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INTEGRATING THE SERVICES' IMAGERY ARCHITECTURES

BY

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ABSTRACT

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The CIO's vision of "the right imagery to the right people in the right format at the right time" would serve well as the objective of a joint, integrated architecture. A joint imagery strategy should be initially shaped by the four pillars of the National Military Strategy of the United States: strategic deterrence; forward presence; crisis response; and reconstitution. In a macro view, it must consist of a series of sub-strategies to include science and technology and research and development, maintenance of the imagery related industrial base, acquisition, resource management, and burden sharing. Common imagery doctrine must follow the imagery strategy. Most of all, control, continuity, and direction must be maintained with regard to organizations and systems development as the architecture evolves. These areas and more must be addressed to reach the long term goal of a joint, integrated imagery architecture. This will require the services and theaters to relinquish some sovereignty over at least systems development and acquisition. Nevertheless, the goal of a joint, integrated imagery architecture is feasible. The author presents arguments and specific recommendations to orient the imagery community in the direction of a joint, integrated imagery architecture.

USAWC MILITARY STUDIES PROGRAM PAPER

INTEGRATING THE SERVICES' IMAGERY ARCHITECTURES

AN INDIVIDUAL STUDY PROJECT

by

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CHAPTER I: INTRODUCTION AND BACKGROUND

"Intelligence imagery is a subject cloaked in classification and compartmentation. One needs to be circumspect when dealing with it. The field is also affected by the technological revolution and has been changing from traditional photo intelligence to include digital, softcopy, and multispectral imagery intelligence, and electronic delivery to the combat area. One can only provide a snapshot of the 'moving train'."[1]

Gaspard Felix Tournachon (known as Felix Nadar) took the first successful aerial photographs from a hot air balloon in 1858, pioneering the art and science of IMINT, or imagery intelligence. Since his time IMINT has evolved into a vast, complex, technology-driven entity considered essential to the security of the United States, its allies, and coalition partners. Because of the importance of imagery, the services face some daunting problems in the post-Cold War era. The military services have evolved a joint warfighting doctrine, but their imagery architectures still maintain vestiges of an era when the services worked independently of one another and the word "joint" was not spoken in polite company. Additionally, connectivity and integration of the service, theater, and national imagery architectures are not sufficiently developed. In the areas of systems interoperability, collection management, exploitation, dissemination, communications and training, the job of folding the service and national imagery architectures together as a seamless, joint, integrated system has only begun.

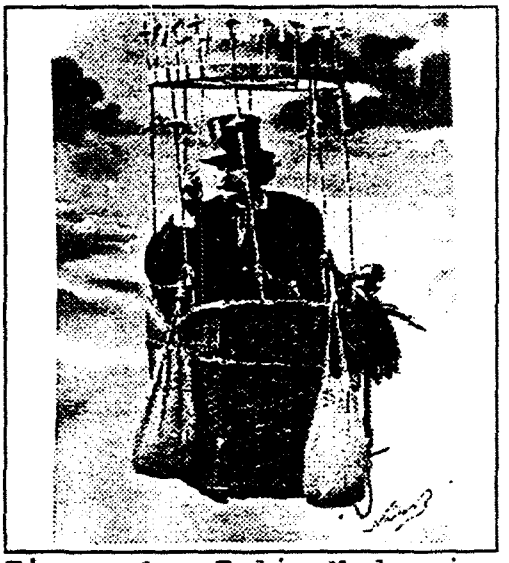


Figure 1. Felix Nadar in his balloon.

The imagery architectures of the services and the theaters must be modified to reflect the

capabilities of a smaller, more jointly focused force. This is much easier said than done. Fortunately, it is widely recognized today that a single, integrated imagery architecture is needed. The path for getting there is not quite so readily apparent. Centralization of imagery management has begun with DoD and some service reorganization. Implementation, however, is far from complete, and questions on the scope and nature of responsibilities are still unanswered. To date there is no master plan. Some true joint systems are being acquired, but they solve only pieces of the problem. Attempts are being made to standardize systems, communications, and training, but are far from complete or all encompassing. The services, DoD, and the national intelligence agencies are all struggling with how best to organize and implement an integrated imagery architecture that provides for an "end to end" joint solution that will serve the tactical commander as well as national decision makers.

The purpose of this paper is to explore the possibility of a single, coherent service imagery architecture by:

1) providing background on the state of imagery intelligence today;

2) examining an imagery architecture with respect to strategy, required capabilities, and ways and means;

3) examining the progress of joint imagery systems; and

4) considering all of the above in recommending possible actions to facilitate a joint, integrated imagery architecture for the services.

It is beyond the scope of this paper and the capabilities of a single person or organization to determine all of the precepts, tenets, systems, and organizational hierarchy of a joint integrated imagery architecture. It is equally difficult to include sufficient useful detail in an

unclassified format. It is possible, however, to point out certain directions that may be of service to those deeply involved in the day to day design and implementation of such an architecture. There should be a word of caution for those who work the imagery architecture challenge. Strategically and operationally the adage "a picture is worth a thousand words" has been proven uncounted times. Pictures, however, may not tell the whole story. While they may not lie, they can be misunderstood or taken out of context. Imagery must be fused with other types of information before a decision on a course of action is made. Miyamoto Musashi, a seventeenth century warrior once said, "You should not have a favorite weapon. To become overfamiliar with one weapon is as much a fault as not knowing it sufficiently well...It is bad for commanders...to have likes and dislikes".[2] While extremely important, imagery is ***only one weapon*** in the intelligence arsenal.

Background

"One picture is worth 10,000 words, or 1,000 Spies." Attributed to Mr. Art Lundahl, in charge of interpreting the first U-2 imagery.[3]

The term "imagery architecture" refers to the functional elements of imagery and how they interact in practice. The elements may vary somewhat between imagery organizations, but traditionally consist of requirements and requirements management, tasking, collection, exploitation, dissemination/communications, and training. A joint integrated architecture spans the services, links the tactical, theater, and national architectures, and provides for operations within alliances, bilateral/multilateral agreements, or coalitions.

An imagery architecture can be driven by many things. Chief among them today are national and military strategy (which address threat), technology, the industrial base, resource management, service requirements, and existing/developing systems. Threats to the

U.S. determine the national and military strategies, but force structure and supporting systems are today driven by capabilities required to implement strategy.

There are two major types of architectures: planning and systems architectures. The planning architecture consists of strategies, doctrine, requirements, resource management, and the organizational structure to work these elements. The systems architecture consists of the hardware, software, and communications necessary to support the services. The services have begun to change strategy, doctrine and force structure to the post-Cold War order but lag behind in almost all other areas in imagery intelligence.

Imagery can be separated into three types: tactical, theater, and national, according to the timeliness of the imagery, type of imaging assets used, who owns them, who pays for them, and whom they support. The first imagery architectures for intelligence were tactical in nature, allowing the tactical commander to "see over the next hill" in the field of battle. Gaspard Felix Tournachon, considered by some as the father of tactical imagery, wrote "'...thanks to my photographic apparatus I am in a position to send to the General Staff the most trustworthy intelligence every fifteen minutes in the form of a positive.'"[4] Timeliness was a primary requirement in the definition of tactically useful imagery, even as it is today. As each service recognized the importance of imagery as an intelligence tool, they began to develop ***their own*** architectures to service their unique needs, simple at first, progressing to the technology driven, complex systems of today. Initially, there was no quick and effective means for one service or one imagery architecture to meet the requirements of each military department. Each separate architecture had to work by itself. Ensuring the separate architectures worked together was not an overriding goal.

As the world became more complex and much smaller due to advances in communication and transportation the need for intelligence became greater. Imagery was not only a useful tool for the tactical commander to see over the next hill, but also for national decision makers to see across the world into the backyard of potential adversaries on the next continent. Camera carrying platforms evolved into satellites and aircraft that could range between continents, and a national imagery architecture was born in addition to the service architectures that existed earlier. In the quest for strategic intelligence collected by national systems, imagery assets like U-2 aircraft and satellites were funded through new organizations, such as the recently revealed National Reconnaissance Office (NRO).[5] The first systems naturally used film to record images, requiring the film to be returned and processed for exploitation, taking anywhere from many hours or weeks in the case of satellites for intelligence gleaned from those images to be available. Today, technology has progressed to the point where systems no longer are restricted to film. Digital image recording and transmission have become commonplace, and timeliness rivals and may, on occasion, be as fast as tactical collection and processing. Speed has made national imagery tactically useful. Technology has also made it possible to send tactical imagery to the national level decision makers from half a world away at the speed of light. Because of the technological revolution in communications and processing, there has been a blurring of the definitions of tactical and national imagery. The two architectures need to reflect that.

Beginning in 1986, as the Goldwater-Nichols Act required the U.S. force structure to become more joint, the theater CINCs found it necessary to devise imagery architectures for joint and component forces. Separate theater architectures have been developed using

portions of both tactical and national architectures. Theater architectures include the exploitation and dissemination assets provided by theater Joint Intelligence Centers (JICs). For example, the theater CINC tasks and can be supported by both imagery satellites and the F-14 Tactical Air Reconnaissance Pod System (TARPS) flown by the Navy. Exploitation can be done by the JIC and disseminated from there to joint users. While this resulted in a merging of tactical and national architectures at the theater level, each theater was free to develop its own architecture with little thought of connectivity to other theaters. Mandated standards and joint systems help ease the transition from one theater or one component to another, but there is still much to be done to make theater architectures interoperable. The CINCs are now in the process of defining those architectures in the Command Intelligence Architecture Program (CIAP)[6], run by the Intelligence Communications and Architectures (INCA) Branch of the Intelligence Programs Support Group (IPSG).[7]

Today any organization requiring imagery must deal with one or more of several imagery architectures: the tactical architectures of the three military departments, the theater architectures, and their separate interfaces to the national architecture. This proliferation of imagery architectures was workable when the services operated semi-autonomously, when the Cold War ensured funding of separate imagery systems in a contest against a known adversary, when technology was less complex and less expensive, and tactical and national imagery were separate and distinct. It was readily apparent during Desert Shield/Desert Storm that modern joint warfare cannot tolerate several imagery architectures that are, overall, incompatible. With today's forces acting under a joint commander and essentially employed as one force, a single, joint, integrated imagery architecture is not only desirable,

it is ***mandatory***. The effort to build that kind of architecture can begin with the integration of the service and theater architectures into a joint military architecture. Army, Navy, Marine Corps, and Air Force imagery can no longer be autonomous.

There is an old adage that says "you don't fix something that ain't broke". National, theater, and tactical imagery are ***not broken***; but neither do they work well enough in a joint, global environment for the military services to accept the status quo. The services' system of imagery systems and diverse imagery programs have somehow have been ***made*** to work together, much like pounding a square peg into a round whole. A plethora of organizations within the services, the Department of Defense, and national intelligence community (CIA, NRO, et al) are now working toward rounding out that square peg. The extent to which the architecture should truly be joint is still being debated, and a master plan that would pave the way to make it happen is still far away. The goal is obtainable largely because ***there is consensus*** among the services, DoD, and national organizations that a joint, integrated architecture must be built. It poses a significant challenge to construct an imagery architecture that will "provide the right imagery data to the right users, in the right format, at the right time".[8]

Shaping the architecture: setting the stage.

> *"Imagery intelligence is one of the principal areas that demands our attention."* Senator David L. Boren, Chairman of the Senate Select Committee on Intelligence.[9]

Since Desert Shield/Desert Storm the pace has accelerated to reform the national, theater, and service imagery architectures. Some groundwork for integrating the services' imagery architectures has been laid. Immediately after the war, significant efforts were made to document intelligence "lessons-learned", many of which concerned imagery. Studies have

been completed or are underway, legislation has been introduced, standards have been stipulated, and new organizations have been established in an attempt to get the intelligence community's "arms" around the problem of making the pieces of the various imagery architectures work together as a seamless whole. The services have attempted to participate in all of these activities to ensure that their requirements have been incorporated.

Problems For Imagery In the Gulf War.

Imagery lessons-learned from the war confirmed many known deficiencies and provided some new revelations for imagery intelligence. The current national and service imagery architectures, optimized for the Cold War and the global threat from the Soviet Union, were overwhelmed in a major regional contingency.[10] Collection managers could not followed their requirements in the approval process. Collection systems were too few. Dissemination systems of the separate services were not interoperable. Imagery dissemination was hampered by insufficient communications and poor capabilities for transferring hardcopy imagery. Quantity, quality, and timeliness of imagery products suffered. Imagery training and methodology in areas such as Battle Damage Assessment (BDA) were addressed differently by the services and national agencies. Interpretation skills had atrophied among active duty and reserve personnel. The list continues.

The services, in concert with the Defense Intelligence Agency (DIA), have attempted to address some of the shortfalls. For example, the questions of joint BDA doctrine, procedures, and training have been aggressively addressed through the BDA subcommittee on the Military Targeting Intelligence Committee chaired by DIA. Also, DIA is working hard for approval of a Mission Need Statement (MNS) to improve primary imagery, and the

services have begun to develop some true joint imagery systems. These efforts may paint a picture that does not seem too bad; but the problems are being addressed piecemeal, with no real adherence to a community-wide, agreed upon agenda. Initiatives in imagery are being worked in an intelligence vacuum. In other words, imagery is looked upon as an empire unto itself, without the close ties it must have to an overall intelligence structure. Imagery should be worked in concert with Signals Intelligence (SIGINT), Human Intelligence (HUMINT), and Measurements and Signatures Intelligence (MASINT). Otherwise, the imagery community will eventually find itself spending time and money trying to get the "INTS" working together, much as it is now trying to get the various pieces of the imagery architectures to work together.

Reorganization.

In late 1991 the Senate Select Committee on Intelligence (SSCI) began a review of the U.S. Intelligence Community, sparked by the controversies made public concerning the performance of U.S. intelligence during Desert Shield/Desert Storm and the lessons-learned during the war. As a part of this review, the Director of Central Intelligence (DCI), testifying before a joint session of Congress on 1 April 1992, "...noted that the current imagery system lacked the ability to produce common data that could be used and understood by both civilian and military leaders."[11] Concurrent with the Congressional review, DCI Gates also commissioned a Blue Ribbon Panel on Imagery to delve into the problems of imagery intelligence.[12] The main conclusion reached by both the Congress and the Blue Ribbon Panel on Imagery was that centralized management was required. To that end, Senator David Boren and Congressman David McCurdy introduced versions of the

Intelligence Reorganization Act of 1992 (Senate bill S.2198 and House bill H.R. 4165).

The Intelligence Community in general was concerned that legislating administrative and structural changes would deny the DCI, DoD, and the services the flexibility needed to cope with the challenges to be addressed or to deal with the fast pace of change. In fact "...there were deep reservations within the CIA, the Defense Mapping Agency, in the Military Services, and elsewhere about proceeding quickly to the formation of a large, new agency and a danger that in doing so activities that are currently being performed might well be disrupted and damaged."[13] Rather than have reorganization imposed by Congress and to ensure that the Intelligence Community retained a flexible organizational structure, The DCI and the Secretary of Defense met with several members of the intelligence community to develop a proposed new structuring of imagery intelligence.[14]

The results were the 6 May 1992 DoD Directive 5105.56 and the 1 June 1992 classified Director of Central Intelligence Directive 2/9 that formally established the Central Imagery Office (CIO) to centrally manage imagery intelligence and lay out its responsibilities (see Appendix B). The CIO is designated as a combat support agency under the Secretary of Defense. It serves as the focus for bringing the national, theater, and tactical imagery architectures together. The CIO is the functional manager for imagery, and as such, will preside over the Consolidated Imagery Program (resource management of national imagery programs) and the Tactical Imagery Program (resource management of DoD imagery programs). How all of these responsibilities will be accomplished is the subject of continuing debate.

