A Methodology for Evaluating Architectural Solutions

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Abstract–The Air Force Scientific Advisory Board (AFSAB) was tasked during 1998 to develop "A Space Roadmap for the 21st Century Aerospace Force." [1] In order to complete this daunting task in less than a year, we had to develop alternative architectures and recommend a preferred architecture based on cost and performance trades. In order to perform these trades, we employed assessment tools and methodologies that were simple, yet provided some confidence that the architectural option being recommended and the corresponding changes to the current baseline force structure will achieve the intended purpose. In this paper we discuss the approach used in making these assessments.

Inherent in our approach is a way to assess how various options for changing the baseline force structure contribute to achieving our vision. We have examined a range of possible changes to the current baseline program and evaluated them against a set of Measures of Effectiveness (MOEs). This analysis has led to the selection of a recommended option. The baseline and recommended force structures were broken out into functional areas. As a way to evaluate the operational effectiveness MOE, we have correlated the baseline and candidate force structure options against the operational tasks of the Air Force. The Joint Mission Element Task List (JMETL) provides a listing of the key tasks which a joint force must be able accomplish to fulfill the requirements of *Joint Vision 2010* (JV2010) [2] the Department of Defense (DoD) operational vision for the future. The specific Desired Operational Capabilities (DOCs) of the JMETL, which currently number 72, are grouped by the JV2010 operational concepts: Command and Control, Information Superiority, Precision Engagement, Dominant Maneuver, Full-Dimensional Protection, and Focused Logistics.

A quantitative comparison of force alternatives against these DOCs would depend on a host of assumptions and subjective judgements about priorities among DOCs and about force effectiveness, supported by an analysis whose scope would go far beyond what is feasible in a summer study. Instead, we have performed a qualitative assessment to identify the kinds of improvements our recommended option would deliver. We have done this by first assigning a rating of critical, important, supporting, or not related to the degree that each functional area of an option is important in satisfying each DOC. Next we have estimated the ability of the option being evaluated, again by functional areas, to achieve each DOC, paying attention to the ways in which the option under evaluation falls short. The result of this analysis is a recommended force structure architecture option which allocates functionality to space, airborne and ground elements in such a way as to maximize the ability to execute JMETL tasks for a given, constrained level of investment.

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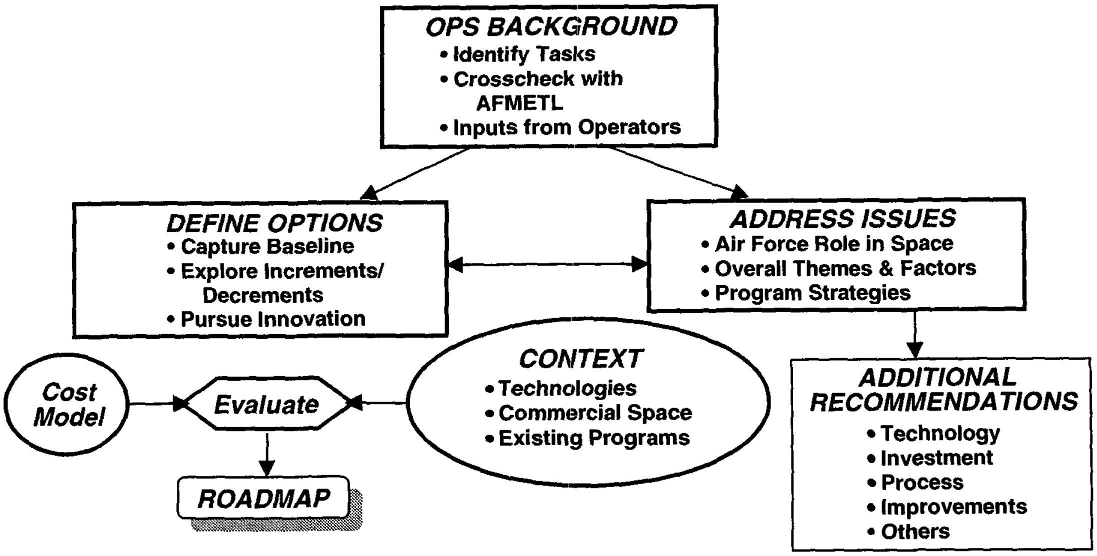

