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
7	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	"Overcoming an adversary's attempts to negate friendly exploitation of space or minimize adverse affects if negation is attempted". (IV-7 Joint Space Doctrine)	Joint C2	Set Priorities, Guidance, and Standards; Operations Security	SN 3.5.3.4 SN 3.5.3.5	These JCAs adequately cover the requirements.
8	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	"Overcoming an adversary's attempts to negate friendly exploitation of space or minimize adverse affects if negation is attempted". (IV-7 Joint Space Doctrine)	Joint Net-Centric Operations	Information Assurance	SN 3.5.3.5	These JCAs adequately cover the requirements.

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
9	IW 0.7-014C	The ability to collect and exploit information on the situation. Obtain significant information on enemy and friendly forces and the nature and characteristics of the area of interest and its resident populations. In contested, hostile, denied, and ungoverned areas Against clandestine insurgent, terrorist, and criminal networks Overtly, clandestinely, or covertly. Persistent and continuous. Before adversaries can react to render information useless	Friendly forces have sufficient information to accomplish their assigned missions.	Joint Battlespace Awareness	Observation and Collection (All Domains)	SN 3.5.3.4 SN 3.5.3.5	
10	SD-SC1	The ability to provide assured U.S. access to space	Space control ensures freedom of action in space for the United States and its allies and, when directed, denies an adversary freedom of action in space.	Joint Space Operations	Space Control, Space Force Application	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3	

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
11	SD-SC2	The ability to proliferate space, link user, and terrestrial segments	Space control ensures freedom of action in space for the United States and its allies and, when directed, denies an adversary freedom of action in space.	Space control New capabilities Military advantage	Space Control, Space Force Application	SN 3.5.1.1 SN 3.5.3.4	
12	SD-SC3	The ability to leverage low-cost production and miniaturization within space systems	Key enabler for Operationally responsive space	Joint Space Operations	Space Force Application	SN 3.5.2 SN 3.5.3 SN 3.5.1.1	
13	SD-SC5	The ability to provide robust space system electronic links	Ensures friendly force real time communications within the net centric environment	Joint Information Operations	Computer Network Operations, Operations Security	SN 3.5.1.1 SN 3.5.3.4	

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
14	SD-SC6	The ability to provide unambiguous indications of deliberate attack/environmental failures/on board anomalies for on-orbit satellites and associated C2	Provides friendly forces evidence and or clearance to respond	Joint C2	Establish/Adapt Command Structures & Enable both Global & Regional Collaboration, Develop & Maintain Shared Situational Awareness and Understanding, Operational Planning, Synchronize Execution Across all Domains, Monitor Execution, Assess Effects and Adapt Ops, Leverage Mission Partners	SN 3.4.1.3 SN 3.5.3.3 SN 3.5.3.5	
15	SD-SC7	The ability to maintain continuous whole-earth coverage from a space vantage point	Provide friendly forces global situational awareness.	Joint Space Operations	Space Force Application	SN 3.5.1.1 SN 3.5.1.4	
16	SD-SC9	The ability to rapidly reconstitute on-orbit satellite capabilities	Key enabler for Operationally Responsive Space Maintain space control	Joint Space Operations	Space Force Application	SN 3.5.1.1	

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
17	SD-SC10	The ability to provide production-line methods for satellite/launch vehicle/C2/user segments	Key enabler for Operationally Responsive Space. Friendly forces benefit from optimization of operational efficiencies related to production	Joint Logistics	Joint Deployment/Rapid Distribution, Agile Sustainment, Op Engineering, Logistics Information Fusion	SN 3.5.1.1	
18	SD-SC11	The ability to ensure dual-use compatibility for Global Strike and responsive spacelift capabilities	Key enabler Operationally Responsive Space	Joint Global Deterrence	Global Strike, Responsive Infrastructure, Inducements	SN 3.5.1.1	
19	SD-SC12	The ability to integrate land/air/sea/space/information systems to achieve space situational awareness	Provides friendly forces the capability to communicate over long distance with assigned, attached, and supporting air, land, sea, space, and special force operations.	Joint Information Operations	Computer Network Operations, Operations Security	SN 3.5.1.1 SN 3.5.3.4	
20	SD-SC13	The ability to deceive/disrupt/deny/degrade/destroy adversary space systems or capabilities	Enhance friendly force advantage through limiting adversarial space access	Joint Information Operations	Electronic Warfare, Computer Network Operations, Operations Security, Military Deception	SN 3.5.2.3	