A key element of the imagery community, the existence of which has recently been

declassified, is the NRO. According to the Washington Post, the NRO spends $5 billion to $6 billion each year "...in designing, building, launching, and operating..." spaceborne and airborne reconnaissance systems.[15] It too, has undergone some reorganization. Senator Boren, chairman of the SSCI, was quoted in the Chicago Tribune describing the declassification of the organization's existence as occurring partially because secrecy was having an adverse effect on its external relations, especially in the controversy over budget reductions and the ability of collection platforms to meet service and agency requirements.[16] The NRO must now work more closely with the services than ever before, which can only serve to strengthen the national and tactical imagery interfaces.

Imagery Architecture Studies.

As the CIO took shape in the minds of the SECDEF and the DCI, the imagery community, through the auspices of the Committee on Imagery Requirements and Exploitation (COMIREX),[17] produced an Imagery Architecture Study (IAS) that primarily addressed the national architecture and its systems and touched on the application of tactical systems. The main goal of the IAS was to address which types and how many national systems should be funded in the coming years. The study essentially confirmed the status quo, but did espouse a baseline of numbers and types of national systems below which the security of the United States could be imperiled and was used to defend funding requests.

Another study, still ongoing, is the Exploitation/Dissemination (E/D) Study. This study began as a joint effort by DIA and the NRO with participation by all service, theater, and civilian agency imagery organizations. Since the CIO has absorbed the DIA study organization, it is now jointly run by the CIO and the NRO with the continued participation

of DIA. This is the beginning of the close relationship the CIO and the NRO will have to nurture. The original purpose of the study was to design an exploitation and dissemination architecture and systems resident within it by determining an imagery baseline, noting unfulfilled requirements, determining the gap between the baseline and requirements, and then developing a plan to meet those outstanding requirements and produce an architecture. The study has now expanded to include an "end to end" architecture[18].

One can see that imagery has indeed received much attention over the past several years. The overwhelming consensus is that imagery requirements need to be satisfied in a faster, more efficient, and less expensive manner, yet the result should be improved utility. This cannot be done by merely connecting systems. A hard look at all facets of military imagery is required. The results of past and future studies need to be brought together in a coherent fashion and worked into a comprehensive analysis. The services must each take a hard look at what passes for their imagery "architecture" and bring them together under one shared roof. The job is difficult not only because of the extremely close interrelationship between imagery, the entire intelligence architecture, but because of a dynamic military force structure and other DoD priorities. It requires a master plan that must bridge a shrinking budget, an emphasis on domestic rather than military priorities, service parochialism, and the inertia of the status quo. The following pages examine ideas and areas that need to be considered in formulating a joint, integrated imagery architecture.

CHAPTER II FOUNDATIONS OF A JOINT INTEGRATED IMAGERY ARCHITECTURE

"Strategic direction is expressed through hierarchial levels of strategy: national security strategy, national military strategy, and theater strategy. " Joint Pub 1[19]

When most people think of an imagery architecture they immediately think of systems and how they work together. Systems are a major part of any architecture, but there must be a foundation on which to field and operate those systems. That foundation begins with a vision, sometimes thought of as an objective or an endstate. A new vision for imagery intelligence has been articulated by the CIO. It states that it is the imagery architecture's objective to get "the right image, to the right people, in the right format, at the right time".[20] It is purposefully general, allowing real world requirements to dictate a detailed strategy for reaching the stated objective. A single, joint strategy to make that vision a reality should be built on: 1) valid requirements that must be met (ends); and 2) sub-strategies that allow satisfaction of those requirements (ways and means). Just as important is a doctrine that characterizes how imagery resources should be employed to support military forces.

Potential Elements of a Joint Imagery Strategy

As the imagery community emerges from the shadows of the Cold War, one of the architectural missing pieces is an overall joint services imagery strategy shared with DoD and national agencies. The evolving world order and the demand for imagery and imagery intelligence products calls for a joint, integrated strategy to reduce costs, improve efficiency, and ensure that the CIO's vision becomes a reality. For the military, an imagery strategy must ***support*** a detailed intelligence strategy (still to be articulated) which is shaped by the requirements of National and Military Strategies of the United States, service strategies, and

theater strategies. It should be ***constructed*** from a series of sub-strategies based on requirements and consisting of the sub-strategy's ends (objectives), ways (methods to accomplish objectives), and means (resources). For the military, not only must the imagery strategy enhance warfighting and the capability to provide accurate intelligence to policy makers, but it also must produce consensus in the services, the theater CINCs, JCS, OSD, and the Congress that the strategy is sound and should be supported with increasingly scarce resources. Politics will necessarily play a part in forging an imagery strategy because of the need to form a consensus involving all of the above organizations. There will actually be two efforts at consensus, one within DoD and the other within Congress (three if you count the national intelligence community). The effort to produce consensus within DoD pales in significance compared with forging consensus in Congress. The key to winning a general consensus, especially in Congress, is to show the imagery strategy to be an integral part of the United States National Security and National Military Strategies, that it is based on joint warfighting (which supports the Congressionally mandated Goldwater-Nichols Act of 1986), and is an efficient and necessary use of resources.

It should not be news to anyone that Congress does pay attention to the connection between national and military strategy and their connection with what the country pays for in terms of personnel, systems, and infrastructure. In fact, "...in the words of the Senate Armed Services Committee Staff, ' The concern is that there is not an assured connection between national military strategy and the formulation of military requirements.'"[21]

For today's Congress, the imagery strategy also must be complementary to the new Democratic administration's domestic agenda. To show the connection, the Intelligence

Community must not only consider service and agency imagery requirements, but also must consider a much more comprehensive approach that addresses how imagery intelligence ties in to the sustainment of the industrial base and the preservation of jobs, how an aggressive R&D program can continue (with spin-offs to the private sector), and how contributions to the economy derive from a prudent acquisition plan. As a money saving measure, a plan with a goal of extensive burden sharing with other nations as well as access and influence on foreign imagery systems should be a part of the strategy. All of the above calls for extraordinary leadership and insight into imagery intelligence, U.S. and world politics, and the security needs of the country.

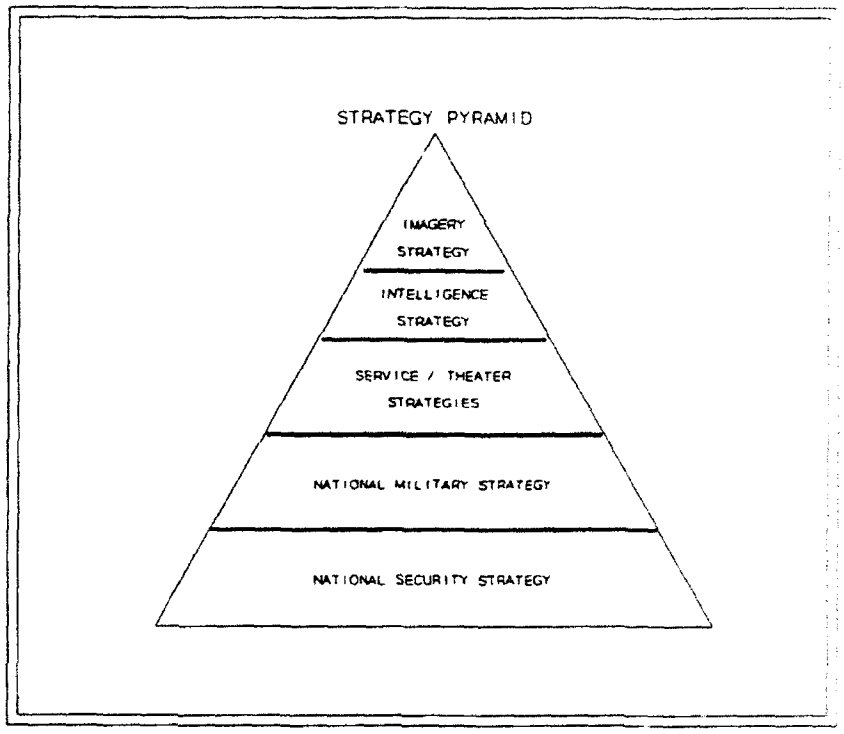


Figure 2. Imagery strategy is built from the bottom up.

General Strategy Guidance from the U.S. National Security and Military Strategies.

The overall national security and military strategies of the United States devised under

the administration of former President Bush should not change significantly (except for force size) under President Clinton. The two national level strategies define the defense program as consisting of the following four unprioritized elements: 1) strategic deterrence; 2) forward presence; 3) crisis response; and 4) reconstitution. A general direction for an imagery

The Four Pillars of the National Security and National Military Strategies	Possible Imagery Architecture Implications
Strategic Deterrence. considerations: a) proliferation of weapons of mass destruction	a) reliable warning (reliable and robust imagery capable communications) b) improved space systems c) global capability for near real time tasking, collection, exploitation, dissemination
Forward Presence. considerations: a) CONUS based forces with potential to deploy anywhere b) rotational deployments c) security and humanitarian assistance d) military to military contacts e) combined exercises	a) global architecture b) imagery support to in garrison forces follows with deployment b) joint/interoperable systems c) inter-theater interoperability d) deployable/mobile systems, doctrine, training, and exercises e) rapid positioning capability f) burden sharing
Crisis Response. considerations: a) short notice contingencies b) regional focus c) unilateral or combined response	a) near real time tasking, collection, exploitation, dissemination in theater b) deployable/mobile systems c) rapid positioning capability d) flexible/dynamic targeting capability e) mix of national/theater/tactical systems to ensure requirements satisfaction f) day/night/all weather capability to ensure requirements satisfaction in short period of time allotted g) burden sharing
Reconstitution. considerations: a) forming, training, fielding new units & systems b) smaller forces requiring build-up for major or multiple conflicts	a) capability to recreate the imagery architecture (strong R&D program, strong industrial base, efficient acquisition and resource management.) b) technological innovation as a force multiplier c) plans for surge in imagery capabilities across the board (from requirements to dissemination as well as training) d) plans for surge in systems production e) balanced imagery force mix (active duty, civilian, reserve)

Table 1.: The imagery architecture as it relates to the National Security and National Military Strategies.

strategy can be determined in part by applying the four elements as shown in Table 1, above. Although extremely general and open to interpretation, these elements can provide initial guidance on the direction for an imagery strategy. From there, some specific requirements can be developed. When shaping the strategy it should be kept in mind that smaller forces and less dependence on forward deployment do not necessarily equate to a smaller imagery architecture across the board. Tactically, U.S. forces can work with fewer systems and small cuts in personnel without sacrificing too much capability. Conversely, national and theater systems are fewer in number and very expensive, so that a cut in systems or infrastructure has the potential to seriously degrade capabilities. The national and theater architectures will need to remain intact.

The makers of an imagery strategy should understand that communications is the imagery architecture's Achilles Heel. There is not enough capability today to assure the dissemination of the required quality and quantity of imagery for U.S. forces to carry out other than short term, minor (in terms of numbers and types of forces used) crisis response missions. Global communications usually means satellite communications. Existing systems such as Fleet Satellite Communications (FLTSATCOM), Air Force Satellite Communications (AFSATCOM), the Defense Communications Satellite System (DSCS), and commercial leased satellite (LEASAT) are insufficient in available bandwidth (imagery data densities can be extremely large) as well as available transponders. An overall intelligence strategy should mesh requirements for intelligence communications (to include imagery) with an enhanced communications architecture. This means that the builders of the integrated imagery architecture must work hand in glove with the communicators. Building an architecture and

assuming that the "comms will be there" is a sure recipe for failure.

The January 1993 U.S. National Security Strategy states that the U.S. has "...shifted its strategy from a focus on a global threat to a focus on regional challenges and opportunities, from containment to a new regional defense strategy".[22] The U.S. regional strategy will put a new focus on theater imagery architectures. Forces should be able to deploy from CONUS or from one theater to another and "plug into" the architecture, no matter which theater it is. Wherever U.S. forces deploy, they will most likely go as a joint force. Joint systems interoperability and compatibility are the only way to make this strategy work. Additionally, procedures must be the same, terms must have the same meaning, and there must be a deep understanding of the imagery needs of the separate services by each service. This calls for jointly funded and procured systems, joint doctrine, joint training, and joint exercises within each theater. The National Security Strategy's requirement that "...our armed forces must be prepared to respond rapidly, to deter, and, if necessary, to fight and win unilaterally or as part of a coalition" has major implications for imagery intelligence burden sharing and classification of imagery and imagery products. Imagery shortfalls can be met by allies and coalition partners with an imagery capability. U.S. imagery intelligence must be shared with allies and coalition partners using procedures that safeguard imagery assets and technology but allow for quick, responsive dissemination to non-U.S. forces.

Requirements.

Specific demands on elements of the imagery architecture are diverse, as shown by the examples in Table 2, below. Note that many of the requirements reflect the four elements of the national and military strategies in Table 1, above. At times it is difficult to tell whether

ELEMENTS OF AN IMAGERY ARCHITECTURE	SAMPLE BASIC REQUIREMENTS (NOTE: the list below is not comprehensive)
Collection Requirements Management	a) automated forwarding of global collection requirements b) ability to follow nomination status through approval process c) feedback on nomination status d) correlation of national, theater, and tactical requests to avoid unnecessary duplication/overlap
Collection	a) near real time tasking b) flexible, dynamic targeting capability c) point targets, broad area coverage d) pre-strike/post strike target images e) multispectral collection f) mapping, charting, geodesy capability g) day/night, all weather (visible/IR, radar) h) mix of national, tactical, theater systems
Processing and Exploitation	a) common training b) rapid positioning c) affordable softcopy capability w/hardcopy backup & imagery data base connectivity d) automated change detection/object recognition (artificial intelligence)
Dissemination	a) global (in garrison/deployed) a) pull vice push (accessible common user archive) b) graphics c) large size target images (20" X 24") d) imagery/products delivered up, down, and across multiple echelons (commonality/interoperability)
Communications	a) global imagery communications a) switchable comms paths (UHF, SHF, EHF) b) adequate band widths c) on-demand availability d) selectable high data compression w/little loss of resolution (same number of pixels but a different number of bits per pixel, thus a different total number of bits stored) e) standard comms protocols f) standardized use of crypto
Training	a) standardized training systems b) standardized imagery vocabulary/training curriculums c) exercises stress the imagery architecture to find weaknesses or areas requiring improvement

Table 2. A sampling of imagery requirements.

strategy generates requirements or vice versa. Strategic aims are most often reflected in requirements which are later translated into research and development and then into systems, or directly into procedures or changes in organization. A comprehensive look at specific imagery requirements would fill volumes. For example, imagery is no longer considered merely a picture from which intelligence is derived, but exists as an integral part of weapon systems guidance packages, weapon system target recognition, mission planning and mission rehearsal systems, and for mapping, charting and geodesy. Most imagery requirements have been captured in the CIO/NRO E/D Study, in which "...users identified over one thousand shortfalls in existing capabilities".[23] The following is an attempt to look at strategies to achieve some of the more important imagery requirements in the context of a joint integrated imagery architecture.

Sub-strategies: Ends, Ways, and Means

U.S. security and military strategies combined with imagery requirements focus imagery strategy into several areas, or sub-strategies. Some of the most important (more can be assumed) are:

1) science and technology (S&T) combined with research and development (R&D) to improve imagery capabilities in needed areas;

2) the industrial base to ensure technologies are implemented;

3) acquisition to procure needed systems;

4) resource management to ensure that programs and systems can be acquired when needed;

5) burden sharing to fill gaps where the U.S. imagery architecture is lacking and to cut

costs; and

6) organizations to work all of the above as well as tend to the day to day workings of the architecture.

