

Transformation Study Report

Executive Summary

Transforming Military Operational Capabilities

Prepared for the
Secretary of Defense

April 27, 2001

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Introduction

The Transformation Study Group¹ was convened at the direction of the Secretary of Defense on March 5, 2001. Guidance given to the study group charged it to identify:

- ▶ capabilities needed by US forces to meet the challenges of the twenty-first security environment;
- ▶ capabilities needed to meet national intelligence and space defense needs;
- ▶ transformation recommendations—how to develop and field the needed capabilities; and
- ▶ opportunities for cost savings, where feasible.

This paper summarizes a report presented to the Secretary in the form of briefing charts on April 27, 2001.

The Changing Need for, and Expectations of, US Military Forces

With the demise of the Soviet Union, there was a fundamental change in what the United States needs and expects from its military forces. The overriding priorities during the Cold War were a clear capability to (1) deter a nuclear attack against the United States and its allies; (2) deter war between superpower coalitions; and (3) if deterrence failed, ensure marginal superiority over Cold War opponents sufficient to assure that a conflict would be resolved on terms favorable to the United States and its allies. All other demands that might be placed on our military forces were regarded as lesser-included capabilities in the forces needed for these three overriding priorities. Even when those forces proved to be inadequate to deter lesser conflicts, such as the Korean and Vietnam wars, the focus remained on the priorities described above.

With the end of the Cold War, the demand quickly evolved to forces able to dominate opponents across the full range of military operations, from strategic nuclear deterrence to humanitarian relief, with the expectation they could do so with little or no loss of life in our forces and minimum unintended damage. This dramatic change in the demands placed upon

¹ Membership listed in Appendix A.

our forces leads logically to a need for significant changes in their capabilities—a transformation of the United States Armed Forces to meet twenty-first century demands. The demand for such a transformation is not theoretical: we are routinely tasking our forces to accomplish missions demanding capabilities that are clearly beyond the lesser-included capabilities of the Cold War force. While transformation needs are complex and far-reaching, successful transformation will build on existing forces that are unarguably the most capable in the world.

In contemplating transformation, we assumed there will continue to be a need for robust forward-stationed air, sea, and land capabilities to contribute to shaping the environment and to provide dissuasion and deterrence. The uncertainties of the future also demand a much more responsive and potent conventional capability, both to underwrite dissuasion and deterrence and to be decisive when crisis intervention is necessary. It is in this response capability area that transformation is most needed. More specifically, transformation activities must:

- ▶ **Capitalize on the relevant capabilities** in what is currently the most effective set of military forces in the world.
- ▶ **Preserve current strengths**—nuclear sufficiency, worldwide power projection, decision superiority, technological superiority, high quality human resources, and training superiority—from erosion in the face of new challenges.
- ▶ **Meet new threats and environments** to include ballistic and cruise missiles, opposed access, dependence on networks, counters to precision strike systems, and widening commercial availability of wideband communications and high-resolution imagery.
- ▶ **Exploit new opportunities** including, but by no means limited to, information technology; standing joint command and control systems; all-weather, persistent battlespace surveillance and targeting; global rapid mission planning and retargeting systems to exploit a potentially massive increase in lethality per weapons platform; rapidly deployable, versatile, lethal, and survivable joint, combined arms forces—land, sea, and air; and joint training and experimentation environments featuring human-in-the-loop simulation and live exercise capabilities.

Broader Transformation Capabilities and Issues

While we believe that conventional force capabilities need to be the prime focus of transformation, conventional forces depend on a set of military capabilities that have roles broader than military operations. Previous studies have highlighted essential changes required, and our study assumed additional capabilities in these key areas, as described in the following appendices:

- ▶ Strategic Nuclear Forces (Appendix B)
- ▶ Missile Defense (Appendix C)

- ▶ Space Dominance (Appendix D)
- ▶ Information Dominance (Appendix E) and classified Annex F
- ▶ Intelligence (Appendix F) and classified Annex F
- ▶ Special Access Programs (Appendix G)

Transformation

Transformation is a process of change that involves developing new operational concepts, experimenting to determine which ones work and which do not, and implementing those that do. Transformation deals with

- ▶ changes in the way military forces are organized, trained, and equipped;
- ▶ changes in the doctrine, tactics, techniques, and procedures that determine how they are employed;
- ▶ changes in the way they are led; and
- ▶ changes in the way they interact with one another to produce effects in battles and campaigns.

The objective of the transformation process is to realize military capabilities that can deal effectively with the new demands of a changing security environment. Transformation involves preserving current US strengths, meeting new threats and environments, and exploiting new opportunities. To some extent, transformation means accelerating the development and fielding of capabilities that we know we need. But it also means exploring capabilities that are less well understood, and correcting the course we are on, as necessary, to ensure that those needed new capabilities are realized.

It is neither possible nor necessary to transform the entire force at once. A relatively small fraction of the force transformed can enable new and revolutionary ways to fight. Thus it is reasonable and prudent to begin transforming a portion of the force to meet particularly pressing challenges while at the same time experimenting with new concepts and technologies to arrive at judgments about new capabilities and the changes necessary to achieve them.

The charter of the Transformation Study Group was to focus on the capabilities needed by US forces to effectively address the twenty-first century security environment. To do that, we examined the spectrum of demands placed on conventional forces—a spectrum ranging from major theater conflicts to humanitarian operations. While we endorse without reservation the need to steadily modernize current forward-deployed capabilities, we identified as our prime focus for transformation a set of capabilities, over and above force modernization and recapitalization, that would enable a joint force to respond rapidly and potently to a wide spectrum of contingencies. We selected the **Joint Response Force concept** as the focus of transformation for a number of reasons:

- ▶ It meets a US strategic need in situations where response time is the critical factor—where there is a need to act decisively before conditions become too hard to change.
- ▶ It presents an ambitious and demanding set of objectives much beyond what we can do today and whose achievement would be truly transformational.
- ▶ The “tip of the spear” capabilities we envision would permit longer effective life for the legacy forces, enabling them to be used in new and innovative ways.
- ▶ It builds on emerging thinking and efforts in the Services and joint communities (e.g., Future Combat System, Network-Centric and Effects-Based Operations, Operational Maneuver from the Sea, Rapid Decisive Operations).
- ▶ Its achievement does not require new physics or technical discovery, but rather the still-challenging integration of available (and soon-to-be-available) technologies into new concepts, doctrine, organizations, and systems.
- ▶ The enabling capabilities needed to achieve Joint Response Force objectives are broadly relevant to other elements of the force and other situations.

Representative Operational Demands and Operational Phases

To translate the broad need for transformation into future military forces, it is useful to select a set of representative situations as the basis for defining needed capabilities. These representative situations need not be comprehensive—they need only explore a wide enough range of demands to lead to a force sufficiently flexible and adaptable to meet real-world response needs. We selected a set of three such situations to accomplish that goal:

- ▶ **major regional conflicts** that include significant adversary military access denial capabilities;
- ▶ **lesser regional conflicts** with no significant adversary access denial, as well as forces deployed to deter; and
- ▶ the range of demands for **peacekeeping and humanitarian operations**.

Across the spectrum of these situations are common tasks that must be accomplished, requiring our forces to have certain capabilities to meet the range of national security needs. While our construct describes three notional tasks, it does not imply a distinct sequence of operations or a “one size fits all” concept of operations for all situations. Rather, it seeks to identify the actions necessary to achieve a decisive result. Depending on the situation and desired effects, the actions may overlap, and be either continuous or discrete in their execution. The three essential tasks or phases common to any of the representative situations are to:

- ▶ **Set the Conditions.** Whatever the situation, this phase is intended to ensure access and freedom of action for friendly operations and to provide the underlying

basis for subsequent operations. Forces already in theater clearly would play a major role here. Joint Response Force capabilities that could begin affecting the situation within hours would be a powerful augmentation to those in-theater forces and would contribute to deterrence.