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
21	SD-SC15	The ability to achieve reversible negation effects on space systems	Gaining advantage through negation with plausible deniability resulting in economic and political transparency	Joint Access & Access Denial	Freedom of Navigation, Counter Operational Mobility	SN 3.5.2.3	
22	NCOE JIC 6.0	Ability to Create / Produce Information in an Assured Environment	Freedom of action for friendly forces to create an assured environment	Joint Net-Centric Operations	Information Transport, Network Management, Enterprise Services, Info Assurance, Knowledge Management, Applications	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	
23	NCOE JIC 8.0	Ability to Establish a Smart, Assured Information Environment	Freedom of action for friendly forces to create an assured environment	Joint Net-Centric Operations	Information Transport, Network Management, Enterprise Services, Info Assurance, Knowledge Management, Applications	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
24	NCOE JIC 16.0	Transport Information end-to-end	Freedom of action for friendly forces to create an assured environment	Joint Net-Centric Operations	Information Transport, Network Management, Info Assurance, Knowledge Management	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	
25	BA JFC 1	The ability to allow for rapidly deployable BA network	Tactical Information and Full Spectrum Dominance	Joint BA	Observation and Collection (All Domains)	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2	
26	BA JFC 2	The ability to allow for rapid insertion of new technology	Tactical Information and Full Spectrum Dominance	Joint BA	Observation and Collection (All Domains)	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	

ORS #	Number	Capabilities Conditions	Effect	Tier 1 JCA	Tier 2 JCA	UJTL Tasks	Remarks
27	BA JFC 3	The ability to allow for timely BA information flow	Tactical Information and Full Spectrum Dominance	Joint BA	Observation and Collection (All Domains)	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	

Appendix B. ORS IT&L Focus FAA

Appendix B. ORS IT&L Focus FAA

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
1	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy, and dynamically tailored ISR system.	ORS IT&L would rapid field an launch qualified dynamically tailored asset suite	SN 3.5.3.5 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.3.5 – Meet specifications and qualified payload /bus available for mission SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up • ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system	and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
2	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy, and dynamically tailored ISR system.	ORS IT&L would rapid field an launch qualified dynamically tailored asset suite	SN 3.5.3.4 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.3.4 – Correct and qualified communications. Payload for mission SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S.	delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
3	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy,	ORS IT&L would rapid field an launch qualified dynamically tailored asset suite	SN 3.5.3.4 SN 3.5.1.1	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission	• Available qualified payloads to cover war fighter need/request in 90

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
		and dynamically tailored ISR system.		ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces,	to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document	defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
4	MCO – 012	Deploy, employ and sustain a persistent, long-endurance, appropriately stealthy, and dynamically tailored ISR system.	ORS IT&L would rapid field an launch qualified dynamically tailored asset suite	SN 3.5.3.1 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission SN 3.5.3.1 – GPS qualified payload in the system and applicable to mission	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission	to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system	to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
5	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	Ability to reconstitute space assets and capabilities rapidly, enhanced ability to put up defeat technologies	SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.3 SN 3.5. 1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission SN 3.5.2.1 – Qualified payloads that meet mission requirements SN 3.5.2.2 - Qualified payloads that meet mission requirements SN 3.5.2.3 - Qualified payloads that meet mission requirements	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.3.3 - Qualified payloads that meet mission requirements ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure • ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility,	• Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry	• Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
6	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	Ability to reconstitute space assets and capabilities rapidly, enhanced ability to put up defeat technologies	SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.4 SN 3.5.3.5 SN 3.5.3.1 SN 3.5.3.2 SN 3.5.3.3 SN 3.5. 1.1	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S.	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S.	support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop	war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
7	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	Ability to reconstitute space assets and capabilities rapidly, enhanced ability to put up defeat technologies	SN 3.5.3.4 SN 3.5.3.5 SN 3.5. 1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electri cal equipment,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				system	qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document	and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
8	MCO – 036	Provide security for our forces, systems and processes (to include critical infrastructure, information and space capabilities) from origin to positions within the Joint Operations Area.	Ability to reconstitute space assets and capabilities rapidly, enhanced ability to put up defeat technologies	SN 3.5.3.5 SN 3.5.3.4 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up	personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
9	IW 0.7-014C	The ability to collect and exploit information on the situation. Obtain significant information on enemy and friendly forces and the nature and characteristics of the	Ability to rapidly respond, tailor payloads , provide high reliability payloads ORS IT&L can field new payloads in orbits that optimize war	SN 3.5.3.4 SN 3.5.3.5 SN 3.5.1.1 SN 3.5.3.1 SN 3.5.3.2 SN 3.5.3.3	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
		area of interest and its resident populations. In contested, hostile, denied, and ungoverned areas Against clandestine insurgent, terrorist, and criminal networks Overtly, clandestinely, or covertly. Persistent and continuous. Before adversaries can react to render information useless	fighters requirements for specific battle field conditions. ORS IT&L will provide needed satellite payloads to augment or enhance info gathering in area of interest	ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize	cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP)	equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
10	SD-SC1	The ability to provide assured U.S. access to space	ORS IT&L providing rapid broad capability space payloads ensures assured U.S. access to space – IT&L ORS qualified stockpile of payloads provides space access assurance.	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics protocols ORS IT&L 3: Develop rapid system test protocols ORS IT&L 4: Utilize dual use and qualified launch system	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	• Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with	facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management	and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Proprietary resistance from vendors resolved	
11	SD-SC2	The ability to proliferate space, link user, and terrestrial segments	ORS IT&L providing rapid broad capability space payloads ensures assured U.S. access to space – IT&L ORS qualified stockpile of payloads provides space access assurance. Provide proliferation assurance through qualified stockpiles and standardization of processes	SN 3.5.1.1 SN 3.5.3.4 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space	facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
12	SD-SC3	The ability to leverage low-cost production and miniaturization within space systems	ORS IT&L will contain costs through tested, qualified, standardized processes and payloads. Operations	SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission	• Available qualified payloads to cover war fighter need/request in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
			will be dedicated to war fighter responsiveness and miniaturization with ORS IT&L provides opportunity for multiple capabilities to maximize requirements.	SN 3.5.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope	• Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and	operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
13	SD-SC5	The ability to provide robust space system electronic links	ORS IT&L will have the capability to reconstitute electronic links in a rapid manner – When capability gaps exists ORS IT&L can respond through operationally efficient IT&L. (information transport, info assurance , enterprise services)	SN 3.5.1.1 SN 3.5.3.4 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				and Stock a suite of payloads ORS IT&L 6: Develop technology management system	ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry	drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days 1. Engineering