The ways and means of these sub-strategies must be carefully crafted to insure that the final architecture can support the strategy foundation. Additionally, the sub-strategies must be developed together, as they are all intimately connected.

S&T/R&D.

The objective of an S&T/R&D sub-strategy is to ensure that advanced technology is used within the architecture as a force multiplier, one of the most important facets of defense strategy. Since World War II, the U. S. military depended on technological superiority to successfully engage and defeat potential numerically superior Soviet and Warsaw Pact forces. DoD's strategy for science and technology programs today includes increased investment (somewhat suspect with a decreasing budget), advanced technology demonstrations, testing and evaluation of capabilities to validate systems prior to formal development, and improved information technology.[24]

Service laboratories have traditionally been in the forefront of S&T and R&D for military systems. They are not immune to budget cuts, however. R&D budgets are juicy targets for services trying to retain required capabilities intact in the face of significant funding cuts. Decreases in service R&D budgets (specifically Program VI in DoD's Tactical Intelligence and Related Activities budget) should be derived primarily through elimination and consolidation of unneeded infrastructure and consolidation of service laboratories considered redundant. Duplicative R&D programs should be consolidated if possible.

Further decrements could well lead to stagnation in some militarily significant areas, possibly including imagery. Roles and missions for laboratories and the Defense Advanced Research Projects Agency (DARPA) are in some cases already being redefined as a step in streamlining service and DoD S&T and R&D.

The services must be able to leverage each other's separately developed imagery and imagery related technologies. As one authority has noted, " The notion of leveraging is based on a simple fact: the services' individual technology base accounts cannot fund all the R&D activities that any one service needs."[25] To address this issue, as well as duplication and overlap of some service R&D, a three-phase tri-service (Army, Navy, Air Force) Science and Technology Reliance study (Project Reliance) was planned by the services in late 1989 and approved by Deputy Secretary of Defense Atwood in November 1990. Phase I addressed 28 technology areas for possible consolidation. Competition and separate development was allowed for service-unique uses of a specific technology. Imagery-related areas included electro-optics, radar, electronic devices, software, communications, command and control, and space. The results implemented in November 1991, with overall responsibility given to the Director of Defense Research and Engineering. Several sub-organizations and committees were to carry out the implementation. The most important for imagery was the Joint Directors of Laboratories (JDL), which has existed since 1974, chartered as a Joint Technical Coordinating Group.

Imagery technologies pursued by the services that do not fall into the categories above should become an adjunct to Project Reliance. The DoD imagery community (CIO, the services, and DIA especially) should push to include additional technologies such as infrared

imaging systems, digital storage and dissemination, softcopy exploitation, artificial intelligence, and secondary dissemination. The JDL should investigate which imagery technologies can benefit from service consolidation and ensure that the results are implemented. National agencies with their own R&D programs, such as the NRO or the National Exploitation Lab (NEL), should become intimately familiar with the JDL and participate in exchange of information. This could be done through a technology panel, chaired by the CIO with participants from the service laboratories, other DoD and non-DoD organizations with R&D efforts, and service staffs.

Testing and evaluation can also be improved by centralized management, but it must be done in consonance with the R&D effort. Program managers and test and evaluation personnel should move toward consistency and commonality in test methodologies, interoperability and interconnectivity of testing systems and capabilities, and commonality in the definitions used for threats and capabilities.[26] As technologies are tested, a cost-benefit analysis should take place to determine if the technology can reasonably contribute to U.S. national security or allow the tactical commander a distinct advantage in proportion to cost. We can no longer afford to provide new imagery technologies or incremental upgrades to existing imagery systems just because a particular technology is available.

Industrial Base.

The 1993 DoD Annual Report to Congress and the President defines the industrial base as "... a somewhat complicated network of contracting, subcontracting and vendor firms, as well as DoD maintenance depots and defense arsenals."[27] The imagery-related industrial base is much harder to define. We need to know more about it to define a workable sub-

strategy. Technology is now a strategic consideration, as the U.S. industrial base has become dependent on foreign suppliers for some system components. It has been suggested that the U.S. has been weakened strategically because of its dependence on foreign manufactured components, such as microchips. An industrial base that makes the U.S. self sufficient in strategic technologies may be an impossible dream. But it is one that should not be lost sight of because of its importance to reconstitution and the national defense.

During the Cold War, imagery technology transfer was a real risk, with possible windfalls in paid for R&D for the Soviet Union and other potential adversaries. Organizations, such as the Coordinating Committee for Multi-lateral Export Controls (COCOM), ensured that security on exported technology was tight.[28] Today, however, we see economic considerations outdistancing old national security considerations where technology is concerned. The notion that military technologies have uses in the civilian sector has a wide audience. The prevailing view is that a strong dual-use technology base is essential to national security. The imagery community can only profit by a dual use strategy. In the past, DoD led in the development of many technologies. That leadership has shifted to the civilian sector in many instances. "Commercial off-the-shelf" (COTS) technology has become a buzzword for new imagery systems. As DoD budgets decrease, it follows that industries supporting DoD will not have as lucrative a market as in previous years, forcing a parallel downsizing in defense industry. It is reasonable to protect that industrial base (sometimes called the fifth service) to assure the continuance of systems, modernization of systems, and reconstitution of pieces of the imagery architecture that must be built from scratch if required. President Clinton has, in fact, proposed that the U.S. switch some of the

federal government's $76 billion research and development investment from defense programs to civilian research.[29] An additional $555 million will be pumped into various Defense Conversion Plans by 1997.[30] Other points in the President's plan include: 1) increasing the civilian share of the R&D budget from 41% to 50% by 1998, making DARPA the Advanced Research Projects Agency (ARPA); 2) continued funding of the High Performance Computing and Communications Act of 1991; 3) $111 million in the FY 1993 budgets of the Commerce Department, the National Science Foundation, NASA, and the National Institutes of Health for R&D on high speed networks; and 4) $784 million for FY 1994-97 to develop applications for advanced computing and communications networks in the areas of health care, education, and manufacturing.[31]

The imagery community should be able to leverage some of this investment, take good advantage of the R&D done by the private sector, and focus it in directions that are advantageous. The services should do what they can to make the private R&D system work. The services' imagery intelligence communities can win by getting the R&D monies funneled to technologies they need, and industry can win by keeping or expanding jobs. This will go a long way toward producing a sympathetic Congress.

DoD is studying the industrial base to determine where problems for defense may occur by dividing it into eight sectors. Those sectors studied that may affect imagery are aircraft, space, communications and electronics, and combat support.[32] As a part of overall imagery strategy, a similar comprehensive study should be done on critical imagery technologies in collection management, collection platforms and associated imagery systems, exploitation, and dissemination/communications. This study could provide justification for using some of

the former DoD research money for imagery R&D within the civilian and military sectors and focus imagery technology policy. The study should be compatible with the data collection and analysis already underway in DoD and should address critical systems, major system changes, and potential problems in the industrial base. It should also tie in with imagery technologies studied in Project Reliance. Additionally, the study should identify what the imagery industrial base consists of, the requirements of the imagery architecture in peace and war, and the capabilities of the industrial base to meet those requirements, including those for reconstitution. The capabilities for surge production must be made clear, the potential contributions of allies and coalition partners need to be known, and substitutions for overseas components need to be found or planned for. A strong program to transfer new technology developed for DoD to the civilian sector will help maintain a viable industrial base.

Imagery-related technologies that could combine DoD and civilian industry include such things as neural networks for use in automatic pattern and change recognition, data compression technology, wide band communications, image manipulation, and digital storage and retrieval technologies.[33] Even potential future technologies, such as holographic storage and retrieval, could eventually pay dividends with military/civilian applications. The trick is to ensure that the information shared with the private sector is not altered such that it becomes proprietary and is sold back to the government. Agreements must be in place to acknowledge DoD and service contributions to ensure use of the technology improvements without large costs. Another problem in the past has been lack of a central monitoring of private sector R&D. Duplication in the private sector is called competition, and competition

can result in innovative thinking and potentially lower costs. But the services, without the certain knowledge of what R&D is occurring and who is doing it, could potentially end up buying or working with technologies that are incompatible. A centralized data base, relying on the results of the industrial base study discussed above (to include contracts and work done for the services) would be extremely helpful in preventing problems from occurring. Industry may be willing to provide input to the data base in the name of competition. The data base could include service laboratories and other DoD agencies that perform R&D.

Acquisition.

There is wide agreement throughout DoD and the national agencies that the acquisition process needs reform. What worked during the Cold War is not necessarily the best way to acquire systems and programs today. Times for the acquisition cycle have become enormous, with some systems taking as long as 10-12 years from design to procurement. System costs have risen exponentially, providing more capable systems but fewer of them, eliminating in some cases efficiencies of manufacture (economies of scale) and raising unit cost. Imagery systems are far from immune to current acquisition problems. For example, the date for the initial operating capability (IOC) for the Advanced Tactical Airborne Reconnaissance System (ATARS), a digital airborne collection system for eventual use with tactical aircraft and unmanned aerial vehicles (UAVs), continues to slip. Another example is the Requirements Management System (RMS), which has been developing since 1985 and will not reach projected IOC until 1995.

The professed new DoD strategy for acquisition includes funding for R&D and technology development, but little to no procurement unless absolutely necessary and then

only when the technology has been thoroughly tested. That procurement, if history is to be any judge, would take place when a crisis occurs, which will probably be too late. At least limited production of critical technologies or upgrades must occur to provide the minimal industrial base to begin surge production, and to provide for training and operational experience. With some technologies or upgrades remaining on the shelf, a rapid prototyping capability must be available if that technology can be of service in a crisis situation. Communications should be first priority.

There are some things that could be done to streamline the acquisition process for all of DoD in general, and for imagery in particular. Again, a joint imagery architecture as a part of an overall intelligence architecture is required. From that, an acquisition plan (already proposed to be constructed by the CIO[34]) should be constructed. The plan must work with programs and systems from development to operation and maintenance, from training to personnel. Piecemeal acquisition hides costs and makes programs and systems more vulnerable to cuts if they are not seen to support a coherent plan. Systems and programs must be a part of a whole. The Air Force's Follow-on Tactical Airborne Reconnaissance System is a partial example, consisting of the ATARS for collection, the Joint Services Imagery Processing System (JSIPS) for processing and exploitation at the wing level, and the Mission Verification System for mission readout at the squadron level. Each system or program should be presented in the budget as a package, to include design, manufacture, operations, interface with other systems, maintenance, training requirements, and personnel over the life of the system.

A requirement for concurrent engineering, strict guidelines for issuing requirements,

professional joint acquisition organizations, and multi-year budgets have great potential for lowering costs throughout the life cycle of new systems. Concurrent engineering is a concept that works a system from cradle to grave, including design concept, development, manufacturing, fielding, and support as a single process.[35] A study by the Institute for Defense Analysis found by using concurrent engineering practices that reduced design changes, shortened the development cycle, cut manufacturing costs significantly, and substantially reduced scrap rework.[36]

Requirements have to be simply stated, and cannot be changed wit any frequency. The services should define the requirements and work the funding while a ***joint professional acquisition organization***, with trained program managers and acquisition experience, works the acquisition side. The services are today building their own combined military/civilian acquisition corps, expecting completion by later in 1993.[37] Separate acquisition organizations are workable for those systems unique to each service. For joint programs and systems, however, they may continue service rivalry and delay the transition to joint warfighting. Based on the fact that warfighting is now joint, a joint acquisition organization should be adopted.

Program reviews should be limited to how money is spent and a review of the success at meeting stated requirements. Every step for every program does not need to be reviewed. Program managers should have predetermined authority to proceed past certain milestones, depending on the program.

The five year fiscal plan does not mesh with the 8-10 year (or longer) development cycles for systems and multi-year production. Most of the focus continues to be on the first

year. Even when DoD went to a two year budget in 1987, still within a five year planning cycle, Congress still concentrated on the first year. What is needed is a true multi-year budget with an annual review process.

Resource management.

Budgeting for intelligence outlays has never been easy, and it is even more difficult now as the defense budget declines. Former Secretary Cheney's 1992 Annual Report to the President and Congress stated, "Under the President's defense request, by FY 1997 the cumulative real decline in defense outlays since FY 1985 will be 36.8 percent."[38] Under President Clinton, the decline may be even larger. Because defense is spending less, a "peace dividend" is alternately proclaimed and denied, causing partisan politics to play an even larger part in the defense budget process as a new president places his highest priorities in a domestic agenda, and Congress rushes to apply "savings" from defense cuts to their own constituencies.

Some argue that a smaller force requires less intelligence support and fewer intelligence personnel. This argument is fallacious; the emphasis and scope of intelligence has shifted from a primary focus on the Soviet Union and other communist nations to dynamic threats and support to forces worldwide. It is inconceivable that the United States would expand a smaller military's role without literally keeping its eyes as wide open as possible. Yet the potential is there for that to occur.

The imagery budget must be looked at in the context of the overall defense budget as well as the intelligence budget. Former Secretary Cheney stated in his 1993 Report to the President and Congress that DoD's budget goal "...is to provide maximum support for

America's regional defense strategy, which was announced by President Bush in 1990". [39] Budget imperatives include prudent acquisition and an assist in sustaining critical, unique elements of the industrial base.[40] For imagery, the budget must be wrapped in a comprehensive strategy, at once seen to meet valid requirements and to be fiscally responsible. It must include national, theater, and tactical imagery systems, communications, personnel, training, maintenance, and security considerations all in a single package. Total costs for any program must be visible and accountable, so that duplication and standardization problems can be readily ferreted out, and funding problems will not be a surprise down the road.

A military with less people and a continued worldwide mission can only be successful with increased productivity, which means (in most cases) automation. Automation leads back to technology, and technology depends on funding in a decreasing budget. The Intelligence Community, including its imagery subset, is attempting to decrease costs without affecting capabilities. But it is handicapped by a budgeting system that is highly fragmented (see appendix B) and lacks a strong, visible link to the national and military strategies. It has been argued that "...the budget is not delivered to the Congress in the framework of a national strategy".[41] In the case of the ***imagery*** budget as a major portion of the intelligence budget, it can be forcefully argued that this is true.

For intelligence resource management, and therefore for imagery resource management, there are:

1) two budgeting bureaucracies with separate systems (the National Foreign Intelligence Program or NFIP[42] and the Tactical Intelligence and Related Activities program or

TIARA[43]) both of which reside in large measure within the Defense budget;

2) two planning and programming systems (Capabilities Programming and Budgeting System for NFIP and Planning Programming and Budgeting System for TIARA) that produce a budget for programs and systems that many times have the same users or are funded in part through the other program; and

3) two sets of administrative dogma (one for NFIP and one for TIARA) with separate administrative bureaucracies to reconcile them.

The effort to reconcile the NFIP with its twelve separate "accounts" (specifically the account labeled General Defense Intelligence Program or GDIP) in support of national intelligence and the TIARA program (specifically Program III) in support of DoD continues, with no real resolution in sight.[44] Although an attempt was made in the 1980's to compile a master list of all NFIP and TIARA programs (including rankings), it died an inglorious death when the list became too difficult to compile and program rankings too difficult to reconcile. Without a method to show how imagery systems and programs within GDIP and TIARA complement each other, duplication is much harder to ferret out, gaps in capabilities are more difficult to see, common requirements are much more difficult to consolidate, and multiple users find it more difficult to make group buys of systems that meet their needs. TIARA funds should go to formal programs that can be reconciled with the GDIP programs, rather than to general accounting aggregations. This would greatly facilitate reconciliation of the two budget programs.