- ▶ **Control the Situation.** Whether the mission is to stop the dying, stop the killing, or stop the use of weapons of mass destruction (WMD), the common element is a need to act quickly. The needed Joint Response Force capability is to begin to take control of any of these situations within only a few days.
- ▶ **Decisive resolution.** The remaining task common to all three situations is to resolve the conditions that led to the crisis in the first place, whether that means deposing a despotic regime, establishing a secure environment in which contending parties can work out their differences peacefully, or restoring vital services. Decisive resolution means achieving the desired end state established by the National Command Authorities. It may require the build-up of sufficient combat power in the theater to defeat large enemy formations, or the imposition of forces to monitor and enforce a peacekeeping agreement. Decisive resolution may take months, as in the case of Desert Storm; years, as in Bosnia; or decades, as in the Middle East or Korea.

In addition, continuous observation and information gathering, done as part of the overall regional strategy of a geographic combatant commander in chief (CINC), is essential to rapid relevant response. Information superiority is an enabler of decisive operations and campaigns. The complexity of future contingencies and the likelihood of facing adaptive and technologically sophisticated adversaries require joint forces to begin the fight for information superiority long before the crisis or conflict erupts. It is during normal peacetime operations, working with allies and partners, that the foundation for decision superiority is laid.

Meeting the range of twenty-first century demands leads to a complex matrix of needs for enhanced or new capabilities, as depicted in Figure 1. While capabilities need to be robust across all three phases and across the range of contingencies, it is in the early stages of a crisis or conflict that current capabilities fall shortest of need. In developing the notion of a Joint Response Force, we therefore concentrated on building a force able to set the conditions within 24 hours and establish control within 96 hours.

JOINT RESPONSE FORCE CAPABILITIES			
	HOSTILE ENVIRONMENT	PERMISSIVE ENVIRONMENT	HUMANITARIAN
SET THE CONDITIONS 24 HOURS	Joint Command & Control ISR Long Range Precision Attack Special Operations Direct Insertion Force Forward Deployed Forces	Joint Command & Control ISR Missile Defense Sustainment APOD/SPOD Support Ground Combat Units Theater Precision Attack Forward Deployed Forces	Joint Command & Control ISR Airlift Security PSYOP / Civil Affairs Special Operations
ESTABLISH CONTROL 96 HOURS	ADD Missile Defense Ground Combat Units Theater Precision Attack Forward Deployed Forces APOD/SPOD Support		Mobility Construction PSYOP / Civil Affairs Interagency Support Unit Infrastructure Mgt Sustainment
DECISIVE RESOLUTION 30 DAYS	ADD Full Capability Ground Units Expeditionary Land & Sea-based Air Forces Population Control / Coordination Reserve Forces Sustainment		Contractor Support Law Enforcement NGO Interface PSYOP / Civil Affairs Training Maintenance

Figure 1. Joint Response Force Capabilities Matrix

Force Modules

A Joint Response Force must be quickly tailored to meet the CINC's specific mission needs. This requires a set of standing force modules with specified capabilities, response times, readiness standards, and a system of verification that ensures the tailored response force has the expected capabilities.

The capabilities needed to set the conditions and establish control in a hostile (anti-access) environment can be summarized as follows:

- ▶ Standing joint command and control system with a rapidly tailored force that has trained and exercised together.
- ▶ Pervasive networks of intelligence, surveillance, reconnaissance (ISR) and targeting assets (space-, air-, sea-, and land-based) which—when coupled with robust connectivity (horizontal as well as vertical) among all elements of the joint force and reach-back to resources and expertise worldwide—provide shared situational awareness, knowledge, and understanding.
- ▶ Stealthy bombers, stand-off cruise missile carriers, other long-range precision-attack means, and information operations to destroy or render ineffective enemy

missile systems, air defenses, command and control nodes, centers of gravity, and other anti-access capabilities.

- ▶ Special Operations Forces (SOF) that are specially equipped; know the region, its geography, its people, its cultures, and its politics; and are able to infiltrate during a crisis to conduct special reconnaissance and position for direct action.
- ▶ A tailored, rapidly deployable potent ground component that can be inserted directly into the battlespace, that arrives ready to fight, is enriched with its own organic ISR and targeting assets (that contribute to and benefit from the larger situational knowledge picture), can fight in a distributed posture, and can help shape the battle through maneuver, fires, and information operations.
- ▶ A capability to deploy and sustain these forces without robust in-theater infrastructure or vulnerable logistics nodes or lines of communication.
- ▶ A capability to defend against/defeat ballistic and cruise missiles, WMD, mines, and other anti-access measures.

Power of Jointness

The synergy that true jointness brings is the most powerful transformation concept. Jointness mandates more cohesion and continuity to the operational level of war. Jointness is essential to gain the synergy inherent in greater integration and interdependence of Service capabilities. Integration and interdependence go beyond merely deconflicting Service operations or even stitching the seams between them. Integration and interdependence will bring the robust connectivity, shared engagement-quality situational knowledge, and other capabilities described in this paper. These in turn allow the joint force to operate inside the adversary's decision cycle and allow the joint force commander to apply force with greater precision, speed, and simultaneity throughout a multidimensional battlespace.

Defining Military Capability Needs

A focused effort across multiple administrations and Congresses, involving the civilian and military leadership of the Department of Defense (DoD), produced a broad vision, currently embodied in Joint Vision 2020, of what is needed to meet the range of emerging situations and expectations. That vision is intended to refocus goals from the marginal superiority of the Cold War to the dominance demanded across the spectrum of twenty-first century challenges to US and allied national security. The need is to translate that vision into transforming concepts and required capabilities, and then into the transforming systems and structures that provide those capabilities.

The following sections of this paper describe some concepts and systems, focusing primarily on early entry capability. In offering these ideas, it is important to stress that some parts of our defense capabilities are more in need of transformation than others. Capabili-

ties that have remained relevant over time as part of the national defense “tool box” will continue to remain relevant through technological modernization and evolution. Accordingly, the specific system recommendations that follow must be balanced against the evolutionary need for modernization of enduringly relevant force capabilities.

Transformational key operational objectives, enabling capabilities, and specific transformational programs for Joint Response Forces are organized into four desired military capabilities:

- ▶ Achieving Information and Decision Superiority
- ▶ Striking with Precision
- ▶ Deploying and Sustaining Military Power Rapidly
- ▶ Dominating Land, Sea, Air and Space Operations in the Battlespace

Achieving Information and Decision Superiority

The first and most urgent need is for information and processes that enable rapid decisions on the right course of action and the command and control necessary to communicate, coordinate and direct joint forces to implement the chosen course of action. The appropriate standard is **decision superiority**—the ability to make better and faster decisions than any adversary, regardless of the information available to that adversary.

The basic need is appropriate across the range of military operations, even those where the only “adversary” is nature’s ability to produce its own brand of disaster. This set of capabilities must also provide feedback to furnish the decision-maker with the results of the current set of decisions and implementation actions. This allows timely new decisions to produce dynamic responses to the inevitably imperfect initial understanding and changing situation. In this context, **joint command and control** is the process by which direction (commander’s intent) is formulated and disseminated to forces, and the process by which decision-makers assess outcomes and dynamically adjust guidance.