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD)	information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					system • Established configuration management • Proprietary resistance from vendors resolved	
14	SD-SC6	The ability to provide unambiguous indications of deliberate attack/environmental failures/on board anomalies for on-orbit satellites and associated C2	ORS IT&L can support a broad array of payload technologies to support the ability to detect deliberate attack, environmental failures. Stockpiled space surveillance payloads with built in test will limit and can monitor anomalies.	SN 3.5.1.3 SN 3.5.3.3 SN 3.5.3.5 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission SN 3.5.1.3 - Qualified payloads that meet mission requirements ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface	90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management	process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Proprietary resistance from vendors resolved	
15	SD-SC7	The ability to maintain continuous whole-earth coverage from a space vantage point	ORS IT&L can respond rapidly and reliably. Reconstitution of resources to maintain whole earth coverage will be a primary objective.	SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space	facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
16	SD-SC9	The ability to rapidly reconstitute on-orbit satellite capabilities	ORS IT&L can respond rapidly and reliably. Reconstitution of resources to maintain whole earth coverage	SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
			will be a primary objective.	rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope	qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP)	launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
17	SD-SC10	The ability to provide production-line methods for satellite/launch vehicle/C2/user segments	ORS IT&L executes production line integration and capitalizes on operational efficiencies to assure rapid effective payload integration to meet launch vehicle/C2/User segments needs. .	SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				ORS IT&L 6: Develop technology management system	ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry	configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system	data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Established configuration management • Proprietary resistance from vendors resolved	
18	SD-SC11	The ability to ensure dual-use compatibility for Global Strike and responsive spacelift capabilities	ORS IT&L will integrate payloads on to buseses that are compatible with dual use space lift technology	Not an ORS Payload and bus IT&L element	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of	• Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	war fighter delivery in 90 to 120 days
19	SD-SC12	The ability to integrate land/air/sea/space/information systems to	ORS IT&L supports the ability to deploy payloads that optimize	SN 3.5.1.1 SN 3.5.3.4 ORS IT&L 1: Stock	SN 3.5.1.1 - Meet specifications and qualified payload /bus	• Available qualified payloads to cover

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
		achieve space situational awareness	integration of information for battle filed and space situational awareness	qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces,	war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD)	information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
20	SD-SC13	The ability to deceive/disrupt/deny/degrade/destroy adversary space systems or capabilities	ORS IT&L provides the capability to rapidly support new space negation technologies	SN 3.5.2.3 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful	• Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document	• Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
21	SD-SC15	The ability to achieve reversible negation effects on space systems	ORS IT&L provides the capability to rapidly support new space reversible negation technologies	SN 3.5.2.3 SN 3.5.1.1 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling,	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with	fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management	vehicle IT&L process to assure war fighter delivery in 90 to 120 days •