Despite the inherent problems, there is still a need for two programs. National programs have never been able to provide for all of a commander's needs, making it necessary for

DoD to provide much of the tactical intelligence and infrastructure necessary to support the commander. DoD must retain control of the TIARA intelligence monies to ensure its requirements are taken care of. At the same time, there must be a way to ensure that the TIARA and NFIP programs mesh, that they are not duplicative, and any overlap is not redundancy for its own sake. With the Defense establishment looking to save money and increase efficiencies, modifying the GDIP and TIARA into a joint SECDEF/DCI system would be a sure way to help accomplish both.

With both GDIP and TIARA having reconcilable programs, SECDEF and DCI guidance should be given jointly so that each budget program knows the other's goals. Development of the budgets should also proceed simultaneously so that a base review and an initiatives review is done by both programs together before the Office of Management and Budget reviews the NFIP submission and the Office of the Secretary of Defense reviews the TIARA submissions in the spring. These reviews and subsequent milestones in each budget preparation should be conducted together, not separately, under the same time line so that the NFIP budget and the TIARA budget are presented to the President as an aggregate budget. The two budgets, at that point, should be completely reconciled, and it should be evident how national and tactical intelligence programs and systems support each other. Reconciled, joint service imagery budgets will be necessary for working the GDIP and TIARA imagery portion of the budgets with the DCI. This can be accomplished before or during joint planning with the DCI.[45]

The CIO's mission to reconcile the two budgets, with only "screaming rights" as its budget authority will be a frustrating, time consuming, and thankless job, with little

assurance that a strong imagery architecture will result. Real authority to cancel, merge, or modify unjustified or nonstandardized imagery programs is required. It provides a method for configuration control, and a "hammer" to ensure interoperability and adherence to standards. Imagery intelligence, as a part of the defense intelligence budget, cannot count merely on wise men of great foresight to ensure that the right programs and systems are funded. There are too many people with too many ideas and agendas to count on benevolent compromise. Additional requirements and responsibilities for producing a jointly developed imagery budget might include:

1) CIO oversight over theater programs as far as duplication and interoperability are concerned;
2) a CIO data base to track all imagery programs, to include information on cost, purpose, who they support, communications paths, contractors, program status, and other pertinent data in order to keep a picture of the imagery architecture as it develops;
3) reconciled service GDIP and TIARA budgets (before they are worked as a part of the overall NFIP and TIARA budgets);
4) true multi-year budgets more in tune with the acquisition cycle; and
5) if there must be a Congressional oversight committee, merge the SSCI and the HPSCI into a joint intelligence committee (Goldwater-Nichols in reverse) to significantly streamline the NFIP/TIARA budget process. It makes even greater sense for a joint intelligence committee if there is an aggregate intelligence budget.

A jointly built (SECDEF and DCI) budget is the best *way* to provide the *means* to

collect, analyze, and disseminate intelligence used to support U.S. application of political, economic, and military power. Separate development of the GDIP and TIARA programs worked well to develop the national and tactical imagery capabilities during the Cold War when the threat was relatively clear and an overall intelligence strategy was not as difficult to formulate.

Implementing these recommendations means the services, theaters, and national agencies would have to accept some politically undesirable things, such as giving up autonomy over a portion of the TIARA budget. The fear will be that the CIO will be another NSA and will, at some point (with good intentions) serve its own priorities and not that of the participating organizations. That is a valid fear. The best defense would be for the services and national agencies to man the CIO with strong, experienced people under their control. The alternative is the status quo, something the CIO was chartered to change. Recent intelligence reorganizations, which have done much to bring U.S. intelligence systems and operations into the post-Cold War era, are incomplete without a streamlining of the budgeting vehicles used to fund vital programs and keep the infrastructure working. It is like using this year's most modern car body to cover an engine and chassis that are twenty years old and have 200,000 miles of wear. It looks good and it will work, but it takes a lot of tweaking and special care, and there is always a chance something is going to break.

The centerpiece of the imagery architecture for military forces is the theater architecture. The CINCs participate in the budget process by identifying shortfalls and priorities in their requirements. To gain the imagery resources necessary to do the job and foster a joint integrated architecture, the CINCs must put forth a ***unified*** plan. Commands must reconcile

their requirements and generate a single, consolidated, non-duplicative input to a joint imagery budget. The weight of the combined CINCs behind consolidated requirements would be a formidable impetus to forge a joint, integrated architecture, and would generate support in Congress.

The theater imagery architectures are described via the CIAP process. The CIO is attempting to bring the various CIAPs together. While laudable, this is not good enough. The unified call for resources must come from the CINCs directly. This means forging a common understanding of what needs to be done and what resources are required. A starting point can be a consolidation of component requirements beginning with those assembled by the Navy in their December 1991 conference in Fallon, Nevada and the Air Force's survey of combat requirements conducted by the Air Force Intelligence Center in 1992. The CINCs can then make an unprecedented combined input to the PPBS, giving tremendous strength to their requests. The services, in concert with the CIO, can then "run" with that input and defend it in the budget process.

Much work would have to be done by experienced and knowledgeable people to work out the details to implement needed changes to the budgeting system. It may be that a completely new and innovative intelligence budgeting system is required. Programs within both GDIP and TIARA could be based on intelligence sources or "INTS", such as SIGINT, IMINT, MASINT, and HUMINT. An IMINT program could be broken into the architecture's components of collection requirements management, collection, exploitation, dissemination, communications, and training. From there, individual systems and programs could be listed. A budget that is visibly tied to a justified architecture could go a long way

toward convincing Congress that specific spending programs are the right thing to do. Other organizations such as the Departments of State, Energy, or Treasury may or may not have a separate program. As the budgets are developed, scheduled joint reviews at certain points in the process should occur. The result must support one imagery intelligence strategy and one imagery intelligence architecture as free of duplication as possible.

A jointly developed and submitted budget program and strategy is obviously not the complete answer to a robust intelligence or even an imagery architecture. It is a bold step down the right road and would require some painful and perhaps politically difficult changes. But it will help provide better direction and for the intelligence community and increase the chances that our armed forces will be able to get the right intelligence at the right time.

Burden Sharing.

The smaller DoD intelligence budget and continued worldwide U.S. military commitments ensure the U.S. cannot meet all of its imagery requirements single handedly. Innovative means to make up for shortfalls must be implemented. One possible means is burden sharing. If it makes sense for other countries with similar military interests to contribute forces, material support, or funding, then it makes sense for other countries with imagery assets to contribute imagery intelligence to cooperative/collective security operations. The U.S. is "...currently a party to seven formal alliances as well as a number of defense agreements and less formal arrangements with other countries."[46] These alliances and arrangements could be used as a springboard for imagery burden sharing negotiations.

Land, air, sea, and space-based imagery programs exist to some degree in almost every

allied or potential coalition military. Unfortunately, the burden sharing concept is a problem for some because it is a two way street. The U.S. would also have an obligation to contribute imagery and imagery products to its partners. This is a tricky subject, not only because of the potential for technology transfer and its use against the U.S., but also because of thinking that the imagery would give an insight into U.S. imagery capabilities and provide a way to defeat collection. This results in the perceived need to keep some imagery classified at a level that not all international participants can see.

These arguments are not reasonable. Every country in the world that has an interest already knows that the U.S. has space-based as well as other national and tactical imagery systems. Attempts to defeat imagery systems will always occur. Camouflage, concealment, and deception is a fact of life. Sharing of U.S. imagery will have no appreciable affect. The U.S. already sells imagery from its LANDSAT multispectral system to nations around the globe (some with their own ground sites) and has provided other intelligence imagery to many countries. Also, foreign access to U.S. ***systems*** is not always necessary. Systems access can be limited. Access to ***imagery*** may, over time, reveal some imaging capabilities of U.S. systems, but it does not follow that knowing capabilities will enable the manufacture or defeat of the same system.

As an example of how two nations' systems can successfully be used together, Norwegian researchers, using SPOT and LANDSAT data and digital terrain data from the Defense Mapping Agency (DMA) which was enhanced by specialists at Japan's Tokai University Research and Information Center in Tokyo, found evidence of nuclear tests by the Soviet Union on the island of Novaya Zemlya that were too shallow to contain all of the

radiation from the blast.[47] SPOT data was also used by the U.S. during the Gulf War to good effect.

Some countries, such as France, already possess imagery systems from which significant intelligence value is derived by other countries, including the U.S. France operates the SPOT multispectral satellite and will field the Helios imagery system by 1994 with a resolution of less than one meter. As an aside, the French company that build the SPOT satellite has a deployable satellite receiving station that the U.S. Air Force has proposed as a theater level ground station for multispectral imagery from LANDSAT and SPOT systems. Several other nations are investigating potential membership in the space-based imagery "club".

Canada is exploring entering space-based intelligence collection with a radar system. It has been reported that "Canada expects to start work on a space-based surveillance system by 2000, most likely in joint development with the U.S.".[48] There is as yet no formal agreement to proceed with joint development by the U.S. and Canada. The Canadian government has also made studies of a space-to-space and a space-to-earth observation system called PAXSATs A and B.[49]

Israel already is developing its own space-based intelligence system with an indigenous launch capability. The Russians obviously have their own mature capabilities, and the Chinese are not far behind. The Japanese and the Indians are working to perfect the technology, and Brazil is looking to space to satisfy some of its information needs. There has even been a proposal for a "MEDIASAT", owned and operated by commercial media such as television news and magazines, and EOSAT (the company that owned LANDSAT,

had plans for a system called STAR (Satellite Tracking and Reporting) that would provide data expressly for the media.[50] The U.S. is a leader in space and today almost holds a technological monopoly on space-based intelligence imagery. That will rapidly change in the years ahead, whether or not the U.S. withholds the technology.

The question is this: should the U.S. assist other countries in the quest for imagery technologies or do we hold back because of a threat to our national security? The strategy has been to control the proliferation of imagery technology, primarily digital imaging and processing. That strategy is a losing battle. Nations need not be technologically advanced to possess an imagery collection capability. Applicability and affordability may be the only requirements. If they do not get assistance for acquiring imagery systems from the U.S. , be they collection, exploitation, or dissemination systems, they will almost certainly get it elsewhere. The Clinton Administration is now considering the question of whether to allow the United Arab Emirates (UAE) to buy a space-based intelligence collector from Litton Itek Optical Systems, an American company.[51] The system would reportedly be launched in the U.S. by a U.S. booster, then operated by the U.S contractor. U.S. objections concern potential technology transfer and the commercial intelligence potential of the system. If the U.S. does not approve the sale, the Matra Marconi Company of France, which builds the French SPOT multispectral satellite and the future Helios system, is waiting in the wings to fill the vacuum. In the meantime, months have passed with no ruling on the sale. This will be a test case on how the U.S. addresses foreign space-based imagery, setting precedents for reported inquiries by Spain and South Korea concerning the export of U.S. satellite technology.[52]

The answer is to ***abandon the current strategy of control for a strategy of influence***. Under a strategy that influences the acquisition of imagery technology, not only will the U.S. have potential access to additional imagery sources that could be compatible with the U.S. imagery infrastructure, but the U.S. imagery industrial base will benefit from additional manufacturing and sales. As imagery becomes more important and force size declines, the U.S. must take advantage of an opportunity to use and shape existing and developing systems. We need to start ***now*** to put together agreements with the countries that are developing systems so that U.S. forces can use foreign systems when needed. Our strategic interests will be more at risk if we do not assist and maintain some controls (e.g., operation of the system perhaps by Americans or with the participation of Americans) and provide for interoperability. In order for our forces to use foreign systems, they must be a potential part of our imagery architecture. This will fill imagery gaps when needed and ensure that foreign systems can operate within the U.S. architecture.

Our interests in tactical burden sharing are just as strong as those on the strategic level. During the Gulf War coalition members such as the United Kingdom and France had their own imagery capabilities and used them extensively. Separate development did not, however, allow them to be interoperable with other countries' systems, just as the U.S. systems were not internationally interoperable. The U.S. should examine its needs carefully as the newest digital systems are brought into the imagery architecture and should work with allies to ensure interoperability in case of multilateral military actions. A case that illustrates the direction the U.S. imagery architecture should go is the cooperation between TRW Corporation and Israel Aircraft Industries (IAI) which have been selected by DoD to produce

a short range unmanned aerial vehicle. The contract is expected to lead to the production of 48 air vehicles for the U.S. government in addition to significant foreign sales. The U.S. program alone may be worth $500 million.[53] Licensing agreements and international development will go a long way to assuring tactical imagery to allied or coalition forces (including U.S. forces) in a post-Cold War scenario.

Doctrine.

One of the sub-strategies in an integrated imagery architecture should be to develop a joint imagery doctrine. The CIO, as a joint imagery organization and the imagery functional manager, has begun to take on this responsibility. The job requires extensive assistance from the theaters and the service staffs, as it requires an in-depth knowledge of service, theater, and joint military doctrine. It is not possible here to offer a comprehensive imagery doctrine; however, it may be useful to examine some tenants that could anchor it.

Doctrine is most useful in a changing environment. The environment in the imagery community fits anyone's description of a changing environment. It has been stated that, "...efforts to change a force will often be wasted unless there is a doctrinal framework to provide for direction and unity of effort."[54] When applying doctrine it must be remembered that doctrine presents "...fundamental principles that guide employment of forces."[55] Imagery doctrine must provide the ***principles*** by which the architecture is exercised, not a cookbook approach on how to employ imagery assets. It should also be capable of evolving as threats change, and technology makes its impact felt.

The first tenet of an imagery intelligence doctrine should be that the imagery architecture is joint. Wherever U.S. forces deploy, they will most likely go as a joint force. Joint

systems, training, and exercises are the only way to make this strategy work. Additionally, procedures must be the same, terms have the same meaning, and there must be a deep understanding of the imagery needs of the separate services by each service.

Joint imagery doctrine is a subset of joint doctrine, described by Joint Pub 1 as that which "...offers a common perspective from which to plan and operate, and fundamentally shapes the way we think about and train for war".[56] A word of caution is necessary. Doctrine, joint or not, needs to be flexible. Rigid interpretations of doctrine cannot resolve every situation. There must be room for flexibility and innovation by those involved, as well as a means of defeating predictability. That does not mean that planning is unnecessary. It is an acknowledgement that while planning is absolutely necessary, plans are ***never*** completely executed the way the planners envisioned.

The next tenant should be interoperability. Joint doctrine makes it quite clear that interoperability is one of the most important facets of joint warfighting. Although it may seem like common sense, Cold War forces, in most cases, were not interoperable. U.S. forces continue to have problems even today. The Unified Action Armed Forces (UNAAF) publication makes it clear that joint operation and interoperability are a high priority for the armed forces. It describes interoperability as a principle by which the armed forces should organize and operate. Specifically it says,

> "The forces, units, and systems of all Services must operate together effectively, to include joint doctrine and tactics, joint plans, joint training, and a material development and fielding process that provides material that is fully compatible with and complementary to systems of all services. The CINCs will ensure maximum interoperability and report interoperability issues to the Chairman."[57]

The UNAAF is even more specific for intelligence. It states, "Intelligence doctrine, such as

ADDITIONAL POTENTIAL TENETS OF AN IMAGERY DOCTRINE

1) SYNCHRONIZATION: Synchronization of imagery with efforts on land, sea and air, with other intelligence efforts and with the plan of action (OPLAN) will avoid wasted effort and ensure the right support at the right time (part of the CIO vision/objective). It involves mastery of time and space relationships and unity of purpose of those working the imagery architecture to reach a single goal. Synchronization depends on good communications and an ability to improvise for the changing battlefield. Additionally, other forms of intelligence may be used to "tip off" imagery resources or vice versa.