There are critical gaps in enabling decision superiority, though the technology is available to meet those needs. Additional emphasis and investment are needed to provide cohesive joint command and control, robust connectivity, responsive and available ISR and targeting, and fully integrated information operations. To a large extent, command, control, communications, computers, intelligence, surveillance, and reconnaissance systems are individually developed by the Services. Steps toward integration range from attempts at meeting jointly developed standards to occasional use in joint training. These all fall short in creating a trained joint system; at times of rapid deployment, command and control of joint forces is handled as a pick-up team. Needed are:

- ▶ A standing, responsive, deployable **Joint Command and Control System** and capabilities in forward theaters. This system, essential to effective use of ready military forces and realizing synergy among them, needs to be treated as a

weapon system—with defined response and performance standards and regular inspection and testing to verify readiness to meet those standards. The **Joint Command and Control System** needs:

- to exploit reach-back to resources and expertise to a much greater extent than today, enabling forward command centers to be much more agile and effective; and
 - to be supported by **families of interoperable operational pictures and collaborative planning, execution, and assessment tools** (battle management systems).
- ▶ Integrated, robust, networks of communications and information systems—a **combat information system** providing commanders and operating forces rapid access to the information needed for decision superiority. The availability of wideband, robust, high-capacity, pervasive communications is a key enabler of developing joint command and control. Management of its acquisition goes well beyond the capability and responsibility of any individual Service. Key elements of the envisioned **combat information system** are:
- an information management concept;
 - more robust reach-back connectivity including the **Teleport Program**;
 - a **new space-based long-haul communications system** employing both advanced laser and radio frequency (RF) technologies and appropriate modification of **Military Strategic and Tactical Relay System (MILSTAR) follow-on, Advanced Wideband System, and Multi-User Objective System**;
 - **airborne relay nodes on unmanned aerial vehicles (UAVs)** to provide in-theater connectivity to the global grid;
 - an enhanced and accelerated **Joint Tactical Radio System (JTRS)** program to provide a high-capacity tactical data link common among all Services;
 - **databases and decision support tools** to make the needed information available to operational decision-makers ranging from the dismounted platoon leader or single fighter pilot to the Joint Response Force commander; and
 - an expanded **Joint Communications Support Element (JCSE)** to match the growing need for communications support to joint operations.
- ▶ An ISR and targeting capability that contributes to a comprehensive, dynamic depiction of the battlespace, enabling commanders to shape the campaign, maneuver to gain advantage, and engage targets. This requires that ISR and targeting assets be networked, high density, and responsive to the joint force commander as well as the needs of subordinate tactical commanders. Robust

connectivity will allow every node on the network to serve as a sensor (eyeball, laser ranging devices, smart weapons), and thus add to the richness of the shared situational knowledge.

To address the chronic problem of high-demand, low-density assets, space sensors and manned and unmanned air and ground-based sensors are needed to provide all-weather, all-hours, multi-perspective, multi-phenomenology, pervasive surveillance and reconnaissance of the operational space—whether it be battlespace or a non-combat operating area. Sufficient numbers of sensor systems need to be available pre-crisis for training and experimentation and pre-conflict for intelligence and commander's preparation of the battlespace. Assets of the intelligence community and the Service elements need to be considered collectively in terms of requirements generation, development and acquisition, and operations. We need to accelerate fielding of:

- tools for sensor tasking, exploitation, sensor data fusion, target discrimination, tracking, prediction and hand-over to weapon systems;
 - a constellation of **Space-Based Radars (SBRs)** with both high resolution and moving-target-indicator capabilities;
 - a family of tactical and operational UAVs to include the **Global Hawk** family and a stealthy **long-endurance, high-altitude UAV**;
 - substantial sensor upgrades on existing manned surveillance and reconnaissance assets that are deficient both in quality and quantity—**Joint Surveillance Target Attack Radar System (JSTARS)**, the **Airborne Warning and Control System (AWACS)**, and other intelligence collection assets such as **Rivet Joint** and **EP-3**.
 - new sensor capabilities including the capability to provide needed information on activities covered by dense foliage—**foliage-penetrating radar**; and
 - organic assets that are highly responsive to ground units operating in a distributed mode and that also make important contributions to the overall theater-wide picture. Examples include **Aerial Common Sensor (ACS)** to replace Guardrail and Airborne Reconnaissance Low (ARL), the **Prophet Ground Sensor Software Upgrades**, and **robotic aerial and ground reconnaissance**.
- Information operations encompass disparate activities such as computer network operations (defense and attack) and psychological operations (PSYOP) and deception. Elements of information operations need to be fully integrated into military campaigns as a complement to air, land, sea, space, and special operations. Conducting information operations to gain and maintain information superiority needs to become as essential and natural to the joint force commander as the fight for air superiority. Information operations are equally critical during

peacetime activities to shape the environment, develop understanding of our vulnerabilities and those of our potential adversaries, or execute propaganda campaigns. To achieve these capabilities we need to:

- Establish a decision process and supporting command and control system for employing information operations. Roles need to be established for the many stakeholders in this arena so that timely decisions can be reached to meet opportunities and challenges in crises and combat.
- Incorporate information operations into joint doctrine, operational planning, and training. This is a particularly complex subject which, to be successful, requires the interests of operations, intelligence, and command and control components to be integrated and balanced. Such issues as when to employ destruction and jamming versus signals intelligence or computer network attack need to be addressed to achieve effects-based outcomes.
- Broaden the **Joint Warfare Analysis Center (JWAC)** capability to depict adversaries as complex, adaptive systems.
- Establish a center of excellence and institutional base for information warfare (just as DoD has done for armor/anti-armor, anti-submarine warfare, etc.).

Developing and acquiring these decision-superiority capabilities presents a special set of challenges, requiring special attention from the Secretary of Defense and the Chairman of the Joint Chiefs of Staff. Many of the elements of information and decision superiority are inherently joint and interagency, stretching across Service and organizational lines.

- ▶ To achieve a truly joint command and control environment, a CINC should be designated to ensure the forging of a joint force command and control system. The candidate CINCs are US Joint Forces Command (JFCOM) and US Space Command (SPACECOM).
 - Establish a CINC/Defense Advanced Research Projects Agency program to support this prototype effort.
 - Establish a joint program office to field the systems and continue development.
- ▶ Recommendations for global connectivity:
 - Get tough with technical architecture standards and protocols, and embed enforcement of these standards into a disciplined process that includes operational testing of interoperability in a joint environment.
 - Grant an organization (perhaps a new National Communications Office) the resources and authority to plan and direct development of the joint connectivity. Consider both DoD and intelligence community needs.

Striking with Precision

Unlike the nearly universal applicability of capabilities for decision superiority, the nature of capabilities needed to exploit decision superiority varies widely, depending on the nature of the contingency and the phase of operations. Still, there are clearly some transforming capabilities needed to set the conditions for a wide range of contingencies. In conditions requiring a heavy strike at the outset of intervention and in which forward-deployed capabilities are insufficient, the fastest response is provided by long-range aircraft, cruise missiles, and forward land- or sea-based based air. If a less-lethal application of force is appropriate, a mix of air, land and sea combatants must be either forward-deployed or on rapid call. In the latter option, the air-land team must be rapidly deployable, versatile, lethal, and survivable. This very rapid response force provides highly effective force application in conflict situations as well as powerful deterrent and dissuasion effects in situations still short of conflict. Essential to effective use of any force application is freedom from crippling interference by adversary actions. Hence, important enabling capabilities requiring increased emphasis include:

- ▶ Near-instantaneous air superiority followed shortly by air supremacy—freedom from interference by adversary air or missile capabilities. Planned capabilities to deal with air threats meet foreseeable needs, but the pace of the programs is inefficient and costly in terms both of program costs and the need to sustain aging systems that are increasingly difficult and expensive to maintain. The **F-22** provides the capability to meet this need.
- ▶ To protect against ballistic missile attacks and contribute to terminal defense against air and cruise missile attacks, the **PATRIOT Advanced Capability—3 (PAC-3)** should be forward-deployed in adequate numbers. The **Navy Area Defense (NAD)** program should also be available for deployment in the near term. In the mid-term, the **Theater High Altitude Air Defense (THAAD)** system should be available. The combination of these systems provides layered defense against intermediate- and short-range missiles and can provide defense of forces in the field and support and host nation assets. In some situations, it can constitute national defense for the host or allied nations.
- ▶ The **Airborne Laser (ABL)** program promises a mid-term, boost-phase capability against ballistic missiles in key geographic areas. The schedule for this program has been extended to meet both technical and fiscal challenges. The schedule should be restored consistent with technical progress.