Figure 1. *Overall Flow of the Space Roadmap Study.*

1. INTRODUCTION

The continuing challenge of modernizing and preparing aerospace forces to meet future national security needs requires anticipation of missions and threats, of trends in technologies and systems, and of long range planning for force structures which will best meet future requirements. The post-Cold War security environment presents a level of ambiguity about opponents and their capabilities, of global challenges to US interests, of growing reliance on information as the key to victory, and of severe limitations on the resources available for national defense. In recent years, the United States Air Force (USAF) has institutionalized a long-range planning process aimed at dealing more effectively with evolving requirements and the long lead times associated with defining, developing and acquiring new systems, as well as laying the foundation for the doctrine, tactics and organizations that will be needed. In particular, it is widely recognized that space will play a rapidly increasing role in defense, and USAF, as the lead military service for space, has particular interest in charting a long-term course to the most effective and affordable combination of air and space assets, in an integrated aerospace force.

As one element of a broad attack on these difficult issues, the Air Force Scientific Advisory Board (AFSAB) was tasked during 1998 to develop "A Space Roadmap for the 21st Century Aerospace Force." The AFSAB was asked to assess alternatives and recommend directions and milestones for evolving the current force to make best use of air and space. In order to complete this daunting task in less than a year, we had to develop alternative force structure architectures and recommend a preferred architecture based on cost and performance trades. In order to perform these trades within the limitations of a summer study, we had to employ assessment tools and methodologies that were simple, yet provided some confidence that the architectural option being recommended and the accompanying changes to the current baseline force structure will provide the basis for responsive, highly effective, and affordable global aerospace capability.

Figure 1 shows the overall study flow and the various elements of the analysis that had to be completed in less than nine months, with most of the work done in a concentrated two week summer study during June 1998. Well over a hundred AFSAB members, supported by experts from Government, industry and academia, were organized in panels dealing with operational concepts, architectures, payloads, satellite buses and boosters, space system protection, ground segments, and cost estimation.

Traditional modeling and simulation techniques would have required both tools and a level of effort that were not available within the confines of this effort. There were daunting challenges in defining the air and space force structure architecture and in evaluating it in mission and campaign level models capable of yielding military utility and cost metrics across the broad range of scenarios of interest. Instead, to provide at least an initial answer to the central question, we defined a set of functional areas and devised a scoring technique to facilitate a quantitative evaluation of the elements of alternative architectures for comparison to the baseline force. The baseline was derived from the current USAF program, i.e., the forces now in hand and contained in future budgets. The process sketched in Figure 1 was the basis for a recommended architectural option which we believe will best serve the future needs of USAF and the nation. The study team recognizes that this result must be followed up with more detailed and quantitative program analysis to support formal planning and budgeting actions.