2) FLEXIBILITY: The U.S. can become involved in a range of conflicts, from military assistance to global war. Each theater may respond to the requirement for applying forces within a series of Flexible Deterrent Options (FDOs). Within the JSCP, CINCs are allocated certain forces in a Time Phased Force and Deployment Data (TPFDD) matrix depending on the location and priority of major Regional Contingencies and Lesser Regional Contingencies. In either case, there is no corresponding force list for intelligence resources, to include imagery. It would be prudent to have already planned the intelligence support and intelligence connectivity to those forces in each level of an FDO within each theater. It should be predetermined what national assets and what tactical assets will be available and how the imagery will get to the forces in each case. Although this is a theater responsibility, the services and other imagery agencies must be involved in the planning (see Appendix C).

3) MAXIMUM REQUIRED DISTRIBUTION TO THE LOWEST POSSIBLE ECHELON: This tenet supports the CIO vision and involves requirements for interoperability and robust communications. The UNAAF states, "Defense intelligence organizations and systems must operate on a shared information basis" and "...intelligence must be distributed up, down, and across all echelons"[58] The UNAAF goes on to say, "Defense intelligence systems and organizations must possess the capability to provide information exchange among the Services, commands, agencies, allies, and international organizations" (read U.N.)[59]

4) INITIATIVE: The intelligence community (to include imagery) may be able to predict a potential turn of events based on fused intelligence. It is prudent to apply imagery assets to a potential problem even without specific requests from the tactical commander (JTF or component) to stay ahead of a developing situation.

5) AGILITY: There should be a mix of systems, each with a range of capabilities. Imagery assets should maintain a continuous reading of the area of interest, applying different assets to meet different situations. To maintain timely support, digital collection, exploitation, and dissemination should be used. Imagery systems should be capable of rapid deployment and employment.

6) DEPTH: In anticipation of future requirements a full complement of tactical and national imaging capabilities must be maintained for the tactical commander to leverage. Support and sustainment of those assets must be continuous.

7) TRAINING: Exercise the architecture like it would be used to support users in war. Work major exercises into the architecture on a routine basis (stress the system as it would be in worst case scenario) to root out "bugs" and determine where improvements can be made. "Our military must be skilled in the use of bytes and bayonets alike."[60] The implication is for training, not only for imagery jobs but also for the operators. Joint and service unique training programs are necessary with periodic refreshers available to hone techniques and learn new systems. Those involved in any facet of imagery intelligence should be trained not only in specific imagery related skills, but also to exercise the tenets of imagery doctrine.

Table 3. Potential elements of imagery doctrine.

that for procedures and systems, must provide for interoperability."[61] Not only must intelligence systems be interoperable, but, "The product of intelligence is integral to command and control and must be compatible with the supporting command and control information systems."[62] Table 3, above, lists some potential additions to imagery doctrine.

PRINCIPLES OF WAR	APPLICABILITY TO THE IMAGERY ARCHITECTURE
1. OFFENSE: capture and holds the initiative, maintains freedom of action, capitalize on the initiative, impose one's will on the enemy, set the terms and select the place of confrontation or battle, exploit vulnerabilities, and react to rapidly changing situations and unexpected developments."[63]	The imagery community must seize and maintain the initiative, not only in the areas of user collection and exploitation interest but also in resource management, the use of technology as a force multiplier,, and other innovative methods of imagery support.
2. MASS: commit or be prepared to commit, a predominance of national power to those regions or areas where the threat to vital national security interests is the greatest."[64]	Targeting capabilities must be dynamic and available to any theater on short notice. Overwhelm a target(s). Concentrating assets to blitz a target, even while potentially missing opportunities in other less important areas, will often lead to good results.
3. ECONOMY OF FORCE: in the absence of unlimited resources, accept some risks in areas where vital national interests are not immediately at stake."	Prioritization of finite targeting, analysis, and dissemination assets is required. Limited resources and an uncertain world order mean acceptance of some risk in numbers and types of systems procured.
4. MANEUVER: React quickly to unforeseen circumstances. react promptly and focus and project power on the primary objective. Maneuverability within the theater to focus max strength against the enemy's weakest point and gain strategic advantage.	Dynamic tasking & retargeting capabilities are needed. Near real time capability in al elements of the architecture. Timeliness and agility in focusing or refocusing the imagery effort. React promptly to focus imagery assets on the primary objective.
5. UNITY OF COMMAND: unity of effort (all efforts toward common ends) under one responsible commander.	Centralized imagery management (CIO) is called for. Unity of effort (joint effort) for planning, budgeting, and implementation.
6. SECURITY: active and passive measures be taken to protect the Armed Forces of the US against espionage, subversion, and strategic intelligence collection	Restricted access to systems data is prudent.
7. SURPRISE: strike when the enemy is unaware and unprepared.	Near continuous surveillance (day, night, all weather) to determine enemy disposition.
8. SIMPLICITY: Clear, concise plans and orders.[65]	Clear doctrine, common & simple systems, terms, procedures.

Table 4. The principles of war are acknowledged by all the services.

Additional tenants can be drawn from service or theater doctrine as well as experience.

The principles of war are applicable to imagery, as shown in Table 4, above. They relate back to doctrine and provide insight into how the imagery architecture can be applied to supporting warfighting. All of the services subscribe to these principles, making their application to imagery and imagery doctrine a matter of degree and semantics.

Aside from doctrine, there is a need to develop tactics, techniques and procedures for imagery systems as a part of the operational art. Joint Test Pub 3.0 states, "Operational art overlaps theater strategy, extends through a range of theater actions, and blends into tactics as forces meet and fight."[66] Employing imagery systems is a part of theater actions and must be integrated into the tactical fight as much as any weapon system. The best ways to coordinate national, theater, and the joint/interoperable tactical assets must be determined. With major new systems to be deployed in the post FY 95 timeframe it is imperative that these new systems are integrated into the joint architecture as soon as possible. The theaters must be able to thoroughly exercise and stress the architecture to the limit to determine what they can and cannot do.

An Integrated Architecture and Imagery Organizations.

Strategy and doctrine, as discussed above, can provide guideposts by which an imagery architecture can evolve. That architecture must be managed and it must support users. Centralized management of the architecture is a given. The CIO is now a designated combat support agency and the imagery functional manager. Centralized management cannot make the architecture work by itself. The services must streamline their own organizations from within.

Just as the imagery community itself is fragmented, imagery within each service is fragmented; from requirements and systems to doctrine and operations, each service consists of many organizations that take part in the imagery process. Service staffs may do the planning, but in some cases even the planning is fragmented. There can be so many fingers in the pie that they get in the way of each other. For a hypothetical imagery processing system, one office may work the intelligence requirements, another may do the software, one might do the hardware, another might do the communications, and still another might do systems integration. Non-intelligence related offices may be working on a system that the intelligence people know little about or vice versa. Service systems commands or laboratories are many times heavily involved. It is sometimes difficult to keep track of just what systems are being built, what technologies are in R&D, and who is responsible for what. There is a way to bring them all together. Within each service there should be a consolidated imagery architecture group. It should involve any portion of the service that deals with the service's own or with joint imagery systems and organizations. It should have a mandate to build a service imagery architecture that is joint, interoperable, affordable, and supportable, with emphasis on imagery support to warfighting.

The Navy and Marine Corps have begun just such a process with the Naval Imagery Architecture Working Group (NIAWG). The group includes intelligence personnel, aviators, surface ship and submarine officers, communicators, TENCAP officers, budget personnel, representative from Navy systems commands and laboratories, representatives from collection management organizations as well as their S&T organization, DMA, Combat Camera, and naval medical personnel.[67] Naval components in each theater are kept

informed of progress and asked for input and comments. The same type of organization should be put to work in all the services to construct a comprehensive architecture that can meet the needs of all of its users.

Service architectures, once defined, need to be brought together. The services should do that under the auspices of the CIO. It could be done in an architecture panel, similar to the CIO technology panel mentioned earlier. Representatives from each service group working the service imagery architectures could meet with CIO, DIA, DMA, CIA, NRO, JCS, and other representatives from organizations concerned with producing a joint integrated imagery architecture. Progress on service architectures could be discussed, duplication surfaced, areas of consolidation explored, and the transition to a truly joint service architecture eased. Modeling of the architecture should be done by the CIO to predict the effects of different configurations as well as provide information for cost/benefit analysis of new or improved systems.

The Defense Intelligence Agency.

DIA's role in the imagery architecture should not change dramatically in some areas, but it should be redirected in others. DIA should continue to reconcile theater imagery requirements, oversee the S&T imagery community, and continue to task the service intelligence centers. DIA should also continue to manage some joint imagery systems and hold the position of head Departmental Requirements Officer for national imagery collection to work conflicts between DoD organizations. As an added requirement, DIA should function as a central repository for digital imagery for the theaters. However, DIA should no longer be in the imagery exploitation business.

The birth of the JICs has made DIA imagery exploitation redundant. DIA's exploitation assets as well as personnel billets should be moved to NPIC and the services and placed at the JICs, including the National Military Joint Intelligence Center (NMJIC) in Washington D.C. (now in the Pentagon serving the Joint Chiefs of Staff, the Secretary of Defense, and other Washington area decision makers). Billets could also be assigned to potential deployable JICs possibly constructed from a DIA's Joint Deployable Imagery Processing Concept (JDIPC; see Appendix F). While a certain amount of redundancy in imagery exploitation is not necessarily a bad thing, the existence of the National Photographic Intelligence Center (NPIC), the CIA, the service S&T centers, the JICs, and now the service components in theater (using JSIPS/IPDS) provide too much of a good thing. DIA would be better suited to coordinate the exploitation and dissemination effort (not necessarily direct) for DoD.

There are certainly other alternatives to attacking the problem of exploitation redundancy. The services could give up their S&T centers; however, that could hurt the services in terms of providing for their unique S&T needs. NPIC serves much more than just DoD, and is already a joint exploitation center by virtue of its employment of military analysts. The CINCs, whom DIA supports in the collection requirements management arena, need the flexibility provided by the JICs to concentrate support to the tactical commander. The best alternative to trim unneeded, duplicative exploitation is to move capabilities from DIA to Joint Intelligence Centers, fixed or otherwise.

Joint Intelligence Centers (JICs).

Just as the theater is the centerpiece for a regional defense strategy, the JIC is the

centerpiece for imagery support to theater forces. Organizations sending imagery or imagery products to theater forces should go through the JIC, and supply imagery or imagery products directly to tactical forces by exception only, meaning prior arrangement with the JIC. The JIC will support the Commander Joint Task Force, the service components, and the Joint Forces Air Component Commander. It can function as a means to get imagery from one component to another, or from the components to the JTF. The JIC in turn should be able to get tactical imagery or product back as far as the National Command Authority. The imagery flow should be both ways.

Each regional JIC should contain a digital imagery library, kept current for a specified period of time before images are placed in less accessible storage. Just as DIA would be a central repository for all theaters (accessible by the JICs), the JICs would be a repository for its own theater forces. This would facilitate the pull versus the push of imagery and imagery products to the user, who would query a data base electronically and get what he wants and no more. This would not prevent the JIC from sending additional products that might be needed, but would cut down requirements on communications assets.

Tactical Exploitation of National Capabilities (TENCAP).

Each service and DIA have a TENCAP office that works to find efficient and innovative ways to leverage national systems for tactical use. The TENCAP organizations tend not to be joint oriented, although exceptions can be found. The DIA and service TENCAP organizations should be combined into a joint TENCAP office manned by the services and DIA. There should also be a NRO national systems representative. The office should be independent of the CIO, but must have CIO oversight for projects to control the imagery

architecture's configuration. The focus for the TENCAP office would be theater component and JTF support as well as inter-theater component support. Applications should be applied across the theaters equally to ensure configuration control of the imagery architecture.

Joint Combat Camera.

Joint Combat Camera is an organization that has been generally overlooked when it comes to imagery. It is the single organization in Washington that ensures imagery from combat camera teams deployed with service components in theater is received and distributed. DIA found during Desert Shield and Desert Storm that Combat Camera imagery was sometimes the best source of imagery intelligence available (especially for BDA), due to lack of coverage by other systems or the unique, ground based close-up viewpoint. Currently, Joint Combat Camera is not linked electronically with any intelligence agency and its systems for electronic transfer of imagery are not designed as part of the military imagery architecture. Provisions should be made to include Joint Combat Camera and deployed Combat Camera Teams as a part of the developing architecture. This means that they must acquire or be given NITF-S/TACO 2 compatible dissemination hardware and software, and must have a digital archive that is accessible at least by DIA for further distribution, if not directly accessible by the theater JICs. They should also become an integral part of the tactical imagery collection system consistent with their job of documenting military operations, with theater and component imagery collection requirements passed to them via the CJTF. This does not mean that the teams would be involved in exploitation, but would actively seek to collect specific imagery and expand dissemination to imagery intelligence users. Their imagery could also be included in the recommended theater archives maintained

by the JIC.

Additional imagery organizations and activities.

As shown in Table 5, below, there is a proliferation of imagery and imagery related groups, organizations and activities throughout the intelligence and civilian communities that begs for centralized management. This partial list does not include service committees and working groups. It illustrates the need to consolidate, and provide centralized direction to them on the development of a seamless imagery architecture.

ADDITIONAL IMAGERY ORGANIZATIONS AND ACTIVITIES
1) Defense Reconnaissance Support Program (DRSP): planning and programming for imagery systems and supporting activities
2) Airborne Reconnaissance Support Program (ARSP): planning and programming for imagery systems and supporting activities
3) Joint Reconnaissance Center (JRC): manages and coordinates the Peacetime Airborne Reconnaissance Program (PARPRO; formerly Peacetime Reconnaissance and Certain Sensitive Operations (PRCSO))
4) Defense Support Program Office (DSPO)
5) Secondary Imagery Dissemination management Working Group (sponsored by DIA)
6) Tactical and Military Multispectral Imagery Requirements Evaluation Group (TAMMREG): sponsored by DIA
7) DoD Softcopy Steering Committee: sponsored by DIA. Addresses joint softcopy exploitation.
8) Joint-Tactical Exploitation of National Systems (J-TENS) Special Working Group: sponsored by DIA. Advises on changes to the J-TENS manual.
9) Military Exploitation of Reconnaissance and Intelligence Technology (MERIT) Working Group: sponsored by DSPO. Addresses military applications of emerging technologies.
10) National Imagery Transmission Format (NITF) Technical Board (NTB): sponsored by DSPO. Establishes standard protocols for IMINT.
11) National Imagery Transmission Format Configuration Board: sponsored by ASD/C3I. Addresses NITF configuration management issues.
12) Committee on Imagery Requirements and Exploitation (COMIREX): formerly sponsored by the DCI, now under the CIO. The Committee and its subcommittees (Operations Subcommittee, Current Requirements Working Group, Standing Requirements Working Group, Planning and Development Subcommittee, Exploitation, Research, and Development Subcommittee, Imagery Security Policy Subcommittee, et al) addresses national imagery intelligence matters.
13) Imagery Acquisition Management Plan (IAMP): sponsored by ASD/C3I for developing and acquiring imagery systems to support military operations.
14) Military Targeting Intelligence Committee (MTIC): sponsored by DIA. Addresses targeting concerns, including those for imagery. Its BDA subcommittee is redefining standards for BDA.

Table 5. There is a proliferation of imagery groups and activities requiring centralized management.

The services, along with the CIO and other DoD and national imagery organizations, need to devise a "reorganization of organizations", determining which, if any, are unnecessary, if one can absorb another, if they are all heading in the same direction, and if not, what the best method might be to get them working together. A point to remember is that the service staffs and subordinate organizations must not only attend meetings and keep abreast of what each of the other organizations is doing, but must also do the same thing within their own organizations. Keeping abreast of what is occurring in the imagery community when diverse organizations are all working a piece of the pie without central guidance can become a nightmare. A coherent organizational "chain of command" for imagery should be established that leads to the CIO.