Greatly enhanced precision strike is available from a series of possibilities:

- ▶ The contribution of all strike platforms is greatly enhanced by increasing quantities of available precision stand-off weapons to include converting more nuclear Air-Launched Cruise Missiles (ALCMs) to **Conventional Air-Launched Cruise Missiles (CALCMs)** and the development and fielding of the **Joint Air-to-Surface Strike Missile (JASSM)**.

- ▶ Given the need to leverage deployed capabilities and minimize collateral damage, precision-attack capabilities are likely to be the preferred option in many situations. The means to achieve precision in ground-, sea-, and air-launched weapons is well in hand. What is needed is to assure that essential enablers are robust and dependable, particularly the **Global Positioning System (GPS)**. Hence, fielding **GPS III** and enhancing anti-jamming capabilities in the GPS-to-weapon interface should be a high-priority issue.
- ▶ Converting the four fleet ballistic missile submarines (SSBNs) excess to Strategic Arms Reduction Treaty (START II) limits into missile-carrying **guided missile submarines (SSGNs)** that carry conventional land attack missiles to provide a potent and stealthy capability that can be moved to the needed proximity on earliest warning.
- ▶ Faster production of the **F-22** will provide improved early strike capability. An earliest practical fielding of the **Joint Strike Fighter (JSF)**, even if not fully developed to its design capability, will give the Navy a forward-based stealthy fighter. It will also replace aging F/A-18, AV-8, and F-16 aircraft with greatly increased capabilities that can be further enhanced through a continuing program of preplanned product improvement.
- ▶ **B-2 enhancements** can provide greatly improved all-weather strike capability. As with the F-22 and JSF, the target attack potential can be multiplied several times over, with the **Small Diameter Bomb** raising the target attack potential from 16 aim points per mission to hundreds. However, effectively using such capability will require **Mission Planning Systems** and a responsive command and control system that far exceeds anything currently planned. The need for such capabilities has been recognized for more than a decade, but efforts to meet the need fall far short.
- ▶ Start concept development for the **follow-on long-range attack** capability.
- ▶ To provide more responsive stand-off attack against critical, movable targets, development should begin on a **Supersonic Strike Missile**.
- ▶ Operationalize the capability of precision weapons against moving targets.

While long-range and tactical air play an important role in setting the conditions in a wide variety of conflict and potential conflict situations, ground forces are essential to setting the conditions in many situations and to establishing control in most. The need is for ground forces with the responsiveness and agility of light forces and the potency of heavy armored forces. The vision for creating agile, potent ground forces is found in the Army's **Future Combat System (FCS)**. Interim Brigade Combat Teams (IBCTs) are being developed to provide an agile lethal force capable of deploying directly to the battle area in 96 hours. The Marine Corps' parallel development is its concept for Operational Maneuver from the Sea.

There is a need to accelerate the process of converting the Army's FCS from a vision into fielded capabilities, and to get on with those force modernizations in the Marine Corps that will move its capabilities into the twenty-first century. Hence, we recommend strong support for the Army's planned IBCTs while moving rapidly to transforming other Army units into a strategically mobile, agile, and potent decisive land force through development of the FCS. Similarly, ground and air mobility for Marine forces must move quickly to more modern and lethal, longer-range systems.

- ▶ Responsive firepower that lessens the need to close with adversary forces in order to produce decisive resolution should include the **Army Tactical Missile System (ATACMS) Block II**.
- ▶ The effectiveness of agile forces against heavy armor opponents is greatly enhanced by the anti-armor firepower of the **Javelin anti-tank system** and robotic fire support systems.

As our precision weapons capability grows, precision targeting proficiency will become an especially critical transformation capability. There is little value in wielding a scalpel if we don't know what, where, and when to cut. Precision targeting should become a primary focus for operationalizing the emerging thinking about effects-based operations as a disciplined approach at the operational-level of war to link tactical actions much more explicitly to strategic ends in a campaign. Key enablers include:

- ▶ A greatly expanded effort to characterize adversaries as complex adaptive systems. This requires more attention to JWAC-like efforts to analyze an adversary's capabilities. This effort would make use of intelligence and open sources, red teaming, and multi-disciplinary teams of experts. Robust reach-back from the joint force commander to these efforts is needed during a campaign as we learn what we had wrong and the enemy learns to adapt to what we had right.
- ▶ Pervasive networks of ISR and targeting assets responsive to the joint force commander and the means to dynamically task these assets in real time. The planning and execution of sensor operations to support effects-based operations and precision targeting will become an increasingly important operational function.
- ▶ The tools and informed judgments to gauge the effects of multi-dimensional actions, such as kinetic strikes and information operations. This systemic effects-based operations approach to battle damage assessment (not merely damage to individual targets) requires in-depth understanding of the joint force commander's campaign intent.

Deploying and Sustaining Military Power Rapidly

Because air and ground forces in combination are needed for many missions, including early entry, it is necessary to make ground forces more strategically mobile, less dependant on re-

ception infrastructure and large forward support complements, and more interdependent with external sources of fire support. It is also necessary to make air forces less dependant on large support deployments to forward airfields, and to provide sufficient strategic air and sea mobility to enable synergistic, near-simultaneous employment of air, land, and sea forces.

An appropriate goal for strategic mobility is to insert forces within 96 hours that are ready to fight and that are far more agile and more potent than either the Army's current brigades or its planned IBCTs.

- ▶ The most obvious near-term contribution to earliest deployment to staging areas is to continue procurement of the **C-17**.
- ▶ Air and sea ports are highly vulnerable until friendly control is established. Hence, direct insertion into the battlespace of agile, potent forces from secure areas, ashore or at sea, is essential in many situations to set the conditions and establish control. This requires combinations of **short takeoff and landing (STOL) aircraft** with capacities somewhat greater than the C-130. These STOL aircraft need to operate from hastily prepared surfaces. **Shallow-draft, high-speed ships** capable of carrying combat-ready ground forces and supporting STOL flight operations would provide an ideal mix of capabilities, allowing the direct insertion of ground forces into the battlespace without passing through vulnerable fixed facilities.
- ▶ **Fast lighterage** is important to rapidly move larger ground forces from strategic sealift to the battlespace or potential battlespace. There are several prototype concepts now afloat. Funding and direction are needed to move forward.

Once technical challenges are in hand, the **V-22 tilt-rotor aircraft** will provide dramatic changes in crisis response, force projection, and battlefield maneuver for Marines and SOF elements at twice the speed and four times the range of any current or foreseeable helicopter. The aircraft will replace the Marine Corps' critically aged helicopter fleet, as well as ten other type/model/series aircraft in the Air Force and Navy.

The air-refueling fleet will continue to be vital to support the range of operational demands. The current fleet is aged and becoming increasingly unreliable and inadequate. There is an opportunity for a **commercially derived tanker** replacement.

Dominating Land, Sea, Air, and Space Battlespace

Once battle is joined, there are a number of operating systems at work in the joint operations area, each of which must be effectively integrated into a "system of systems" to ensure the dominance that flows from synchronization. A number of individual improvements are needed in each area, some of which are key to transforming individual capabilities, but the totality of these changes has the real prospect of transforming the basic character of how we fight in terms of pace, breadth and depth of action, precision of action, and economies of sustainment.