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Proprietary resistance from vendors resolved	
22	NCOE JIC 6.0	Ability to Create / Produce Information in an Assured Environment	ORS IT&L provides the ability to deploy technologies to sustain an environment for assured and smart information	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space	facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
23	NCOE JIC 8.0	Ability to Establish a Smart, Assured Information Environment	ORS IT&L supports the ability to deploy technologies to sustain an environment for assured and smart	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission	• Available qualified payloads to cover war fighter need/request in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
			information	SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope	• Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and	operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information, documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
24	NCOE JIC 16.0	Transport Information end-to-end	ORS IT&L supports the ability to deploy technologies to sustain an environment for assured and smart information	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5 ORS IT&L 1: Stock qualified standard spacecraft bus ORS IT&L 2: Develop	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up	• Available qualified payloads to cover war fighter need/request in 90 to 120 days • Available qualified buses to cover war fighter need/request in 90 to 120 days and support multiple payload configurations • Integration engineering data,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
				rapid integration and logistics program ORS IT&L 3: Develop rapid system test program ORS IT&L 4: Utilize dual use and qualified launch system ORS IT&L 5: Develop and Stock a suite of payloads ORS IT&L 6: Develop technology management system	ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry	drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Test information and test parameters, facility, test equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Launch information, launch interfaces defined, operational launch facility, equipment, and personnel in place to support overall war fighter delivery in 90 to 120 days • Engineering information,

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD)	documentation, data, and plans in place to transition and transport hardware and data rapidly through the payload to bus IT&L process; then to the launch vehicle IT&L process to assure war fighter delivery in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					system • Established configuration management • Proprietary resistance from vendors resolved	
25	BA JFC 1	The ability to allow for rapidly deployable BA network	ORS IT&L supports the ability to deploy technologies to produce a new BA network	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing,	• Available qualified payloads to cover war fighter need/request in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop	

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
26	BA JFC 2	The ability to allow for rapid insertion of new	ORS IT&L supports the ability to deploy	SN 3.5.1.1 SN 3.5.2.1	SN 3.5.1.1 - Meet specifications and	• Available qualified

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
		technology	new technologies	SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry • The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program • Defined robust technology and comprehensive qualification programs • Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments,	payloads to cover war fighter need/request in 90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document	

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system • Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	
27	BA JFC 3	The ability to allow for timely BA information flow	ORS IT&L supports the ability to deploy technologies to sustain an environment for timely information flow	SN 3.5.1.1 SN 3.5.2.1 SN 3.5.2.2 SN 3.5.2.3 SN 3.5.3.1 SN 3.3.3.2 SN 3.5.3.3 SN 3.5.3.4 SN 3.5.3.5	SN 3.5.1.1 - Meet specifications and qualified payload /bus available for mission ORS IT&L 1: Stock qualified standard spacecraft bus – • Successful realignment of U.S. Space industry	• Integration engineering data, drawing system, configuration management, facility, mechanical/electrical equipment, and personnel in place to support overall war fighter delivery in

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• The will of the U.S. to fund a space technology build-up ORS IT&L 2: Develop rapid integration and logistics program Defined robust technology and comprehensive qualification programs Defined handling, processing, equipment and facility infrastructure ORS IT&L 3: Develop rapid system test program • Defined test program, • Established training, • Dedicated facility, • Defined environments, • Defined interfaces, • Defined mission scope ORS IT&L 4: Utilize qualified dual use launch system • The will of the U.S. to fund a space technology build-up	90 to 120 days

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Successful realignment of U.S. Space industry • Defined interface, environment and data requirements with bus and payload • Defined interface control document requirements (ICD) system ORS IT&L 5: Develop and stock a suite of payloads • The will of the U.S. to fund a space technology build-up • Successful realignment of U.S. Space industry • Defined interface control document requirements (ICD) system • Defined Test and Evaluation Master Plan (TEMP) ORS IT&L 6: Develop technology management system	

ORS IT&L #	Number	Capabilities	IT&L ORS Mapping	UJTL Tasks – FAA IT&L	Conditions for Task	Standards / Performance Measure
					• Defined interface control document requirements (ICD) system • Established configuration management • Proprietary resistance from vendors resolved	