Collection Requirements Management.

National collection requirements management for the services is done in two ways. For component forces assigned to a CINC, requests are made by units within a component to the Component Command Intelligence Officer, who validates the request and passes it to the Joint Task Force Intelligence Staff, who in turn passes it to the theater command J-2. From there it goes to DIA for deconfliction with other DoD requirements and then to the Committee for Imagery Requirements and Exploitation (COMIREX), where it is integrated into the standing or ad hoc requirements from all sources and tasked to national systems.

For tactical requirements, units with an organic capability can use collection assets to satisfy requirements, with the understanding that those assets can be tasked by the JTF or the CINC. The CIO has also been given the authority to pass requirements down the chain for resolution by tactical assets. There has been some discussion and consternation about the

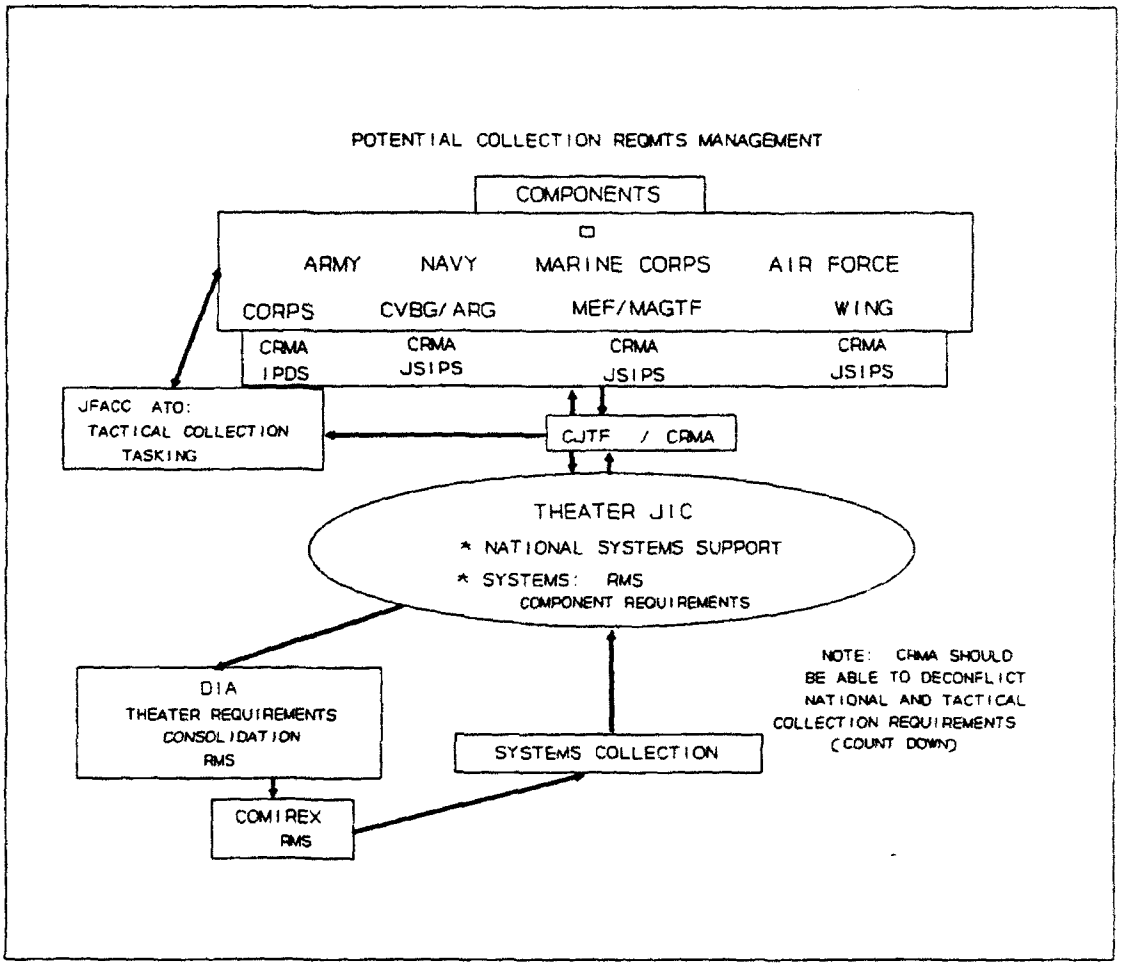


Figure 3. Potential collection requirements management flow usin CRMA and RMS.

CIO being involved in tasking tactical assets. In no case should the CIO be able to task tactical assets directly. If tactical collection assets can satisfy a known requirement, that fact can be made known by the CIO to the JTF (while advising the theater), but it should be the JTF's call as to whether or not a tactical asset is tasked. The tactical commander must have full control of his assets.

Currently there is no way to "count down" tactical imagery collection against national requirements or national against tactical. In other words, if national systems are tasked to image a target, the approval for that collection may not be known by tactical commanders. A tactical imagery asset may be tasked redundantly to image the same target. The same is true in reverse. The JTF's tasking of collection requirements, made known through the promulgation of the Air Tasking Order, should be made available to the organizations that task national systems. It should be computer readable so that it may be automatically compared with ongoing national tasking. The reverse should also be investigated. National system target lists may be easier to promulgate and send electronically so that the JTF could compare the list with potential tactical targets. The Collection Requirements Management Application (CRMA) being worked by DIA (which will have an electronic message handling capability) for use by theaters and components could incorporate algorithms to compare the national taskings with the tactical taskings, giving the JTF much more flexibility in his collection plan.

Multispectral imagery is used extensively by the services, yet there is no single procedure used by all of the services for acquiring it. Although DMA is ostensibly the liaison for the services to multispectral vendors such as EOSAT or France's SPOT IMAGE, in practice there are many organizations that procure multispectral imagery. At times it has been done by the theater J2 staff directly, by the service staffs, or by service space commands. This process must be centralized so that duplicate buys of imagery do not occur and a straightforward procedure can be used with confidence from theater to theater.

The best and easiest way to work multispectral collection requirements management is to

integrate it into the current national collection requirements management system. To do that, the architecture must ensure that collection managers can use current and future automated Collection Requirement Management (CRM) systems to request multispectral imagery. All tactical units with a potential CRM capability (currently division, carrier battle group, or wing level) would use published and enforced procedures so that the request ends up with the COMIREX to prioritize and forward to the collection organization, who in turn would prioritize DoD collection with civil collection. In wartime, DoD collection should take priority with LANDSAT, as DoD and NASA now jointly own and operate the system. DMA would simply be another DoD user and use the same system.

Collection.

National collection systems should remain under the operational control of current organizations. The services could not support the infrastructure for those systems. The NRO remains the best organization for designing national collection systems, but should not be in the business of defining requirement; rather, the NRO should be assimilating requirements from DoD and national agencies in order to update, improve, or build new systems. The intelligence ***and operational*** communities of the services as well as national intelligence organizations should jointly agree on requirements, and the NRO should design and build to those specifications. Service participation in requirements specification should remain assured.

Tactical assets should remain under the authority of the tactical commander to be used at

his discretion unless tasked by the CJTF. Only when the commander's forces are secure should he have to release imagery reconnaissance assets for other missions. It may be that collection assets can be divided between the local commander and other tactical units that have imagery requirements. The JIC or organizations outside of the theater should not be allowed to have priority tasking authority, unless the CINC or the CJTF agrees. While moving information up the chain is important, it should be a first priority to move it down to the people facing the bullets.

Exploitation and Dissemination

Digital imagery and communications have made it possible for lower echelons to exploit primary national and tactical imagery. Tactical imagery normally is exploited at the Corps/Division, CVBG/ARG, and Wing level; but new joint tactical systems, such as JSIPS, will allow exploitation of primary national imagery. Procedures and agreements must be worked out between the JIC and the components as to what each will be responsible for. This needs to be done to assure a complementary role for each and reduce duplication. Basic agreements can be worked out in advance; however, since each conflict is different, the details would have to be worked in each instance. The components would have to work out agreements between themselves as well to avoid duplication. Although some duplication cannot be avoided entirely, and may even be necessary, maximum efficiency can be achieved by splitting the workload and assuring wide dissemination. As with collection tasking, tactical commanders should have first priority on exploitation and dissemination unless

specifically overridden by the CINC or CJTF.

The capabilities of precision weapons and the need to avoid collateral damage have generated a requirement for rapid and precise mensuration and determination of coordinates. Hardcopy Point Positioning Data Bases (PPDB) have been available for some time. The capability to work with new images (via JSIPS) minutes or hours after they have been taken, in both tactical and national formats, requires a rapid positioning capability for digital primary imagery and softcopy exploitation systems. DMA has developed a digitized PPDB stored on Very Large Data Storage (VLDS) tapes, but a pre-constructed data base rapidly loses its utility after the first weapons begin to destroy or damage targets and the enemy disperses to areas not previously covered. Hardcopy PPDB production is to stop in FY 95, when the digital PPDB will begin production.[68]

Aside from pre-produced imagery, a complementary effort is required to enhance near-real-time imagery with the capability to be used for precise positioning that can be also be achieved in near-real-time. DIA is part of an effort to enhance national digital imagery with a rapid positioning capability prior to its being sent to theater. The technique involves a short delay and additional processing of the imagery, but the result is a capability to determine coordinates precise enough to plan strikes with precision weapons.

Tactical digital rapid positioning is somewhat more difficult to implement. Whatever is done in this context should be compatible with national imagery formats. Several formats are available. The Common Mapping Standard (CMS) merges many of these formats and

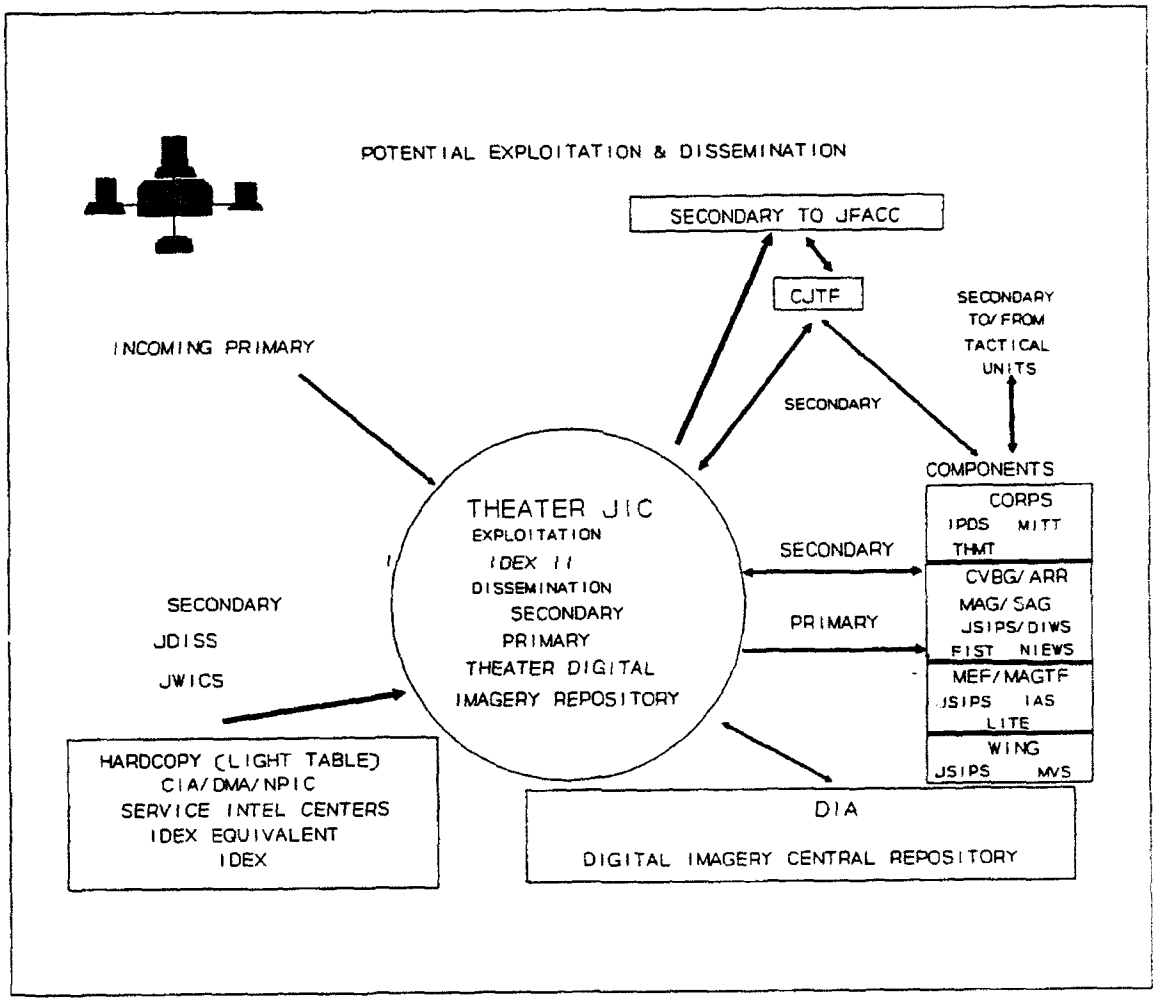


Figure 4. Potential exploitation/dissemination flow.

can include the digitized PPDB. It is the *defacto* Air Force standard today. Whatever choice is made, a second choice must be made as to whether to modify the JSIPS to use the chosen format or to preprocess imagery into the JSIPS format. Initial costs to modify JSIPS would be high, but to have to modify imagery continuously to meet JSIPS requirements will eventually cost more over time. The JSIPS should be modified now to accept the CMS in order to save money in the long run.

Battle Damage Assessment, as demonstrated in Operation Desert Storm, requires vast improvements. The BDA subcommittee of DIA's Military Targeting Intelligence Committee has the responsibility to develop BDA doctrine and a BDA Concept of Operations (CONOPS). Other issues it will address include: standardized definitions; damage criteria for certain precision weapons; BDA training; reporting; and a Joint Tactics, Techniques, and Procedures publication. Service and theater participation has been strong. Their work should be adopted quickly into the various service schools and the joint targeting training that is to begin at the Naval Strike Warfare Center at Fallon, Nevada.

A joint, integrated imagery architecture should address all these considerations and much more. Basic strategies must be constructed for use of technology as a force multiplier to a strategy for acquisition and resource management, including provisions for burden sharing and revamped and new organizations. Imagery ***systems*** also must be addressed. It is the systems that allow the work to be accomplished. Imagery systems are heavily dependent on data processing and the integration of computers. The trend has been that the more

automation involved, the more expense the architecture will have to bear. Strategies such as these may help to reverse that trend, but there is no alternative to automated processing and information management. Technology will allow the armed forces to retain or improve their capabilities as the forces draw down. Without modern systems, a joint, integrated imagery architecture would be impossible.

CHAPTER III DEFINING A SYSTEMS ARCHITECTURE

"There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain by the new one."[49] **Machiavelli**

Several tactical imagery systems are well along in joint development, but there is still much work to be done before a true joint architecture is a reality. The military still suffers from systems designed during the Cold War, and is only just beginning to deal with the imagery requirements for new roles in the post-Cold War era. There are three major themes to which systems must adhere in a final architecture: first, they must be deployable to fit the strategies of forward presence and crisis response; second, they must be joint or at least interoperable; and third, imagery standards must be incorporated and adhered to as systems are designed and fielded. This will require control, continuity, and direction of the architecture to be maintained as myriad organizations plan and develop systems to meet imagery requirements. Examples of joint and service-unique systems are listed in appendices E through M.