- ▶ **Command and control.** The networked battlefield will generate substantially compressed planning and decision cycles, will allow unprecedented continuity of command regardless of conditions, and will, in effect, generate an “infosphere” in which secure and timely information flow will create conditions for dominant application of strike, maneuver, fires, and protection measures.
 - Ground elements will need **Future Battle Command Brigade and Below (FBCB2)**, **Warfighter Information Network—Tactical (WIN-T)** and **Global Command and Control System (GCCS)** to ensure their part of the joint command net.
 - The naval force will continue **Joint Command and Control Experimental (JCCX)** exploration.
 - The aerospace element will both ensure command of air operations and provide air- and space-based enabling capabilities through the development of such systems as **SBR**, **stealthy UAVs**, and **Military Satellite Communications (MILSATCOM)**.

Achieving joint interdependence is a key goal in this area—**JTRS**, **Cooperative Engagement Capability (CEC)**, **GPS III**, and sustained **joint experimentation** will all be crucial to attaining effective joint battlefield command and control.

- ▶ **Maneuver and mobility.** Speed and agility will be the dominant outcome of mating agile information networks with space, air, land, sea and undersea warfighting equipment. Mismatches in the inherent characteristics of either would suboptimize the potential of each, and eradicate the leap-ahead potential of their pairing.
 - To satisfy the ground capability requirement, the Army is developing a totally new warfighting capability that will be as deployable as today’s light forces and more lethal than today’s heavy forces. **The Future Combat System** is being developed as the centerpiece of this force. The FCS will be clusters of command and control, ISR and targeting, attack, and protection capabilities emphasizing robotics and longer-range strike capabilities. It will ultimately replace today’s heavier systems and operate with 50-percent reduction in logistics. The **Comanche** helicopter is crucial “seed corn” for this force (technology carrier) and will be its rotary-wing “quarterback.” As this capability is developed, the Army is concurrently building a number of **IBCTs** centered on wheeled, armored vehicles. Each will be a versatile, lethal, sustainable force capable of worldwide deployment by air in 96 hours and ready to fight in close, complex, or urban terrain.
 - Amphibious operations will require the unique sea-to-land agility of the **V-22** and the **Advanced Amphibious Assault Vehicle (AAAV)**. Naval forces will be a key player in the anti-access measures necessary to ensure

initial maneuver through **mine countermeasures** and with supporting fires.

- The **Common Aerospace Vehicle (CAV)** will “overwatch” air, ground, and sea maneuver, and enhance space operations.
- These transformations in both land and amphibious capabilities will assure the following significant improvements:

We will achieve the ability to project joint forces directly to centers of gravity with minimal intermediate staging or support buildup.

We will be able to apply forces simultaneously throughout the joint operations area, and to recast or reorient forces in the midst of battle.

We will be able to overcome or avoid any anti-access measures and to protect the force from launch to conclusion.

We will be able to operate either independently or as a part of a coalition.

The result of the transformation will be greater force agility in the near term and dramatically increased strategic relevance and decisive warfighting capability in the more distant future.

- ▶ **Intelligence.** Dominance in the battlespace will require a consistent, timely, accurate, and secure situational picture and targeting support, seen and understood in near real time by all friendly elements. The most challenging part is delivering continuous precision location of the enemy. The range of possible future protagonists and their motivations will drive us away from templating and other threat-based techniques toward the creation of a family of collectors (human, signal, imagery, etc.) that ensure an ongoing baseline from which change can be readily discerned and quickly assessed. This will require revolutionary change in areas such as affordable space-based collectors, sensor management tools, advanced interactive displays, standardized data and management protocols, and advanced distribution systems with no single-point failure. The information gleaned from this family of collectors must be processed as rapidly as necessary to make it quickly available and useful to tactical commanders. As the pace of operations increases, timely intelligence has the potential, on one hand, to be made easier by advances in collection technologies—but, on the other hand, to be made less effective through the difficulties experienced in using the information. Intelligence must be less and less the domain of the “intelligence family,” and more and more a direct tool of the commander. Appendix F provides a comprehensive listing of intelligence observations related to transformation.
- ▶ **Fires and Precision Engagement.** Rapid advances in precision technologies have added precision engagement to the traditional roles of air, land and sea fires as enablers of ground maneuver. An integrated system of systems is needed to

assure destruction of time-critical targets at greatly increased ranges in all weather conditions. A robust air, land, sea system of systems will, in addition to precision engagement, be capable of direct ground force support if that is the nature of the fight.

- There is a need for air strike forces capable of creating precise effects rapidly with the ability to retarget quickly against large target sets anywhere, anytime, for as long as required. **F-22, Small Diameter Bombs,** and **advanced stand-off munitions** are all crucial capabilities in setting the conditions for successive operations.
- The **High-Mobility Artillery Rocket System (HIMARS)** and **ATACMS Block II** are ground-based systems with sufficient range and volume to lessen or delay the need to close with adversary forces. The **Crusader** indirect fire system is a crucial technology carrier for development of the **FCS**. From the **Crusader** program will come the robotics, digital ports, sensor-to-shooter linkages, integrated mission planning, and embedded training devices of the transformed ground force.
- **Tactical Tomahawk** and **Advanced Land Attack Missile (ALAM)** provide sea-based long-range missile capabilities and the retargeting flexibility to strike relocatable targets.
- As the battle is joined in the four- to two-kilometer “red zone,” the C-130 deliverable **Line-of-Sight Anti-Tank (LOSAT)** can acquire and track two targets simultaneously. Within the two-kilometer battlefield, the **Javelin** gives the individual soldier or Marine a shoulder-fired, top- or direct-attack, fire-and-forget, anti-tank weapon that can be fired from enclosures—a truly transforming individual weapon.

This suite of advanced fires and precision engagement capabilities enabled by effective information networks will extend the ranges from which effective fires can be brought to bear and will increase the density of fires available to support ground forces and assure precision against a wider range of fleeting targets.

- ▶ **Logistics.** Future logistical effectiveness will require a transformation in the information networks underlying the accountability and application of goods and services. Moreover, the cultural and doctrinal logistics patterns must also be transformed. The goal must be a system that transcends responsiveness and approaches anticipatory capability. To reach this goal, operations and logistics must merge into a near-seamless process—the logistician cannot simply wait to respond to a stated battlefield request but must be capable of arriving at the point of need with the capability required precisely when it is needed.
- The basis for such a condition is a merged worldwide operations and logistics database accessible by authorized users from a single terminal. This database must offer near-real-time visibility of cargo, transportation assets, and services.

- Another element requiring transformation is the capacity and speed of the strategic lift fleet. More and enhanced **C-17** airlift is clearly the near- and mid-term fix to a long-standing deficit but **shallow-draft high-speed sealift** and **ultra-heavy airlifters** will be the future of strategic lift. The **V-22, STOL airlift**, enhanced **materiel handling equipment**, and a family of new **Joint Logistics Over-the-Shore (JLOTS)** capabilities will begin to underwrite the agility and flexibility needed to optimize reach-back and rapid throughput on the battlefield without the need for intermediate or in-theater staging and extensive reception infrastructure.
- ▶ **Protection.** The space, air, land, sea, and undersea battle force of the future requires a vested family of protective capabilities to shield it from home station into the theater and throughout all operations. The protection measures must counter enemy air and missile threats and an array of conventional and unconventional sea and ground threats, and must be a credible deterrent to WMD attack or coercion. In all these areas, the protective systems must seek a predictive or anticipatory ability; we can no longer lean on reactive response for protection. A consistent, complete, secure, and timely operating picture of all entities in the joint operations area is the essential underpinning for adequate sensing, reduced sensor-to-shooter times, and effective application of protection in a fleeting target environment. A family of theater-level systems will use the common operating picture to defend against aircraft and missile attacks. Each offers significant improvements in deployability, range, target coverage, and protection assurance.
 - **Tactical High-Energy Laser (THEL)** uses directed energy to defeat targets outside the capability of other systems and also opens the technological path into the tactical and operational use of lasers.
 - At the tactical level, **SENTINEL radar** offers 360-degree, all-weather digital air pictures at twice the current range.
 - **HUMRAAM/CLAWS** (Advanced Medium-Range Air-to-Air Missiles mounted on a “Hummer” vehicle, which the Marine Corps calls the Complementary Low-Altitude Weapon System) is the C-130 deployable air protector for all future ground forces.