Appendix C. FNA: IT&L Operationally Responsive Space

Appendix C. FNA: IT&L Operationally Responsive Space

Task	Standards	Gap: Yes/No	Risk : High / Medium/ Low
Stock a suite of payloads	Requested Payload/s Available from stock < 5 days Payload Reliability exceeds .97	Yes Yes	High
Stock spacecraft bus	Requested Bus/s Available from stock < 5 days Bus Reliability exceeds .97	Yes Yes	High
Develop rapid integration program	Integration of any payload/bus in < 5 days	Yes	High
	Assembly information available in < 1 days	No	
Develop rapid system test program	Test of any payload/bus in < 62 days	Yes	High
	Test Environments defined in < 1 days	No	
Stock launch system/s	Launch Vehicle available from stock in < 60 days	Yes	High
	Launch Vehicle Reliability exceeds .75	No	
Develop technology management system	All project information is available to the full project team in < 2	Yes	Medium
Launch and Initialize New Satellites	New Satellites launched in 90 to 120 days	Yes	High
Provide Space Surveillance	New Satellites for Space Surveillance launched < 120 days after request	Yes	High

Task	Standards	Gap: Yes/No	Risk : High / Medium/ Low
Provide Space Protection	New Satellites for Space Protection launched < 120 days after request	Yes	High
Provide Space Negation	New Satellites for Space Negation launched < 120 days after request	Yes	High
Provide Navigation Support	New Satellites for Navigation Support launched < 120 days after request	Yes	High
Provide Weather/Environmental Support	New Satellites for Weather/ Environmental Support launched < 120 days after request	Yes	High
Provide Theater Ballistic Missile Warning Products	New Satellites for Theater Ballistic Missile Warning Support launched < 120 days after request	Yes	High
Provide Communications Channels	New Satellites for Communications Support launched < 120 days after request	Yes	High
Provide Surveillance/Recon Support	New Satellites for ISR Support launched < 120 days after request	Yes	High

Appendix D. AMA Decision / Matrix

Appendix D. AMA Decision / Matrix

	ORS 1	ORS 2	ORS 3	ORS 4	ORS 5	ORS 6	ORS 7	ORS 8	ORS 9	ORS 10	ORS 11	ORS 12	ORS 13	ORS 14	ORS 15	ORS 16	ORS 17	ORS 18	ORS 19	ORS 20	ORS 21	ORS 22	ORS 23	ORS 24	Total
MQ1 Predator	2	2	2	2	1	1	1	1	3	0	0	0	0	0	0	0	0	0	1	2	0	3	3	3	**27**
RQ4 Global Hawk	3.5	3.5	3.5	3.5	1	1	1	1	3.5	0	0	0	0	0	0	0	0	0	1	2	0	3	3	3	**33.5**
RC135 V/W Rivet Joint	2.5	2.5	2.5	2.5	0.5	0.5	0.5	0.5	3.5	0	0	0	1	0	0	0	0	0	1	2	1	3	3	3	**29.5**
JSTAR E-8	2	2	2	2	0.5	0.5	0.5	0.5	3.5	0	0	0	1	0	0	0	0	0	1	2	1	3	3	3	**27.5**
U2 Manned Aircraft	3	3	3	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0	3	3	3	**25**
Near Space Balloon	1.5	1.5	1.5	1.5	0	0	0	0	2.5	1	1	1	1	1	1	0	1	0	1	1	0	3	3	3	**26.5**
Conventional Space	3.5	3.5	3.5	3.5	3	3	3	3	4	4	4	2	3.5	3	4	1	4	5	3	1	1	3	3	3	**74.5**
ORS	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	3	3	3	**113**

Appendix E. Analysis of Material Alternatives

Appendix E. Analysis of Material Alternatives

E.1 Summary of Operationally Responsive Space (ORS) Analysis of Material Alternatives (AMA)

Listed below are the alternatives to using the ORS concept in support of the warfighter. There are approximately six alternatives that are covered in the analysis, primarily the more prominently used methods that are employed in the current conflicts around the world. Figure E-1shows the different methods and their placement in the battlespace.