Service System Architecture Concepts.

Each of the four services is in the process of defining their own imagery systems architecture concepts based primarily on their own imagery requirements and their force structure. Although they are not developing their concepts jointly, all of the systems concepts have common points which should make producing a joint architecture easier. These concepts must be leveraged if a joint integrated imagery architecture is to become a reality. Table 6, below, shows a sample some of the similarities.

COMMON SERVICE CONCEPTS FOR AN IMAGERY ARCHITECTURE	COMMON SERVICE INFRASTRUCTURE REQUIREMENTS
1) distribution of imagery and imagery products to the lowest possible echelon 2) open systems architecture 3) pull vs push- users select and receive only the imagery and products they need 4) common plug-in, plug-out modules, common sensors/processors - scaleable, platform independent systems - uses specified industry standards - leverage commercial technology - common data links for interoperability and jointness 5) near real time dissemination 6) deployable/mobile systems 7) wide area surveillance capabilities 8) high targeting accuracies 9) multispectral imagery 10) large area format prints 11) integration of emerging technologies	1) trained imagery analysts 2) digital storage and retrieval 3) wideband, high data rate recorders and data links 4) on demand communications 5) high resolution paper printers 6) tasking and dissemination for multispectral imagery 7) imagery S&T R&D programs

Table 6. Some common points of service imagery systems concepts.

Disagreements over the architecture include:

1) who has the power and control (not necessarily the responsibility) to shape the architecture with funding and fielding of specific systems;

2) the utility of service-unique systems that are accorded scarce funding;

3) the intransigence of one service or another to be involved in development or to buy a joint system;

4) service departmental priorities or changes in the way a service must do business;

5) differences in service roles, missions, functions, and force structure which determine the identity of the consumer and the use of the product, which in turn determine different qualities and quantities of imagery product; and

6) system program offices purportedly not responding to service requirements.

They all boil down to scarce resources and the absolute need of each service to meet its own requirements. Scarce resources are a difficult problem to manage and one that is not going to become easier any time soon. One could make the argument that in the long run, joint systems are less expensive because the costs are shared, and there are economies of scale to be achieved by manufacturing more to accommodate all four services. By combining resources, each service can, in some instances, meet its imagery systems goals quicker and less expensively than by going it alone. The sum can be greater than its individual parts.

Ensuring that each service meets its requirements is also a difficult task, but it is tempered by fiscal realities. If the services can agree that a joint, integrated imagery systems architecture makes budgetary sense, then their concepts of the architecture will merge much more easily. Agreements on what is required, taking into consideration the types of information in Table 7 below, for imagery to accomplish specific tasks, such as targeting, mission planning, wide area search, mapping and charting, dissemination quality and quantity, and others must be accomplished before a systems architecture is built. In other words, some specifics need to be added to the CIO vision of the right imagery to the right people at the right time. Those specifics may differ from service to service based on force structure and mission. If the CIO works with an architecture panel, as recommended earlier, the services could articulate their needs equally from the same level playing field.

Aside from service requirements, a joint, integrated systems architecture will require standards that are enforced. There are some standards that have become a defacto part of

	ARMY	NAVY	USMC	USAF
General	Most forces to be garrisoned in CONUS. Will deploy to harsh environments (desert, jungle, arctic). Support focused at Corps level.	Heavy forward presence compared to other services. Highly mobile. Extremely limited space, vibration, temperature & power fluctuations afloat.	Uses Navy architecture afloat, USMC architecture ashore. Highly mobile. Imagery needs for MAGTF independent of size of the force. Imagery support focused at MEF or MAGTF level.	Can deploy squadrons within 24 hours. Harsh environments (desert, tropic, arctic). Imagery Support focused at wing level.
Imagery Users	1) ITAC 2) FSTC 3) TENCAP 4) Corps, Division, Brigade, Battalion, 5) SOF	1) Office of Naval Intelligence (ONI) 2) TENCAP 3) Naval Space Command 4) Carrier Battle Group (ships/airwing) 5) Amphibious Ready Group (ARG) 6) Maritime Action Group (MAG)/Surface Action Group (SAG) 7) SOF	1) TENCAP 2) Marine Air Ground Task Force (MAGTF) 3) Marine Expeditionary Force (MEF) and associated Surveillance, Reconnaissance, and Intelligence Group (SRIG) 3) Marine Expeditionary Brigade (MEB) 4) Marine Expeditionary Unit (MEU) 5) SOF	1) AFIC 2) TENCAP 3) Air Force Space Command 3) Wing 4) Squadron 5) SOF
Imagery Uses	1) *Visual representation* (topography/facilities, CP's, HLZ's) 2) Situation Development 3) Targeting 4) BDA 5) Counternarcotics 6) Noncombatant evacuations 7) Survival, evasion, resistance, & escape	1) *Strike/route planning* 2) Post strike BDA 3) Ocean surveillance 4) Target recognition 5) Counternarcotics 6) Recognition for maritime intercept & embargo enforcement 7) Noncombatant evacuation 8) Survival, evasion, resistance, & escape	1) Strike/route planning 2) Post strike BDA 3) Visual representation (topography, facilities, hydrography, beach landing zones, CP's, HLZ's & trafficability) 4) Targeting 5) Survival, evasion, resistance, & escape	1) Strike/route planning 2) Post strike BDA 3) Target recognition 4) Counternarcotics 5) Noncombatant evacuation 6) Survival, evasion, resistance, & escape
Flagship Imagery & Related Systems	1) IPDS (Army JSIPS) 2) ASAS 3) UAV-CR, SR, & endurance 4) JSTARS is considered an imagery system (see appendices F, G,& J)	1) ATARS 2) JSIPS 3) APS/DIWS 4) UAV-MR (ATARS) 5) F/A-18 RC (ATARS & APG-73 radar) (see appendices F, G,& K)	1) JSIPS 2) IAS 3) UAV-CR, SR, MR 4) F/A-18 RC (ATARS & APG-73 radar) (see appendices F, G,& L)	1) ATARS 2) JSIPS 3) MVS 4) RF-16 (ATARS) (see appendices F, G,& M)

Table 7. Some general characteristics that guide service imagery systems development

imagery systems. New systems (not limited to imagery) that are built by and for the Army, Navy, and Marine Corps are built in what has been termed a Common Operating Environment (COE). Essentially the COE consists of compatible hardware built with an open architecture, the same operating systems, and man-machine interfaces. Three of the four services have a written agreement to ensure systems are built to an open architecture. The Air Force has not yet formally signed but informally adheres to its tenants and is considering signing. A formal agreement signed by all four services and other DoD organizations further defining a common operating environment should be a goal.

Another more familiar standard is the National Imagery Transmission Format- Standards (NITF-S). NITF-S defines how imagery data is digitally packaged for transmission. In order for one system to receive imagery from another, the image must be able to be decoded when it arrives. NITF-S is seen by some to have created a level playing field between large and small private companies in addressing many imagery requirements. An example is Paragon Imaging Inc., whose ELT/2 NITF has been adopted by such imagery programs as JDISS, JWICS, IAS, and MITT (see appendices G, H, J, and L). Tactical Communications 2 (TACO 2) is an agreed upon communications protocol that has become synonymous with secondary imagery dissemination systems and NITF-S. Sending and receiving systems must have the same protocol as well as the same formats to be interoperable.

While COE, NITF-S, and TACO 2 are big steps in the right direction, there are some additional standards that must be jointly set before systems are completely interoperable. For example, the services must agree on which crypto and keys will be used on systems that will communicate with each other. Standard communications paths must also be defined and

agreed upon. There should be additional provisions agreed upon that include image transmission quality and timeliness, which would drive common, selectable communications paths, bandwidth, and compression ratios. Standards for imagery directories that can be queried in order for users to pull imagery rather than have an organization push it out are needed. Standards in all aspects of imagery training, tasking, databases, image products, operational interfaces and dissemination are also vital for a workable systems architecture. For additional interoperability and cost cutting, standard recording formats for video forward looking infrared (FLIR) systems (which proliferate throughout the services) must be implemented.

Some things that should be considered when designing a systems architecture are:

1) capabilities (such as for secondary imagery) should be software applications loaded on common or compatible hardware;
2) use commercial off-the-shelf or government off-the-shelf hardware whenever possible;
3) ensure compatibility of upgrades to previous versions of hardware or software;
4) work toward communications flexibility (switchable compression ratios, switchable communications paths from UHF to EHF);
5) use a concurrent engineering approach;
6) ensure fusion with other intelligence sources;
7) adhere to standards without deviation or waivers; and
8) develop analysis and modeling tools to simulate the systems architecture as it develops in order to find and fix problems and ensure service requirements can be met

Each service can look to the others to discover what is working and what is not. For example, the Navy's Naval Tactical Command System-Afloat (NTCS-A) is an example of an integrated system that uses common hardware to run diverse applications, including applications for secondary imagery transmission and receipt, and moving imagery to various stations throughout a ship via a local area network. Imagery applications are not another "box". The Marine Corps' prioritized methods of fulfilling a validated operational requirement should serve as an example for systems acquisition. It consists of: 1) purchase of another service's fielded or developed system or purchase of COTS equipment; 2) co-development with another service; and 3) standard DoD lifecycle acquisition.[70] Standard DoD lifecycle acquisition is last because it is the most expensive and takes the longest time. It is a philosophy that should be adopted as a way of doing business throughout the imagery community, especially in this day of lower budgets and joint forces.

Systems development by the services incorporates a hodgepodge of organizations. Service Staffs, service system commands, service labs, joint and service program offices all are involved to one degree or another in putting together a service imagery architecture. There needs to be a central data base that contains all the systems fielded and under development with additional data (to include projected IOC, contract specifications, points of contact, and other useful data). The CIO is the best candidate to create and maintain such a data base. Maintaining it in DBASE IV or Paragon would be inexpensive and quite sufficient. Updated hardcopy printouts could be mailed to the service staffs every six months or upon request.

Joint Collection Requirements Management (CRM) Systems (see Appendix E).

The most critical issues regarding CRM systems is their current lack of connectivity. Neither the current nor the planned systems have the necessary connectivity to make them interoperable. Additionally, the current COMIREX Automated Management System (CAMS) and the planned Requirements Management System (RMS) scheduled to replace it in FY 95 are multi-billion dollar imagery stovepipes. They are stand-alone imagery systems not only because they work only with imagery requirements, but because they work only the national and potentially the theater sides of the problem. It is a travesty that an extraordinarily expensive CRM system handles only one type of intelligence requirement.

The Collection Requirements Management Application (CRMA), which will combine the best features of the currently used Collection Management Support Tool (CMST) and Swift Hawk, is a "multi-int" system, but to date has no interface with RMS. The theaters which will operate the CRMA cannot manage imagery requirements automatically from one system to another. In fact, the imagery management portion of CRMA at the theater level is in part redundant, since the RMS will do the national imagery requirements management. If the CRMA, which will have the capability to manage tactical as well as national imagery requirements, could interface directly with the RMS both tactical and national requirements could be managed together, thus preventing duplication and overlap. Theater components, which may have CRMA, will not have an automatic method of interfacing with RMS. Since both programs are managed by DIA, the agency would do well to investigate merging them.

Neither the RMS nor the CRMA will have a capability to manage multi-spectral imagery requirements. Both should eventually upgrade to such a capability. CRMA or a compatible application should become the deployable tactical collection management system,

incorporated as an application (not as another "black box") in the Marine Corps and Air Force JSIPS, the Army's IPDS, and the Navy's NTCS-A. It may be feasible to incorporate the CRMA application (or a compatible one) in the Marine Corps' IAS, the Air Force's data link capable MVS, the Army's THMT and MITT. The NTCS-A for smaller ships requiring imagery may also be a vehicle for a CRMA-like application. A capability as an application within the above systems would solve deployability requirements.

The Navy has no plans for CRMA afloat because it is incompatible with its shipboard NTCS-A local area network. This is a good micro example of how interdependent imagery, communications, and automated data processing have become. If one system does not work with the others, an imagery architecture cannot be built without going outside of a standard configuration. There has been discussion of an alternate CRM application within the shipboard NTCS-A, but with a very limited capability and without a communications interface to RMS. A CRMA-like system has great potential for use at sea. Afloat forces do not currently have a means to electronically transfer imagery requirements through the chain of command except by voice or hardcopy message. A compatible version of CRMA afloat with its proposed interface with RMS would be ideal. It is especially useful because it will track requirements for all intelligence sources and will not be another stovepipe system.

Joint Service Collection Systems (see appendix F).

Joint collection systems are absolutely required in order to have a workable joint architecture. Fortunately, several are being developed as deployable, interoperable systems. Unfortunately, they are also very expensive.

The Advanced Tactical Airborne Reconnaissance System (ATARS) will give the Air

Force, Navy, and Marines a near-real-time tactical imagery capability. The Army is not buying ATARS or a platform to fly a digital collection system, but after much negotiation, has agreed to a tactical imagery segment on their IPDS to receive ATARS imagery. ATARS is currently suffering from development and acquisition delays. It will fly in the RF-16, the FA-18D/E/F reconnaissance capable aircraft, and the Unmanned Aerial Vehicle-Medium Range. If the ATARS' problems are not solved and the system is cut, there is no replacement in the wings. When the Marine Corps decommissioned VMFP-3 in October of 1990, it eliminated the RF-4B tactical, film based photo and SLAR sensors.[71] Airborne collection continues with handheld 35mm cameras. The Air Force RF-4's are now in the reserves. The Navy's F-14 TARPS is aging and needs replacement. The services cannot afford to let ATARS fail in its development.

The objective of the UAV-MR program is to develop a common airframe to support reconnaissance requirements using the ATARS payload and be compatible with JSIPS.[72] The Navy is planning to buy 215, the Marines 50, and the Air Force 260. The systems will fly to a radius of 350 NM at 0.9 Mach at a maximum altitude of 40,000 feet. It can be ground- or air-launched and recovered on the ground or in the sea. Although not as versatile as a manned aircraft, it provides a programmable reconnaissance capability for extremely high threat areas. The close- and short-range UAV will carry television systems that will data link back to a ground station. The Defense Support Program Office is now defining the capabilities for the UAV-Endurance.

Joint Processing and Exploitation Systems (see appendix G).

The Imagery Digital Exploitation (IDEX) system is the Cadillac of exploitation systems

and an example of how to spend money by the barrelful. It is in use by the Army, Air Force, the JICs, and national imagery agencies; however, it is not easily interoperable with other imagery systems, such as secondary dissemination systems. This problem is being worked. Although it is an outstanding system, it is extremely expensive, not only for the hardware but also in operation and maintenance. It was designed for fixed operations. The actual softcopy workstation is not deployable.

Many of the IDEX capabilities are intentionally redundant, i.e., it has backup capabilities if part of the system fails. This was due to the extreme importance of having an exploitation system that was as reliable as possible. Designed during the Cold War, the impetus for reliability was the high strategic risk involved in not exploiting imagery of the Soviet Union and its allies and surrogates immediately upon receipt. It has become somewhat of a white elephant as organizations have had to scramble for funds and cut back on operating hours to keep the systems operational. Nevertheless, IDEX is now a standard for softcopy exploitation. Deployable softcopy workstations, such as that for JSIPS or other softcopy systems should all work from that standard, but they do not do so today. Imagery from IDEX must be reformatted for JSIPS and vice versa.