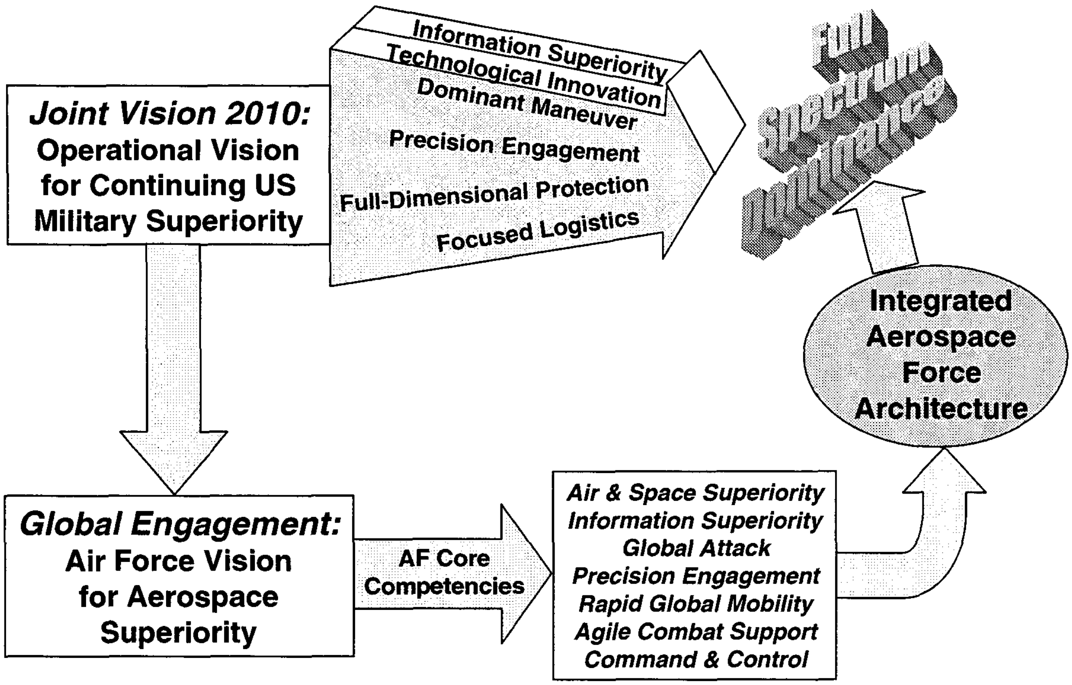

Figure 2. *Relationship of Air Force Core Competencies and Force Structure Architecture to JV2010.*

2. ARCHITECTURE

The study started with a vision of 21st century aerospace operations drawn both from earlier analyses such as New World Vistas [3] and Spacecast 2025 [4] and from the JMETL and DOCs described above. Overarching operational and infrastructure tenets of JV2010 and the resulting USAF core competencies are closely intertwined. Architectures that were developed during this study were designed to support the core competencies as we transition into the 21st century. This relationship is shown in Figure 2. For purposes of the study, aerospace force architecture was divided into seven functional areas:

- Infrastructure/Command, Control & Communications (C^3)
- Position, Navigation & Timing
- Space Control
- Intelligence, Surveillance & Reconnaissance (ISR)/ Warning
- Launch
- Force Projection
- Modeling, Simulation & Analysis (MS&A)/High-Payoff Longer-Term Capabilities

Each of these functional areas was subdivided and, during the architecture development, it was determined whether the mission could be best performed by a terrestrial, airborne or a space-based system. As an example, Table 1 shows examples of the potential space system contributions to the JV2010 operational concepts. The baseline force structure architecture was derived from existing forces and programs using the most recent President's Budget and the Future Year Defense Program (FYDP) as the principal sources.

Obviously, an almost unlimited number of excursions from this baseline could be chosen. To keep the study task tractable, three alternatives were defined in an attempt to explore the trade space. In essence, these options involved (1) a major transfer of capability from terrestrial to space systems ("aggressive" option), (2) the opposite extreme of a minimal migration to space and even some retrenchment from the existing space force posture ("conservative" option), and (3) an intermediate position that sought to exploit the advantages of space in functional areas where the potential improvement is greatest while preserving a balance in the overall architecture ("balanced" option).