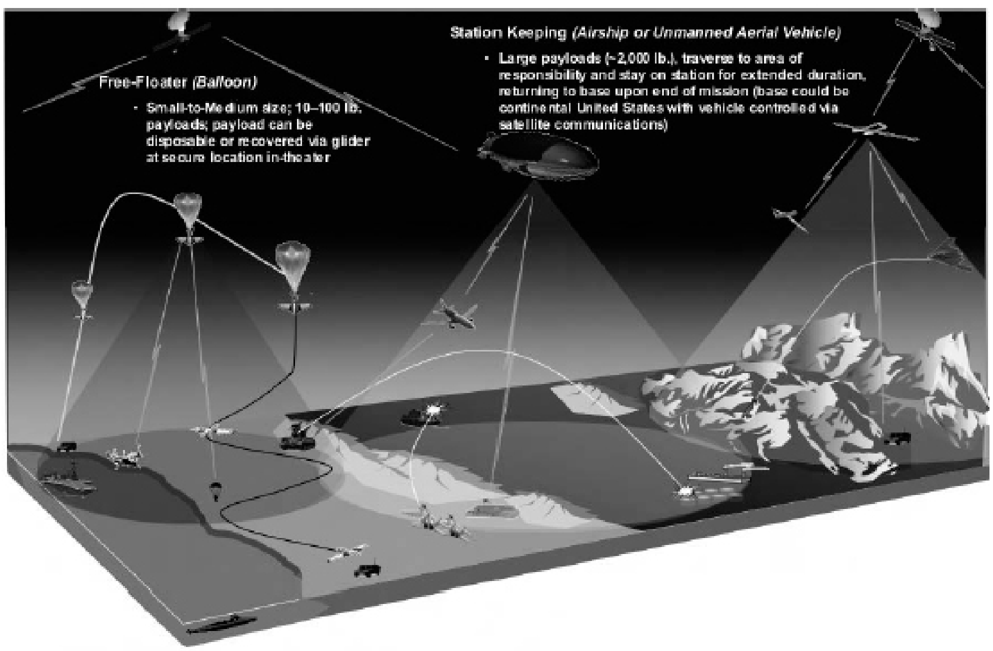


Figure E-1. OV-1 for Battlespace Awareness

OV-1 operationally responsive space: view of near-space architecture AMA. (From "Operationally Responsive Space/Near Space Initial Capabilities Document," draft [Peterson AFB, CO: Headquarters AFSPC, Directorate of Plans and Requirements, n.d.], app. A.)

E.2 MQ-1 Predator

E.2.1 Command and Sensor Systems.

The aircraft is equipped with Multi-spectral Targeting System, a color nose camera (generally used by the pilot for flight control), a variable aperture day-TV camera, and a variable aperture infrared camera (for low light/night). Previously, Predators were equipped with a synthetic aperture radar for looking through smoke, clouds or haze, but lack of use validated its removal to reduce weight. The cameras produce full motion video and the synthetic aperture radar produced still frame radar images. There is sufficient bandwidth on the datalink for two video sources to be used at one time, but only one video source from the sensor ball can be used at any time due to design limitations. Either the daylight variable aperture or the infrared electro-optical sensor may be operated simultaneously with the synthetic aperture radar, if equipped.

All Predators are equipped with a laser designator that allows the pilot to identify targets for other aircraft and even provide the laser-guidance for manned aircraft. This laser is also the designator for the AGM-114 Hellfire missiles that are also carried on the MQ-1.

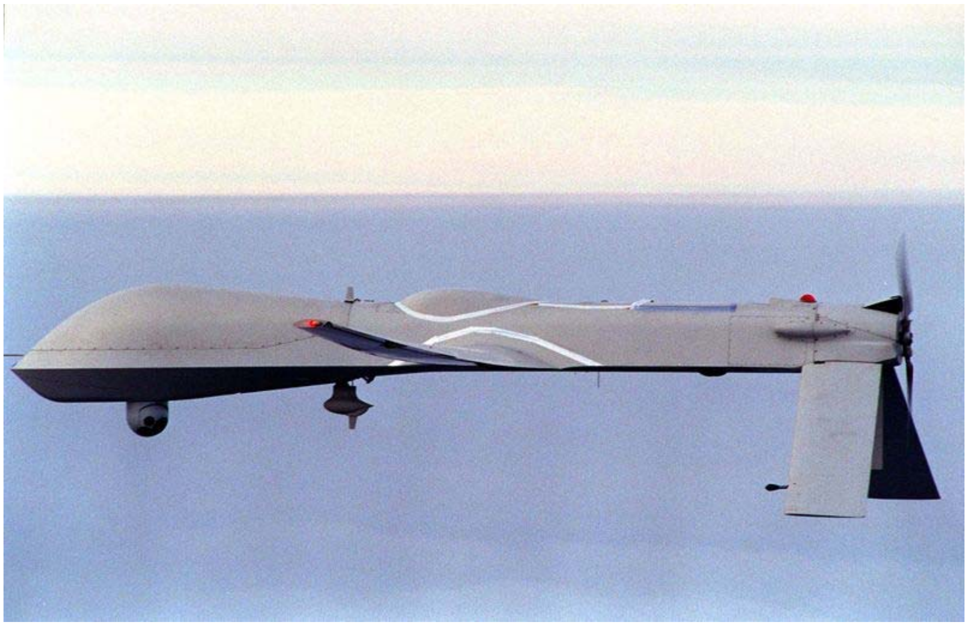


Figure E-2. A Predator Flying on a Simulated Navy Aerial Reconnaissance Flight Off the Coast of Southern California on December 5, 1995