In addition to the air defense systems described above, a transformation in protective theory of ground forces and platforms is underway and must be accelerated. Whenever possible, battlefield agility—empowered by information, physical litness, and dispersion—is being pursued as a key contributor to protection rather than historic and current focus on physical protection (armor, discrete protective formations, reserves, etc.). As in other battlefield systems, this will require significant cultural change both internal to the force and in industry.

Transformational Research and Development

Force transformation is a dynamic condition rather than an end state—a journey, not a destination. In a world where technological change is unrelenting, it is not just necessary but imperative to constantly reach for the new enablers needed to maintain the technological advantage that has always been our greatest asymmetric strength. Much of militarily relevant technology now comes from the commercial sector, which puts out its products to the global marketplace. Nevertheless, the culture resulting from several decades of being the sole customer is deeply rooted in DoD acquisition, and the Department often still conducts its affairs as if it were a monopsony.

Thus, DoD must transform its research, development, and acquisition processes. It must learn how to better engage the information and biotechnology sectors, understand and exploit technology opportunities, adapt to product cycles of months to a few years rather than decades, and understand the ways adversaries might use these same technologies. To maintain the edge and remain on the path toward transformation, major DoD research and development thrusts should include the following:

- ▶ **Information and decision superiority.** Our ability to gain and maintain the initiative is dependent on our ability to get accurate and timely information about all aspects of the battlespace, analyze it, and disseminate militarily exploitable information to the commanders of space, air, land, sea, and undersea forces while denying adversaries access to that information. DoD will depend on commercially developed information technology.

However, there are unique requirements such as collaborative software and components that will survive in hostile environments, and high-end computing. For example, not only must we make GPS more robust and resistant to jamming, we must also develop capabilities to deny our adversaries its use.

Our current sensor suites are advanced, but they limit us to use of a single band in the infrared spectrum. We need to pursue development of ultra-large focal plane arrays that would allow a single sensor to work in multiple spectra (i.e., visible, mid-wave infra-red; long-wave infra-red; ultra-violet).

Laser-based communication links will allow us new degrees of freedom beyond digital broadband fiber-optic infrastructure, enabling all-weather, all-locations communications and providing needed redundancy and connectivity with the fiber-optic communications nodes. Information and decision superiority will be achieved through our ability to develop effective decision support tools.

- ▶ **Information warfare.** A focus on both offensive and defensive information warfare capabilities calls for additional infrastructure. A complex of laboratories and research and development facilities connected through secure means to the information warfare offense and defense nodes is also necessary.

- ▶ **Directed energy.** We must continue to pursue advances in high-energy beam propagation and control and push the maturation of solid-state devices.
- ▶ **Stealth and counter stealth.** It is necessary to maintain sustained investment in stealth technology for next-generation bombers, fighters, and other weapons to include unmanned systems. We must also continue technology development that would allow us to maintain the advantage by countering the stealth technology of our adversaries.
- ▶ **Robotics.** Focus needs to be on the integration of unmanned systems into future forces. Robotic systems based on current technology lack a robust perceptual capability to detect and adapt to nuances in the environment. This limitation dictates a greater need for human-in-the-loop today than is envisioned for the future. The way forward calls for dedicated experimentation tied closely to doctrine development. Phased requirements will allow us to get a useable capability to the field in the near term with a commitment to conduct spiral development for air, land, sea, and undersea capabilities in the future as the technology matures.
- ▶ **Non-lethal capabilities.** More and more robust options are needed for dissuasion, influence, and control. There is a need to expand means to conduct experimentation in this area.
- ▶ **Chemical and biological warfare.** There is need for a sustained program to develop reliable means to detect and characterize chemical and biological agents so that active and passive protective measures can be developed to counter them. We must leverage dual-use technology from the commercial biotechnology industry.
- ▶ **Power Supplies.** There is a growing need for high-energy-density power sources to supply power for military operations in remote areas. This is an area where dual-use technology holds promise (e.g., fuel cells, micro fuel cells, and microturbines).
- ▶ **Modeling and simulation.** A new generation of models and simulations will be needed to support distributed training; robust and continuous experimentation; and operational planning, execution, and assessment tools.

Transforming to a Joint Force of the Future

The future joint force will take special attention from the Secretary of Defense and the Chairman of the Joint Chiefs of Staff, not only to get the necessary resources but also to create an environment conducive to transforming. To transform our military capabilities we need to transform the way we prepare forces, including the requirements, acquisition, infrastructure, training, and personnel (including leader development) processes. The Secretary and Chairman will need to provide oversight for the joint integration that brings force components together to achieve full synergy. This includes standing, ready, exercised and tested

joint command and control, and joint theater air and missile defense systems. Transformation will require aggressive experimentation to identify the risks and work out solutions.

To provide the means for focusing top-level attention on transformation, we recommend the following:

- ▶ **Establish a means for independent input and assessment of the Department's transformation vision.**
- ▶ **Set up a standing "red team"** to aggressively challenge transforming concepts and to help provide adaptive adversary inputs to experiments.
- ▶ **Establish a process that links results of joint experiments more directly to the decision and budgeting process.** One means to do so would be a Secretary of Defense Transformation Discretionary Fund of about \$500 million, allowing the flexibility to quickly fund transformation initiatives of extraordinary potential.
- ▶ **Establish a periodic review process whereby the Secretary has an opportunity to assess and refine overall transformation goals and initiatives in light of evolving circumstances.** This review should become a major input to the Planning, Programming, and Budgeting System.
- ▶ **Mature JFCOM as an integral part of stimulating and developing future transformation visions and initiatives.** JFCOM's mission and responsibilities should focus on concept development, experimentation, and training activities in direct support of the overall DoD transformation vision resulting from the Secretary's periodic transformation review process. JFCOM needs resources, focus, and clear guidance from the Secretary of Defense about its role in transformation. We recommend the following:
 - Divest CINCFJCOM of his Supreme Allied Commander, Atlantic, and geographical responsibilities.
 - Establish a national joint experimentation capability (including a distributed human-in-the-loop synthetic environment) to support continuous experimentation promoting innovation and "skunk works" type spiral development.
 - Establish an experimental joint task force headquarters at JFCOM to be the focus for experimentation on the Joint Response Force concept
 - Establish closer relationships between JFCOM and technologists by creating a "skunk works" venue for the integration of emerging technology into joint experimentation.
 - Tie JFCOM's concept development and experimentation much more closely to the Services' centers for change.

- ▶ The Secretary should establish an educational initiative to engrain transformational thought processes throughout the professional military and civilian career development paths.

Overarching Study Conclusions

- ▶ The synergy that true jointness brings is the most powerful transformation concept.
- ▶ Joint command and control is the most enabling transformation program.
- ▶ Focus transformation on new capabilities for Joint Response Forces.
- ▶ Initiate new programs identified as essential in transformation.
- ▶ Review and accept acceleration of black programs identified.
- ▶ Missile defense, space dominance, information dominance, and intelligence are also essential transformation areas.
- ▶ Institutionalize the transformation process in DoD.