The candidate increments and decrements to space-based capability were based on the expert judgement of the study team, which was fortunate to have the services of many of the nation's leading experts on both military and commercial space systems. Under each of the three force structure options, specific candidate increments and decrements to the space-based functions of the baseline architecture were defined, along with acquisition strategy and estimated costs to implement each of the options. A good example is provided by the alternatives for space-based intelligence, surveillance and reconnaisance (ISR) sensors to support tactical operations. The current baseline force includes space platforms only for intelligence, missile warning, and other strategic missions. The aggressive option incorporated the earliest feasible fielding of a multifunction

Table 1. *Examples of Space Contributions to JV2010 Operational Concepts.*

Operational Concept	Aerospace Capability	Space System Contributions
Dominant Maneuver	• Expeditionary Air Power	• Global Situational Awareness • Smaller Deployed Footprint
	• Dispersed/Synchronized Ops	• Communications/Networking • Intelligence Support • Weather/Environment Sensing
Precision Engagement	• Precise Delivery of Tailored Effects	• Space/Time-Referenced Battlespace • Precision Targeting • Precision Navigation
	• Battle Damage Assessment	• Multimode/Fused Sensing
Full Dimensional Protection	• Detection/Defeat of Hostile Actions	• Detect Use of Nuclear/ Chemical/Biological Weapons • Real-Time Intelligence/Warning • Denial of Hostile Use of Space
	• Highly Survivable Services to Warfighters	• Intel Transmission/Processing/ Exploitation/Dissemination • Robust/Survivable Connectivity
Focused Logistics	• Tailored Sustainment	• Reachback Connectivity • Navigation & Communications for Tankers & Transports
	• Effective Space Logistics	• Responsive Launch • Satellite Retrieval/Servicing

space-based radar (SBR). The conservative option has no new space sensors. The balanced option calls for an orderly transition from all air breathing ISR platforms to a complementary mix of space and aerial systems on a schedule driven by risk reduction and development of an optimized concept of operations. Similar alternatives were examined across the functional areas. The ultimate goal was to find a future force that greatly improves the ability of USAF in meeting its responsibilities to organize, train and equip aerospace forces in support of JV2010.

3. MEASURES OF EFFECTIVENESS

Metrics

The heart of the analytical technique we have employed is the choice and definition of MOEs for comparing alternatives. After extended discussion, we settled upon four metrics:

Operational Effectiveness–ability of the proposed force structure to address current and projected tasking.

Affordability–ability of the proposed alternative to fit within reasonable budget projections.

Technical Risk–availability of the required enabling technologies and products to implement the system or systems involved on a given schedule.

Integration–ability of the proposed alternative to maintain continuity of services to warfighters and to fit into an evolving force structure, including backward compatibility as appropriate.

Additional Factors

Particularly with respect to the first and fourth MOEs, some additional attributes and definitions are needed to ensure consistent evaluation of alternatives. A future force which can implement the vision articulated in this study yet be feasible in the likely fiscal circumstances will be characterized by:

Effectiveness in executing the exceptionally diverse taskings anticipated in the 21st century.

Survivability when exposed to new, ambiguous, asymmetric and rapidly changing threats.

Efficiency in delivering precise effects with great economy of force.

Elements of Operational Effectiveness

We further expanded on the effectiveness attribute by seeking to evaluate the following, with due attention to the growing criticality of information in military operations:

Response Time–ability to meet service delivery time requirements of customers, including the time to generate mission tasking and the latency in delivery.

Coverage–rate and continuity of information collection, delivery of service (including prosecuting targets), or other service to warfighters.

Information Quality–sensor resolution, communications data transmission and error rates, spatio-temporal positioning accuracy, correctness in identifying targets, robustness against counter-measures, and similar factors.

Operability/Supportability–ability to deliver services reliably with acceptable requirements for staffing, user equipment and other infrastructure.

Effect Delivery Quality–ability to induce desired and controlled effects across the spectrum from denial to destruction and against all targets of interest, including projectile, directed energy, materiel delivery, jamming, and other means.