E.3 RQ-4 Global Hawk

E.3.1 Overview

The Global Hawk air vehicle is able to provide high resolution Synthetic Aperture Radar (SAR)—that can penetrate cloud-cover and sandstorms—and Electro-Optical/Infrared (EO/IR) imagery at long range with long loiter times over target areas. It can survey as much as 100,000 square kilometers (40,000 square miles) of terrain a day. If a Global Hawk were flown out from San Francisco, it would be able to operate in Maine for 24 hours, observe a 370 x 370 kilometer (230 x 230 mile) grid, and then fly back home.

Potential missions for the Global Hawk cover the spectrum of intelligence collection capability to support forces in worldwide peace, crisis, and wartime operations.

According to the Air Force, the capabilities of the aircraft will allow more precise targeting of weapons and better protection of forces through superior surveillance capabilities.

E.3.2 Integrated system

Figure E-E-1. Global Hawk

The Global Hawk UAV system comprises an air vehicle segment consisting of air vehicles with sensor payloads, avionics, and data links; a ground segment consisting of a Launch and Recovery Element (LRE), and a Mission Control Element (MCE) with embedded ground communications equipment; a support element; and trained personnel.

E.4 RC-135V/W Rivet Joint

The RC-135V/W sensor suite allows the mission crew to detect, identify and geolocate signals throughout the electromagnetic spectrum. The mission crew can then forward gathered information in a variety of formats to a wide range of consumers via Rivet Joint's extensive communications suite. The interior seats 34 people, including the cockpit crew, electronic warfare officers, intelligence operators and airborne systems engineers.

Figure E-E-2. An RC-135 Rivet Joint Reconnaissance Aircraft Moves into Position Behind a KC-135T/R Stratotanker for an Aerial Refueling

General characteristics Primary Function: Reconnaissance Contractor: L-3 Depending on mission requirements, minimum consisting of three electronic warfare officers, 14 intelligence operators and four in-flight/airborne maintenance technicians Unit Cost: unavailable Initial operating capability: January 1964 Inventory: Active force, 13; Reserve, 0; Guard, 0

E.5 U-2 Manned Aircraft

E.5.1 Design Description

The unique design that gives the U-2 its remarkable performance also makes it a difficult aircraft to fly.[2] It was designed and manufactured for minimum airframe weight, which results in an aircraft with little margin for error.[2] Some joked that it was built of tin foil since the sheets of the fuselage were so thin. Most aircraft were single-seat versions, only 5 two-seat versions being known to exist.[3] High-aspect-ratio wings give the U-2 some glider-like characteristics, with a lift-to-drag ratio estimated in the high 20s. To maintain their operational ceiling of 70,000 feet (21,336 m), the U-2A and U-2C models (no longer in service) must fly very near their maximum speed. However, the aircraft's stall speed at that altitude is only ten knots (18 km/h) less than its maximum speed. This narrow window was referred to by the pilots as the "coffin corner". For 90% of the time on a typical mission the U-2 was flying within only five knots above stall, which might cause a decrease in altitude likely to lead to detection, and additionally might overstress the lightly built airframe.[2]

Figure E-E-3. **The Lockheed U-2R/TR-1 in flight**

Figure E-E-4. Photograph taken from the Window of a TR-1 (U2) aircraft from an Altitude of Approximately 75,000 feet

E.6 E-8 Joint STARS

The E-8 Joint Surveillance Target Attack Radar System (Joint STARS) is a United States Air Force airborne battle management and command and control (C2) platform that conducts ground surveillance to develop an understanding of the enemy situation and to support attack operations and targeting that contributes to the delay, disruption and destruction of enemy forces. These functions support the primary mission of Joint STARS - to provide dedicated support of ground and air theater commanders.

Figure E-E-5. USAF E-8C Joint STARS

E.7 Development

Joint STARS evolved from separate United States Army and Air Force programs to develop, detect, locate and attack enemy armor at ranges beyond the forward area of troops. In 1982, the programs were merged and the US Air Force became the lead agent. The concept and sensor technology for the E-8 was developed and tested on the Tacit Blue experimental aircraft.