Appendix A. Transformation Study Group Membership

General Jim McCarthy, USAF (Ret.)
Chairman

Admiral Stan Arthur, USN (Ret.)	Dr. Paul Kaminski
Mr. Vic DeMarines	General Carl Mundy, USMC (Ret.)
Dr. Ted Gold	Admiral Bill Studeman, USN (Ret.)
Dr. Bill Graham	General Larry Welch, USAF (Ret.)
General Bill Hartzog, USA (Ret.)	

Appendix B. Strategic Nuclear Forces

US strategic force posture will remain our country's highest and most sensitive security requirement, but new thinking needs to go into definitions of US nuclear strategy, policy, doctrine, organization, the forces themselves, and the weapons technology and mix that constitute our future capabilities. As we move to a smaller inventory of weapons, the nature and character of these weapons; their delivery context; and the support, surety and control setting into which these capabilities are cast need adaptation and further evolution.

This strategic area was not the major focus of this task force, but the Transformation Study Group recognizes that strategic capability underlies our effective conventional capabilities and that some generalized considerations can be advanced.

In general, a smaller weapons mix will require new doctrinal considerations as to how concepts such as deterrence, dissuasion, and response should be characterized. This needs to be underpinned with secure command and control organizations and processes; a deliberate planning process; revalidation of safety, surety, and security issues; and new looks at technologies and the specific mix of weapons to be retained in the inventory, including careful consideration of new weapon activities. A specific review of the vulnerabilities inherent in our future nuclear capability is required.

It is important that future scenarios relating to how nuclear and nuclear-like weapons might be applied by both the United States and our adversaries be wargamed and simulated. These reviews should take into account a future environment (1) where the United States has multiple large and small adversaries and (2) where considerations of stability and secondary effects of nuclear exchange potentials need to be analyzed. To prevent a not-invented-here perspective from a policy point of view, the United States should carefully review and analyze the nuclear strategies and policies of other countries, including potential adversaries, that have smaller inventories of weapons. This analysis should also address how US nuclear capabilities might be relevant to preventing nuclear conflict between two nations where the United States is not a direct combatant, but where the use of nuclear weapons by others on others has broad implications for the United States and its allies.

Finally, the Transformation Study Group supports the continued maintenance of a US nuclear triad for the foreseeable future, and also emphasizes the ability of the US nuclear force to conduct rapid assured retargeting and to maintain full functional flexibility in the context of the overall strategy.

Appendix C. Missile Defense

Ballistic Missile Defense

Ballistic missile defenses cover the spectrum of needs from defending forces in the battlespace to protecting homelands—US and allies—worldwide. At least three classes of missile defense capabilities are needed to deal with threats of varying ranges, varying trajectories, varying basing modes, and varying countermeasures. There are advantages and disadvantages to each of the three.

- ▶ **Mid-course systems** provide wide coverage from a minimum number of sites against intermediate-to-long-range threats. These systems can be configured to defend both the United States and its allies. The disadvantage is vulnerability to sophisticated countermeasures that include fractionated payloads (early release submunitions). The existing mid-course program is the product of extensive development work and provides the nearest term capability for defense of large areas.
- ▶ **Terminal systems** (currently under development against only shorter-range ballistic missiles) are useful to defend limited areas, and are also highly resistant to certain kinds of countermeasures. But large numbers of systems are required to cover substantial areas or to deal with even medium-size raids. At least two of the ongoing terminal systems are sufficiently mature to have high confidence in their effectiveness and could be fielded in significant numbers in the near to mid-term.
- ▶ **Boost phase intercept** has the advantage of global protection against the covered launch area. Boost phase also deals with a wide range of countermeasures. However, there are formidable technical and geo-political challenges to fielding boost phase systems; the only program currently underway is the ABL system.

Cruise Missile Defense

Recent intelligence estimates have helped focus increased attention on the cruise missile threat and the availability of technologies and systems to a wide range of potential adversaries. Air defense systems—aircraft and missiles—have some capability against cruise missiles, and there are a number of important technological developments underway to enhance capabilities. Still, there is not yet a defined, comprehensive program to deal with this threat. Classification constraints have hampered the sharing of technologies and should be removed or opened up to a broader audience. (See Appendix G.)

Battle Management

Robust command and control capabilities exist within missile and air defense programs. It should be a matter of priority to ensure that they have a seamless interface into the common operating picture.

Appendix D. Space Dominance

Space capabilities developed by the United States during the Cold War were a national resource of fundamental strategic importance. Our superiority in space is no less valuable in today's security environment. Our everyday life and military capability depend on space assets. Space capabilities are inherently global, unaffected by territorial boundaries or jurisdictional limitations; they provide direct access to all regions and, with our advanced technologies, give us a highly asymmetrical advantage over any potential adversary.

But our space superiority is not guaranteed. Space systems are potentially vulnerable to attack in a number of ways. Overhead systems themselves can be attacked from the ground or by other systems in space. The ground stations that control our satellites and receive their data are vulnerable, and so are the communications links that connect them to overhead systems. Therefore, we recommend the following:

- ▶ To assure our continued space superiority, accelerate the use of space for our national interests—military, commercial, and scientific—and be prepared to protect US assets from all hostile uses of space.
- ▶ To make US access to space more robust and to assure its uninterrupted availability in view of the termination of production of the current generation of space boosters, provide adequate support to the Evolved Expendable Launch Vehicle (EELV) program.
- ▶ To enable the United States to project power through space to any region in hours, accelerate research and development to develop the Space Maneuver Vehicle (SMV) as a sortie platform and the Common Aerospace Vehicle (CAV) as its primary payload.
- ▶ To establish and maintain a robust commercial space sector, make commercial space capabilities the preferred choice for DoD and intelligence community peacetime requirements (communications, imaging, and sensing).
- ▶ To ensure US dominance on the space battlefield, establish a high-performance micro-satellite program for both offensive and defensive missions.
- ▶ To ensure continuing US information dominance in conventional military operations, integrate present and future space systems (including moving-target-indicating radar and spectral imaging) into a global ISR capability and improve the integration of airborne and space-based reconnaissance and surveillance.
- ▶ Finally, address the recommendations of the US Space Commission, including the development of military and civilian cadres in space-related activities and implementation of organizational change.

Appendix E. Information Dominance

Information superiority is currently an important asymmetric advantage for the United States and its allies. Decision superiority enabled by information is central to most of our twenty-first century military concepts. This brings both a growing set of opportunities and a potential vulnerability: our adversaries are also focused on the importance of information warfare in the Information Age. The solution is a comprehensive program of offensive and defensive information warfare, supported by strong intelligence exploitation capabilities. This area of operations is greatly complicated by a number of factors:

- ▶ the pre-eminence of the civil sector in information systems (particularly in developing defensive technologies),
- ▶ the wide set of equities involved (interagency, industry, financial community, infrastructure systems),
- ▶ the international interdependence of information technologies, and
- ▶ the pace of technological advance, to name but a few.

Information operations is a broad emergent warfare area that involves a number of topics related to computer network (cyber) operations (both attack and defend), hard kill, and exploitation activities—all placed within the context of affecting the adversary's perception about the degree to which he can control his own warfighting information and knowledge environment, and negatively affect ours. A strong relationship must exist between US intelligence and information operations disciplines in order to prevail in information warfare.