Scoring

In order to arrive at a numerical score for each MOE, we defined the following scale and applied it in evaluating the various architectural alternatives:

Fully Meets or Exceeds Requirement	1.0
Substantially Meets Requirement	0.7
Meets Major Part of Requirement	0.5
Meets Some Part of Requirement	0.3
Does Not Address Requirement	0

4. EVALUATION OF ALTERNATIVE ARCHITECTURES

The ultimate goal of this methodology is to assess force structure alternatives against operational tasks. Accordingly, in addition to the MOEs defined in the preceding section, we needed a way to express the relevance of each element of a candidate architecture to each task. Thus, an SBR has no correlation to delivering communications services, but is highly relevant to tasks such as battlespace awareness and target tracking. In a fashion similar to the *effectiveness* scale just defined, we developed the following *relevance* scale for scoring the extent to which a given element of a proposed force structure is important to a given DOC:

Critically Important	1.0
Important	0.7
Supporting	0.3
Not Related	0

The approved JMETL contains 72 DOCs, grouped by the JV2010 operational concepts:

- Comand and Control (C^2)
- Information Superiority
- Precision Engagement
- Dominant Maneuver
- Full Dimensional Protection
- Focused Logistics

Given that the study was concerned with a roadmap to the future, the study team added three new DOCs to capture important aspects of increased reliance on and operations in space. These involved protection of space assets, rapid replenishment of space assets, and delivery of directed energy effects from space. We believe this modest adjustment enhances the validity of the result. Appendix A tabulates typical military effects in which space systems participate and lists the DOCs.

A fully quantitative comparison of alternatives against these DOCs necessarily entails a host of assumptions and subjective judgements. Realistically, not all DOCs are of equal importance to success in aerospace operations, but opinions about relative importance differ greatly among various military operational and support communities. Moreover, evaluation of operational outcomes involving different force structures depends heavily on the scenarios analyzed and many other factors and should be addressed with detailed MS&A, supported by actual force experiments. As noted earlier, this study was limited in the depth of analysis that was feasible. We treated all DOCs as equal in importance and used expert judgement to score effectiveness and relevance.

Accordingly, the methodology used to compare force structure architectures against the Effectiveness MOE was:

- Capture the baseline from the sources listed earlier and documented at the level of individual systems in the current and programmed inventory.
- Define plausible increments and decrements to the space segment of the baseline through the collective judgement of the study team.
- Aggregate alternatives in each functional area to construct the aggressive, conservative, and balanced options described in Section 2 .
- Assign effectiveness and relevance scores to each functional area of the three options against each DOC.

- Multiply relevance and effectiveness scores and sum results across the DOCs and across functional areas.
- Normalize the result to a perfect score of 1.0.

The Cost Estimation Panel was charged with evaluating the Affordability MOE. Their efforts were supported by Tecolote, a leading company supporting financial analysis

Table 2. *Summary of Baseline and Recommended Force Structures.*

Functional Area	Segment	Baseline Program	Recommended Option
Infostructure/C^3	Space	DSCS, Milstar, UFO, GBS/IBS, Gapfiller, NRO Communications, Commercial SATCOM	Core MILSATCOM (Milstar), NRO Communications, Commercial SATCOM, ServerSAT Gateways
	Terrestrial	Troposcatter, DISN/SIPRNET, TENCAP, Commercial Landline	Baseline, Enhanced User SATCOM Gateways, Enhanced Fusion/BM/C^2/TPED Nodes
ISR/Warning	Space	DSP, SBIRS High, SBIRS Low, NRO Sensors, NUDET, Commercial Sensors	Baseline, New Sensor Constellation (1)
	Terrestrial	AWACS, JointSTARS, Rivet Joint, U-2, COBRA BALL, Predator, Global Hawk, Dark Star, Other UAVs, Other ISR Aircraft, BMEWS/North Warning, PAVE PAWS, COBRA JUDY, COBRA DANE, Surface ELINT	Baseline, w/ Adjusted Acquisition & Phase-Out Schedules as Allowed by Deployment of New Space System
Space Control	Space	N/A	Space-Based Surveillance, DE Projection (2)
	Terrestrial	GEODSS, FPS-85 Spacetrack, Haystack	Upgraded Sensors, DE Sources (2)
Launchers		Delta, Atlas/Atlas II/Atlas III, Titan II/Titan IV, EELV, Pegasus/Taurus, Other Commercial	Commercial Launch Services, EELV, AOV (3)
Force Application	Space	SBLRD	DE Projection (2)
	Terrestrial	ICBMs, CBMs, ABL, Combat Aircraft, NMD Interceptor	Baseline
Position, Navigation and Timing	Space	GPS/GPS IIF Transit, WAAS	Baseline + GPS Enhancements and Augmentation
	Terrestrial	NAVAIDs (VORTAC, ILS, etc.)	Baseline
Environmental	Space	DMSP, GOES, POES/NPOES, Foreign METSATs	Baseline (4)
	Terrestrial	Surface & Balloon Weather Sensors	Baseline
Infrastructure		Eastern/Western Test Ranges, AFSCN, ARIA, Commercial Ranges	National Space Ports GPS Space-Based Ranges Modernized Ground Environments
Modeling, Simulation & Analysis		Thunder, TACWAR System & Engineering Models	Upgraded Campaign Models for Space & Air