E.8 Near space balloons

The enthusiasm of the Air Force's leadership for "near space" vehicles is undiminished. They foresee that these craft will resemble inflatable aerostats or balloons and will dwell, for months at a time, at over 20,000 meters, where they will provide a variety of functions for US forces within a given theater of operations, such as Iraq. The roles they are considering include communications relays as well as intelligence, surveillance, and reconnaissance (ISR).

Appendix F. Acronyms

Appendix F. Acronyms

AFB	Air Force Base
AMA	Analysis of Materiel Alternatives
AOI	Areas of Interest
BA	Battlespace Awareness
C2	Command and Control
CBA	Capability Based Assessment
CJCSM	Chairman of the Joint Chiefs of Staff Manual
BIT	Built in test
BITE	Built in Test Equipment
BIST	Built in Self Test
COCOM	Combatant Commander
COI	Communities of Interest
CONOPS	Concept of Operations
COTS	Commercial Off The Shelf
CR	Configuration Review
CRI	Certified Ready to Integrate
DoD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Material, Leadership, and Education
EMI	Electromagnetic Impulse
ESD	Electrostatic Discharge
FAA	Functional Area Analysis
FNA	Functional Needs Analysis
FSA	Functional Solutions Analysis
FSD	Full Spectrum Dominance
IAR	Immediate Anomaly Review
ICD	Interface Control Documents
ICOMS	Inputs, Constraints, Outputs, and Mechanisms
IPT	Integrated Product Team
ISP	Intelligence, Surveillance, & Reconnaissance
IST	Integrated System Testing
IT&L	Integration, Test & Logistics
IW	Irregular Warfare
JCA	Joint Capability Area
JCIDS	Joint Capabilities Integration Development System

JFC	Joint Force Commander
JIC	Joint Integrating Concepts
JOC	Joint Operating Concepts
JOpsC	Joint Operating Concept
MCO	Major Combat Operations
MET	Multiaxis Exciter Testing
MLI	Multi-layer Insulation
MOE	Measures of Effectiveness
MOP	Measures of Performance
NCOE	Net Centric Operational Environment
NMS	National Military Strategy
NSPD	National Security Presidential Directive
NSS	National Security Strategy
NSSO	National Security Space Office
OFT	Office of Transformation
ORS	Operationally Responsive Space
OV	Operational View
QDR	Quadrennial Defense Review
R&D	Research and Development
S&T	Science and Technology
SC	Space Craft
SD	Strategic Deterrence
SMAD	Space Mission Analysis and Design
SME	Subject Matter Experts
SPO	Special Program Office
STM	Stockpile to Mission
TSRDS	Tactical Satellite Rapid Deployment System
TVAC	Thermal Vacuum
U.S. STRATCOM or USSTRATCOM	United States Strategic Command
UJTL	Universal Joint Tasks List
WMD	Weapons of Mass Destruction

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REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
19-06- 2008	Master Thesis	January 2007 to June 2008

4. TITLE AND SUBTITLE
Operationally Responsive Space: An Architecture and Enterprise Model for Adaptive Integration, Test and Logistics

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Jeff Alexander
Martha Charles-Vickers
Talbot Smith
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5d. PROJECT NUMBER
N/A

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Way
Wright-Patterson AFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GSE/ENV/08-J01DL

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The capability to rapidly deploy tactical satellites to meet a Joint Force Commander's immediate battlespace requirements is a well-documented joint capability need. Key U.S. strategic documentation cites the need for the capability to maintain persistent surveillance or an "unblinking eye" over battlespace and to rapidly reconstitute critical space capabilities to preserve situational awareness. The warfighter requires a tactical space-based deployment capability which employs a request to launch and operational deployment window of 90 to 120 days. This master's thesis executed two (2) major areas of work: apply, and reinforce the Operationally Responsive Space (ORS) mission tasks using the Joint Capabilities Integration Development System (JCIDS) process; then based on capability gap data generated from the process, analyze and define the capability gap of an ORS Adaptive Integration, Test and Logistics (IT&L) process for payload to bus deployment to meet the identified time scales. This document recommends engineering solutions and processes for the ORS IT&L "to-be" state for this warfighter capability. The ORS adaptive IT&L CONOPS developed as part of this work focuses on the Tactical Satellite Rapid Deployment System (TSRDS), which is an adaptive integration, test and logistics capability that enables rapid and effective payload to bus integration to meet a 90- to 120-day war fighter window.

15. SUBJECT TERMS
N/A

16. SECURITY CLASSIFICATION OF: a. REPORT	b. ABSTRACT	c. THIS PAGE	17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
U	U	U	UU	238	Dr. Joseph Carl
					19b. TELEPHONE NUMBER *(Include area code)* 937-255-3355 ext 3351

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