Elements of information operations need to be fully integrated into military campaigns as a complement to air, land, sea, space and special operations. Information operations need to become as essential and natural to the joint force commander as the fight for air superiority. While it is essential to fully integrate information operations into warfighting, it is also important in the pre-engagement or peacetime activity to “shape the environment” (including the conduct of covert operations); understand vulnerabilities; conduct targeting; or execute PSYOP, electronic warfare, and propaganda campaigns. Four transformational activities are needed:

- ▶ **Defining a decision process.** There are many stakeholders in the US Government and industry (including the National Security Council, the Departments of State and Justice, various DoD elements, and the critical infrastructure protection community). Roles need to be established so that decisions can be reached quickly to support the pace and nature of actual information operations in warfare. Some decisions have broad national implications and therefore need broad discussion but many others can be pre-judged and appropriate authorities can be delegated to the joint force commander. The supporting command and control

system enabling collaborative interactions among the stakeholders should be reviewed for adequacy.

- ▶ **Training and doctrine.** Within DoD, doctrine for information operations should continually evolve and be incorporated into operational planning, leader development, legal analysis, and training. This is a particularly complex subject, requiring that the interests of operations, intelligence and command and control components be integrated and balanced. Such issues as employing information operations in conjunction with signal intelligence and the associated coordination issues need to be addressed to achieve effects-based outcomes. This leads to the need for improved efforts to model adversaries as complex adaptive target systems. Classification issues will need to be resolved since many of the information operations tools are necessarily protected because they are fragile (disclosure could allow an adversary to create relatively simple countermeasures).
- ▶ **Development of tools.** Techniques for electronic attack by jamming are well developed by the electronic warfare community. However, computer network attack is accomplished by various organizations in DoD and the broader intelligence community. The needs of the operational commander are somewhat different from those of the intelligence community, and the two need to be harmonized. SPACECOM and Joint Task Force–Computer Network Operations need to accelerate the implementation of a comprehensive approach for leadership and management of DoD information warfare activities. Coordination among intelligence community organizations for warfare support should be a responsibility of the National Security Agency. There are also issues related to DoD-industry relationships that need to be improved.
- ▶ **Defense.** Network-centric warfare offers dramatic advantages but carries the risk of a major loss of capability if our networks are disrupted or penetrated. The more DoD relies upon commercial off-the-shelf based computer networks to provide command and control and ISR functions to warfighters, and the more military concepts exploit the advantages of having good, shared information, the more important it becomes to defend these computer networks. While information assurance is a problem being addressed in the commercial sector, DoD cannot depend on industry alone and must invest in protection. For example, improvements in tools to detect enemy activity are needed, and a form of integrated attack and warning system needs to be established. Defense-in-depth needs to be established so that adequate backups are provided once a system is determined to be unreliable. This situation will be improved with the consolidation of the very many systems currently in use into fewer but more robust systems. Specific transformation and capability recommendations for information operations are contained in classified Annex F.

Appendix F. Intelligence

The twenty-first century environment creates increasingly complex intelligence demands, beginning with the need for deeper understanding of the capabilities and likely intentions of a wider range of potential adversaries. High expectations for rapid and decisive military (and political) success across the spectrum of situations multiply the expectations and needs from the range of intelligence disciplines—human intelligence, imagery intelligence, signals intelligence, technical intelligence, etc. The demand is for faster, more precise information for political decisions and military operations in a wider range of situations in a wider range of places. Meeting that demand is likely to require changes in organization, authorities, technologies, human resources, and management and leadership focus.

For a Joint Response Force to succeed on distant battlefields in the face of asymmetric threats possessing potential surprise anti-access features, it requires premier ISR capabilities. Collection, target access and sensing capabilities must be linked to a responsive tasking, processing, exploitation, and dissemination system that provides complete, accurate, relevant, and timely intelligence to decision-makers at all levels. Simultaneously, intelligence must strongly support the conduct of information warfare defense and attack (both kinetic and non-kinetic) operations.

To adequately respond to these demanding warfighting requirements, US intelligence must be transformed, focusing on three major thrust areas.

- ▶ First, on a steady state and surge basis, intelligence must be able to gain better access to the adversary’s deepest “secrets” in order to prevent surprise and to support crisis and conflict planning and operations. Our national capabilities in particular must be dramatically transformed in order to improve our capabilities against more highly developed, hard-to-penetrate, hard-to-track, modern threats—whether posed by a nation-state or terrorist organization.
- ▶ Second, the ability to see on, over, into, and under the modern battlefield with arrays and cooperative apertures of complex multi-sensing means must be incorporated into a transformed ISR and targeting architecture to provide responsive dwell, synoptic coverage, and search capabilities. These upgraded ISR and targeting means can also support electronic and information warfare. Improved ISR and targeting capabilities require that the US intelligence community focus on its ability to effectively manage the “river” of information and intelligence to truly support high intensity “knowledge-based” decision-making.
- ▶ Finally, there are many issues associated with maintaining defense against information warfare threats and ensuring the security of our information and intelligence means from unauthorized access and timely exploitation by adversaries.

Specific intelligence, counter-intelligence and security recommendations are contained in classified Annex F. They focus on improvements in the three main thrust areas where transformation is required, as well as providing some recommendations in related areas where streamlining of intelligence community organization and processes is warranted.

Investment in improved intelligence and overall ISR and targeting capabilities, and the “back end” that quickly manages and accurately packages and delivers this information to key decision nodes, is critical to future battlefields where power and success are defined, expressed and measured in terms of directing “smart” force capabilities to the points of maximum leverage and effectiveness against the modern enemy.

Appendix G. Special Access Programs

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Appendix H. Glossary of Acronyms and Abbreviations

AAAV – Advanced Amphibious Assault Vehicle	JCSE – Joint Communications Support Element
ABL – Airborne Laser	JFCOM – US Joint Forces Command
ACS – Aerial Common Sensor	JLOTS – Joint Logistics Over-the-Shore
ALAM – Advanced Land Attack Missile	JSF – Joint Strike Fighter
APOD/SPOD – Aerial/Sea Port of Debarkation	JSTARS – Joint Surveillance Target Attack Radar System
ARL – Airborne Reconnaissance Low	JTRS – Joint Tactical Radio System
ATACMS – Army Tactical Missile System	JWAC – Joint Warfare Analysis Center
AWACS – Airborne Warning and Control System	LOSAT – Line-of-Sight Anti-Tank
CALCM – Conventional Air-Launched Cruise Missile	MILSATCOM – military satellite communications
CAV – Common Aerospace Vehicle	MILSTAR – Military Strategic and Tactical Relay System
CEC – Cooperative Engagement Capability	NAD – Navy Area Defense
CINC – commander in chief	NGO – non-governmental organization
CINCJFCOM – Commander in Chief, US Joint Forces Command	PAC-3 – PATRIOT Advanced Capability-3
DoD – Department of Defense	PSYOP – psychological operations
EELV – Evolved Expendable Launch Vehicle	RF – radio frequency
FBCB2 – Future Battle Command Brigade-and-Below	SBR – space-based radar
FCS – Future Combat System	SMV – Space Maneuver Vehicle
GCCS – Global Command and Control System	SOF – special operations forces
GPS – Global Positioning System	SPACECOM – US Space Command
HIMARS – High Mobility Artillery Rocket System	SSBN – fleet ballistic missile submarine
HUMRAAM – a system consisting of Advanced Medium Range Air-to-Air Missiles (AMRAAMs) mounted on a High-Mobility Multi-Purpose Wheeled Vehicle (“Hummer”), called Complementary Low Altitude Weapon System by the Marine Corps	SSGN – guided missile submarine
IBCT – Interim Brigade Combat Team	START – Strategic Arms Reduction Treaty
ISR – intelligence, surveillance, reconnaissance	STOL – short takeoff and landing
JASSM – Joint Air-to-Surface Strike Missile	THAAD – Theater High Altitude Air Defense
JCCX – Joint Command and Control Experimental	THEL – Tactical High-Energy Laser
	UAV – unmanned aerial vehicle
	WIN-T – Warfighter Information Network-Tactical
	WMD – weapons of mass destruction