(1) Includes space-based radar with synthetic-aperture radar imaging and ground moving-target indication modes; may include additional functions such as Hyperspectral Imaging sensor.

(2) May be terrestrial laser with relay mirror satellites or space-based laser; development contingent on successful technology demonstrations and concept of operations (CONOPS) development. Deployment requires a change in national policy.

(3) Highly Operable Space Transportation Family of Integrated Vehicles (AOV) development contingent on successful technology demonstrations and CONOPS development.

(4) New space sensor constellation may support chemical/biological agent detection.

Table 3. *Examples of Shortfalls of the Baseline Force and Improvements from the Recommended Option vs. JV2010 Operational Concepts.*

JV2010 Operational Concept	*Baseline Force Structure*	*Recommended Option*
Command and Control	• Unity of effort limited by connectivity & interoperability • Overall timeliness & responsiveness similarly limited • Many problems with inadequate MS&A	• Improved connectivity, near-real time information collection & dissemination • Significantly improved decision aids, including MS&A tools able to adequately represent aerospace
Information Superiority	• Inadequate situational awareness, esp. in WMD, MOOTW, & low-level conflict • Shortfalls in capacity, assurance, & interoperability • Shortfalls in protection of military & civilian assets	• Significant improvement in all areas of concern with baseline • Remaining deficiencies in affecting adversary information operations
Precision Engagement	• Significant limitations on time critical targeting • Little or no space control capability • Lack of near-real time force projection	• Significant improvement in time critical targeting • Range of space control options • Multiple options for global delivery of tailored effects
Dominant Maneuver	• Little capability for short notice global conventional attack • Inability to deny hostile use of space	• Global delivery of tailored effects at orbital speeds • Range of space control options
Full-Dimensional Protection	• Limitations on intelligence preparation of the battlespace • Limitations on positive ID & data fusion • Little ability to protect space assets	• Significant improvement in all areas of concern with baseline
Focused Logistics	• Problems with logistics information systems & processes • Little ability to sustain or replace space assets	• Significant improvement in all areas of concern with baseline • Problems remain with joint logistics

for space systems. The panel developed a methodology for assessing and comparing the costs of various program and system options in order to provide a basis for affordability assessment. An existing automated cost-estimating integrated tools cost analysis shell and the RI$K model were used for formatted outputs, access to cost data bases, and various cost estimating relationships (CERs).

The first step was to compile the fiscal data corresponding to the force structure in the baseline. The panel then developed time-phased estimates of the required investment for each architecture alternative. For each proposed alternative, this required that a high-level schedule be developed showing when various system development and acquisition programs would be conducted. The panel also estimated potential offsetting savings from improved efficiency in operations and divestiture of missions and assets that are not properly part of the USAF space mission. The resulting profiles were compared to standard USAF budget planning assumptions to assess whether a given alternative was or was not at least roughly compatible with projected available resources.

The remaining MOEs, for Technical Risk and Continuity, were essentially binary – a given element of a given architecture was assessed on the basis of whether projected technology availability would support the estimated schedule to develop new systems and whether that schedule could be harmonized with the needs of warfighters and the phaseout of older systems. For example, the schedule for SBR is paced by technology demonstrations such as the Discoverer II program and by the feasibility of maintaining ISR services to warfighters as current systems such as AWACS and JointSTARS age out of the force. Any situation where these tests were not passed was adjusted to correct the problem.

5. RESULTS

The full details of the baseline and alternatives and of the scoring and evaluation fill many pages. The result was the definition of the study's recommended option for the future of USAF in space. Table 2 summarizes the baseline force and the recommended option, which is very close to the balanced option of the three excursions used in the evaluation. (The acronyms are decoded in an Appendix.)

The scoring technique is sufficiently general and subjective that precise computations of the fraction of operational tasking satisfied by a given alternative are hard to defend. However, the differences among alternatives, arrived at through a consistent methodology and supported by deep and diverse expert judgement, are significant. The evaluation indicated that the preferred alternative was highly effective and was roughly 30% better on the Effectiveness MOE than the baseline. Table 3 gives examples of shortfalls in the baseline which are addressed by the recommended future force. At the same time, the Affordability analysis suggested that if USAF were to avail itself of the full savings made possible by improved practices, reduced manpower and facility costs, divestiture of peripheral missions, and other such measures, the recommended option is fiscally achievable. The Technical Risk and Continuity MOEs are also satisfied.

6. SUMMARY

The goals of this methodology development were to achieve completeness and consistency, to provide a sound basis for developing a recommended force structure architecture and roadmap, and to support analysis that is feasible in the context of a relatively quick study. The resulting instrument allowed us to compare at an aggregated level the operational effectiveness and fiscal impact of alternative courses of action. The economic analysis allowed a top-level check on the extent to which economies can offset increased investment costs and on the overall prospects for fitting a future force into a reasonable budget projection. The methodology must and does account as fully as possible for all cost elements associated with development, acquisition and operation of the systems in question. It also addresses the full spectrum of military taskings. Applied consistently, it provides the basis for a valid comparison of alternatives.

7. APPENDICES

A. OPERATIONAL TASKS

ENDOATMOSPHERIC EFFECTS
Wide Area Surveillance/Imagery/Detection
AMTI/Target Identification
GMTI/Target Identification
Tactical Comm/Direct Broadcast
Precision Positioning
ELINT/SIGINT/Threat Warning
Target Tracking/Fire Control
DE Weapon Delivery
Projectile Weapon Delivery
Covert Communication/Exfiltration

EXOATMOSPHERIC EFFECTS
Space Volume Search
Space Object Tracking/ID
Missile Launch Detection
Missile Trajectory Estimation
DE Weapon Detection
Projectile Weapon Delivery
DE Weapon Delivery
Jamming/Disruption
Lift

DESIRED OPERATIONAL CAPABILITIES

Command & Control
Situational Awareness
Experience & Judgement
Make Sound Decisions
Direct Military Actions
Achieve Unity of Effort
Supervise Execution
Prepare Plans & Orders
Organize Headquarters & Force
Prioritize/Allocate Resources

Information Superiority
Battlespace Awareness: WMD
Battlespace Awareness: Terrorism
Battlespace Awareness: Information Operations
Identification Friend or Foe
ISR Familiarization
Battlespace Display & Assessment
Improve Analytical Procedures
Comprehensive Battlespace Awareness
Battlespace Awareness: Urban Operations
Battlespace Awareness: MOOTW
Collection Management for Joint Operations
Battlespace Awareness: Targeting
Battlespace Awareness: Indications and Warning
Affect Adversary Battlespace Observation
Affect Adversary C2
Affect Adversary Force Effectiveness
Affect Enemy Support of Forces
Affect Enemy Civilian Infrastructure
Protect Battlespace Observation
Protect Command & Control
Protect Effectiveness of Forces
Protect Support of Forces
Protect Civilian Infrastructure
Assurance
Capacity
Interoperability

Precision Engagement
Tailorable Force Packages
Control Collateral Damage
Time Critical Targeting
Fratricide Prevention
Defeat Threat Protective Systems
Integrated Battlespace Maneuver

Precision Force Protection
Global Energy Projection from Space

Dominant Maneuver
Provide Organized, Trained & Equipped Forces
Rapidly & Effectively Position Forces
Achieve/Preserve Freedom of Maneuver
Generate Overmatching Lethal/Nonlethal Effects
Employment of Forces
Synchronized Effects Througout Battlespace
Short Notice Conventional Global Attack

Full Dimensional Protection
Enhanced Intelligence Prep of the Battlespace
Single Integrated Air Picture
Early ID of Air & Missile Threats
Early Engagement of Air & Missile Threats
Employ Terrorist Countermeasures
Mitigate Effects of Terrorist Actions
Recover from Terrorist Incidents
Fused, Positive ID
Detect Entities in the Combatant's AOR
Identify/Characterize Entities in the AOR
All-Source Fused Positive ID Throughout AOR
Continuous Positive ID Throughout AOR
Continuous Protection of Operational Forces
Continuous Protection of Friendly Space Assets

Focused Logistics
Unimpeded Access to Logistics Information
Asset Visibility, Control & Management
Mobility System - Worldwide Sustainment
Deployed & Distributed Sustainment
Support Rapid Force Maneuver
Protect Forces from Medical Threats
Infrastructure & Logistics Support
Synchronized/Integrated Cross-Service Logistics
Provide Essential Care in Theater & Evacuation
Optimize Logistics Between All Echelons
Rapid Replenishment of Space Assets

B. TABLE 2 ACRONYMS

ABL Airborne Laser
AMTI Air Moving Target Indication
AOR Area of Responsibility (Theater of Operations)
ARIA Advanced Range Instrumentation Aircraft
AFSCN Air Force Satellite Control Network
AWACS Airborne Warning & Control System
BM/C2 Battle Management/Command & Control
BMEWS Ballistic Missile Early Warning System
CBM Conventional Ballistic Missile
DE Directed Energy
DISN Deffense Information Systems Network
DMSP Defense Meteorological Support Program
DSCS Defense Satellite Communication System
DSP Defense Support Program
EELV Evolved Expendable Launch Vehicle
ELINT Electronic Intelligence
GBS/IBS Global/Interim Broadcast System
GEODSS Ground Based Electro-Optical Deep Space Surveillance
GMTI Ground Moving Target Indication
GOES Global Operational Environmental Satellite
GPS Global Positioning System
ICBM Intercontinental Ballistic Missile
ILS Instrument Landing System
ISR Intelligence, Surveillance & Reconnaissance
JointSTARS Joint Surveillance, Target & Attack Radar System
METSAT Meterological Satellite
MOOTW Military Operations Other Than War
NAVAID Navigational Aid
NMD National Missile Defense
NPOES National Polar Orbiting Environmental Satellite
NRO National Reconnaissance Office
NUDET Nuclear Detonation (Detector)
POES Polar Orbiting Environmental Satellite
SATCOM Satellite Communications
SBIRS Space Based Infrared System
SBLRD Space-Based Laser Readiness Demonstration
SIGINT Signals Intelligence
SIPRNET Secret Internet Protocol Router Network
TENCAP Tactical Exploitation of National Capabilities Program
TPED Transmission, Processing, Exploitation & Dissemination
UAV Unmanned Aerial Vehicle
UFO UHF Follow-On
VORTAC VHF Omnidirectional Range System/Tactical Air Navigation
WAAS Wide Area Augmentation System
WMD Weapons of Mass Destruction

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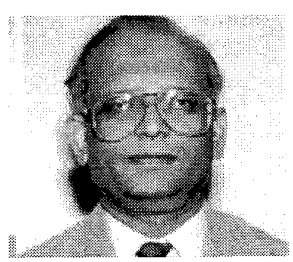

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