While an affordable, standard softcopy system (of which there are many to choose from) must be made available to insure for national, theater, and service intelligence centers that can approximate the capabilities of the IDEX and work within its standard imagery formats, deployable versions should be built simultaneously. Technology is now reliable enough that systems can be produced mostly from off-the-shelf components. Decisions must be made on how much capability is required (e.g., do you turn an image at one degree increments or 45

degree increments). The next generation joint softcopy system, incorporating lessons learned from IDEX, should be smaller and less expensive, with standard capabilities transferrable and interoperable with fixed and deployable systems such as the Joint Services Imagery Exploitation System (JSIPS). It would also be worthwhile to explore standardized imagery formats and exploitation systems with allies such as the UK for potential use in bi-lateral or multi-lateral military operations.

The JSIPS is modular and will process tactical and national imagery for exploitation and or further dissemination. Its objective is a mobile, common, interoperable imagery ground station capable of processing electro-optical imagery from visible, infrared and radar systems. Tactical imagery will be input from ATARS sensors via a real-time data link or pre-recorded reconnaissance data from ATARS or EO-LOROPS. Outputs will be written reports, annotated imagery and other products tailored to the user. JSIPS is a self-contained system, capable of generating its own power. Modules include the Tactical Input Segment (TIS), the National Input Segment (NIS), Softcopy Exploitation Segment (SES), Hardcopy Exploitation Segment (HES), Communications Support Segment (CSS), and System Support Segment (SSS).

All four services will buy the system, but different configurations abound. The Army calls its version IPDS. The Navy version is called JSIPS-N. Navy is not buying the NIS (but will receive national imagery via the LVDS), CSS, SES, or HES because of shipboard space limitations and the fact that shipboard intelligence centers are already designed to have softcopy and hardcopy capabilities. A special antenna called the Common High Bandwidth Data Link (CHBDL) will function as part of the Navy's input segment. The Marine Corps is

buying only one JSIPS with a NIS. The Air Force is buying their JSIPS essentially intact. There are two additional processing and exploitation systems that should be noted. The first is the Contingency Airborne Reconnaissance System (CARS) and the second is the Joint-Deployable Intelligence Processing Concept (J-DIPC).

Two CARS systems are being designed. They will be modular, mobile systems that will work with the U-2 ASARS aircraft. The TR-1 (U-2) Imagery Ground Station (TRIGS) and the Tactical Reconnaissance Exploitation Demonstration System (TREDS) systems already in existence could be evolved into CARS, to be kept in CONUS for contingency deployment. The system is a stovepipe system typical of the Cold War era. It is incredibly expensive, requires over 300 personnel, and is not yet interoperable with other systems such as ATARS.

In June 1992, DIA was directed by the Military Intelligence Board (MIB-Chaired by the Director of DIA) to devise a deployable intelligence processing capability to support a JTF/Theater CINC during a contingency or war.[73] The core of the system is made up of CARS, MIPE, and JSIPS. DIA developed a Mission Needs Statement which has been briefed to the MIB. The services were not happy because it would take component assets to field the system. The JDIP-C would also require extensive manpower.

CARS should be dropped as a program and the JDIP-C (which incorporates CARS) should be made into a concept for a deployable JIC garrisoned in the U.S. Theater and functional JICs were established primarily because they gave the CINCs a readily available intelligence capability. Theaters are extremely large, and forces may deploy thousands of miles from the JIC. Direct support in the area of interest within a theater is much more efficient, and provides the commander a more timely product and better support to

components. During Desert Storm a forward deployed Joint Imagery Production Complex (JIPC) was created and subordinated to the Central Command J2. It had over 200 imagery analysts to work current intelligence, targeting, BDA, operations planning, search and rescue, and terrain analysis.[74] While a deployable JIC would not initially have 200 imagery analysts, planning for augmentation should take place in case it is needed. Imagery capabilities of the CARS, MIPE, and JSIPS (as a deployable receive location for national imagery) would be formidable additions to a forward deployed JTF. The deployable JIC should be a part of contingency force packages, and its deployment within a theater planned for in the JSCP.

Joint Dissemination (see appendix H).

Primary dissemination to the exploitation agencies, including the JICs, has occurred through the Defense Dissemination System (DDS). DDS must now be able to forward primary imagery one echelon lower to component JSIPS. There are many secondary imagery dissemination systems (SIDS) available, but none has been designed as a joint system. A common communications protocol, NITF-S, common crypto and keys, and a common communications path are required. The JICs still require several different systems to communicate with components. CENTCOM has gone as far as requiring components to use the Digital Video Imagery Transmission System (DVITS) which employs an HF radio for transmission and receipt. Efforts continue to make all SIDS compatible. JCS began the process to define a joint mission needs statement for a secondary imagery system in 1992. Requirements were defined and agreed to by all the services. In the meantime, the certification of SIDS systems for NITF-S and installation of NITF-S upgrades continues.

The m'ssion needs statement for a joint secondary imagery system calls for flexible communications capabilities, large-size images, color and multispectral imagery capabilities, and shorter transmission and receipt times. It may be possible to include any resulting system as an application in other systems with the function of accessing secondary imagery.

Additional systems and demonstrations that will incorporate dissemination of imagery are proliferating. There needs to be centralized control over their development and fielding to maintain configuration control over the imagery architecture. This means that the theaters must give up some autonomy over their efforts to spearhead imagery dissemination efforts by coordinating first with the CIO, which should direct the imagery architecture's development. Two recent systems developments are the Joint Worldwide Intelligence Communications System (JWICS) and the Joint Deployable Intelligence Support System (JDISS). JWICS is actually more of a communications capability than a "box". It will incorporate a dedicated

ADDITIONAL IMAGERY DISSEMINATION DEVELOPMENTS
1) Demonstration of Direct Digital Dissemination (4D): conducted in PACOM in October 1992. U.S. forces Korea was instrumental in making the demonstration possible. ASD C3I and INCA were involved, as was the JDISS program office. It is a relatively s nple idea of using a file server to push imagery to secondary imagery dissemination systems direct from a source of softcopy imagery (whether a storage medium or an imagery workstation). The demonstration was successful and LANTCOM and EUCOM are starting the fileserver concept as well as PACOM. This system will allow users to pull imagery from a directory. This concept is a good one, but requires supporting configuration control to ensure that directories, file naming conventions, and query structures remain standard in all theaters.[75] The CIO is working the issue.
, Low Volume Dissemination System (LVDS): This system functions as a scaled down version of a ground receive location, but will not be able to handle the same huge amounts of data. Instead it is meant to handle tailored primary imagery support. In other words, it will receive images of the area of interest and no more. It will probably be the national input segment to JSIPS, and it has potential use by organizations that require primary national imagery for exploitation. For example, the Office of Naval Intelligence is exploring the use of LVDS to replace courier runs of hardcopy imagery. While initial cost is not trivial, it will essentially eliminate the multiple courier runs each day and allow the Navy to obtain its imagery much quicker.
*Note: additional dissemination is discussed in communications.

Table 8. Two additional efforts underway to improve dissemination

1.54 Megabit per second (T-1) line for communications and will interface with theater communications. JDISS, a system that incorporates a secondary imagery capability, will be able to leverage JWICS to send and receive imagery. JDISS is also deployable, and can provide support to a deployed JTF or as far down as the division, wing, or carrier battle group. Two additional examples of dissemination developments are shown above in Table 8.

A question that comes to mind is which system, if any, will become the joint secondary imagery system? Will it be a service-unique system (of which there are more than 12), the JDISS system, a system designed as joint from the ground up, the system in JSIPS, or another system yet to be named? Currently, secondary systems are being made compatible by backfitting standard imagery formats, communications protocols, compression algorithms, and communications capabilities. This is expensive and does not guarantee interoperability. A joint system should be on the drawing board, not as another box to be integrated into other systems, but as an application that can work on standard hardware already deployed within the services.

Communications (see appendix I).

The need for imagery communications can be summed up by the following:

> "As weapon system technology makes it increasingly feasible for the time between warning and attack to be compressed, so must the processing and transmission time for warning, critical intelligence, and operation plan execution information be compressed. The demand for rapid communications throughout the Defense establishment...requires that the speed be considered during all aspects of communications system planning."[76]

Communications is the "long pole in the tent" for a joint, integrated imagery architecture. As the imagery architecture is developed, global and theater communications architectures must be developed simultaneously. Several initiatives are underway, as shown in Table 9.

below, to find workable communications methods for imagery. All are good steps in the right direction; but all efforts are not coordinated, leaving a potential imagery communications architecture somewhat fragmented. These efforts did successfully

ADDITIONAL SERVICE IMAGERY COMMUNICATIONS EFFORTS
1) Exercise Tandem Thrust 92: a PACOM exercise conducted in the spring and summer of 1992, with imagery communications/dissemination coordinated by Navy TENCAP. The exercise took advantage of then unused SHF capacity on DSCS to move imagery from and to an afloat CJTF. STU III's were used to encrypt and transfer the imagery. JICPAC was used as an imagery hub. Since not all components could use the SHF link, imagery was sent to the JIC and further disseminated from there. A rudimentary capability was used for the CJTF to pull imagery from a data base archive set up especially for the exercise via this network. Portions of a full national systems image was transferred from IDEX to a disk, then transferred from the disk to a secondary imagery system without having been seen by an imagery analyst. This effectively transferred primary imagery to the CJTF. The system was left in place and should undergo upgrades for the next Tandem Thrust exercise.
2) Navy commercial satellite experiment: SHF transponders on a commercially available satellite, capable of 1.54 megabits per second data transfer, a large, powerful antenna ashore for transmission (required because the forces involved were mobile and could not carry an antenna large enough to capture the imagery at sufficiently high quality), and high power applied to transmitting a signal (the higher the transmission power the smaller the antenna receiving it can be) proved to be extremely successful. The test used LVDS as the receiving system.
3) Senior Troupe Block II: successful Air Force demonstration to provide imagery to either a composite wing or Air Operations Center occurred at Langley Air Force Base in late 1992. The Intelligence Correlation Module inside a 36 foot, air transportable Winnebago was used to attempt to receive at least 55 images per hour and to put them into a data base that would support ATO planning and execution.[77] Communications was supported by SHF SATCOM, DSNET III, and STU III. Although only 33 images were eventually data based, the results validated the concept of rapid imagery support, integrated from multiple sources into a common database.[78]

Table 9. Efforts at improving imagery communications are diverse and uncoordinated.

demonstrate some interesting and potentially cost effective methods for improving imagery communications. Costs to rent commercial transponders for global communications are minimal compared to designing, launching, and maintaining military systems on orbit. Commercial communications, with agreements in place to assure continued use, should be strongly considered as a primary communications means. The JIC used as a hub for imagery dissemination and communications was proven to be a workable concept, as was the concept for an imagery archive at the JIC accessible by component forces. Additionally, imagery

from various sources was successfully placed into a single database archive. If the results of these three efforts can be combined with the dissemination efforts listed in Table 9, a major portion of a workable theater architecture can be designed and implemented.

Additional communications efforts that can be used for imagery transmission are coming to fruition. A new military communications satellite that is soon to become available, called Military Strategic and Tactical Relay (MILSTAR), will have not only UHF and SHF capabilities, but will have EHF capabilities as well. Congress has directed that more emphasis be placed on tactical communications. To satisfy that requirement, a medium data rate (MDR) payload will be added to the fourth and subsequent satellites.[79] A single MDR payload provides eight steerable beams carrying a total of 12 channels at 1.54 Megabits per second.[80] About 1500 MILSTAR terminals are to be acquired.

The services have their own communications capabilities that should be included in any imagery communications planning. The Navy is designing the UHF Follow-On (UFO) satellites to provide upgraded UHF communications. Nine satellites (the first was lost in April 1993 due to a failure to attain the proper orbit) with upgraded bandwidths will eventually replace the current FLTSATS and LEASATS. From the fourth satellite onward, the UFO satellites will carry EHF augmentation packages to complement the MILSTAR network. The Army is about to field Trojan Spirit, a system with links to national intelligence organizations through DSNET I and III, and through a Trojan switch which sends the imagery to deployed, truck mounted receivers. There are also experimental Multiple Access COMSATS (MACSATS), and Demand Assigned Multiple Access (DAMA) systems that can increase the number of users by allotting bandwidth according to priority.

Communications are being worked, *inter alia*, by the RDT&E Division of the Naval Command, Control, and Ocean Surveillance Center, Air Force Systems Command Electronic Systems Division, and the Army Communications-Electronics Command and other organizations. It cannot be over-emphasized that the imagery community must reconcile these efforts with their own and incorporate useful facets into the imagery architecture.

Communications burden sharing is a concept whose time has come. This concept was used to some extent during the war. Planning now for flexible deterrent options and imagery support should include the potential for using foreign communications satellites. Like agreements to use imagery collections by foreign systems, the concept should be fully explored now; and negotiations to incorporate foreign communications satellites into the U.S. communications architecture should begin immediately. Examples of potential foreign satellites that can be used are the French Defense Ministry's Syracuse SATCOM system, the UK Ministry of Defense Skynet 4 COMSATs, and the Spanish HIPASAT. The Italians are due to launch a Sicral satellite in late 1995 or early 1996[81] that might be useful to a U.S. communications architecture. Additionally, the European Military Satellite Communications initiative, co-sponsored by France and the UK, could bear fruit for the U.S. if it were aggressively pursued.

Other communications programs have specifically targeted imagery. A theater communications program, the Long-Range Imagery Networked Communications System Program (LINCS), run by INCA, is designed to assist in the implementation of secondary imagery dissemination systems network architecture for each U&S command.[82] The program's goal is to eventually integrate U&S Command SIDS into a worldwide network

using the Defense Data Network (DDN) as a backbone. The architecture would incorporate SIDS at the tactical level and requires the U.S. Defense Information Systems Agency (DISA) to provide information on the DDN architecture. EUCOM will be the first beneficiary of the program in 1993, and TRANSCOM will be the last in 1996.

It is heartening to see the efforts that are occurring to enhance imagery communications, but the efforts need to be brought together and lessons learned freely promulgated to those who may need them. The CIO should be the DoD organization to bring these efforts under one roof, not to control them, but to coordinate and pass on information to other groups that may be trying to solve similar problems. Eventually, an imagery communications architecture should come from all of these efforts, agreed to by the services, theaters, and national imagery agencies, with established configuration control and commonality across all theaters. Communications should be the priority problem for the systems architecture, not only because it is the most difficult, but because a joint integrated imagery architecture depends on communications for its very existence. Communications used for imagery should be designed with low failure rates, error correction techniques, alternate routes, and standardized equipment and procedures. DISA is already working with LINCS to provide access to communications documentation, including architectural changes.[83] Services need to be included to prevent separate, redundant, overlapping efforts.

There are many additional types of systems that the architecture must deal with. Mission planning systems such as the Navy's Tactical Air Mission Planning System and the Air Force's Mission Support System need to be merged into a single program. National, DoD, and service imagery databases require in depth study to merge them or make them

interoperable. To build a truly joint systems architecture is a formidable task indeed, but not so formidable that it should not be attempted. Systems should provide efficient and sufficient support to the warfighter, which should be the objective of all architecture efforts.

CHAPTER IV: CONCLUSIONS AND RECOMMENDATIONS

"Hey! They're lighting their arrows!...Can they do that? Gary Larson[84]

Conclusions

Imagery intelligence is a complicated field of endeavor. This paper can only touch on some of the larger issues. It is apparent that the Imagery Intelligence Community of today is like the two cowboys taking cover inside the circle of covered wagons as the Indians shoot fire arrows at them. The quote above tells us that they must come to grips with the fact that their paradigm of how Indians fight has just been shattered. Like the cowboys, the services have realized that imagery requirements for support to the military have changed. Imagery architecture paradigms must change. Furthermore, ***they must change together and in the same direction***. Requirements for the post-Cold War era are like the fire arrows. Unless we are able to do something about them, our imagery architecture will

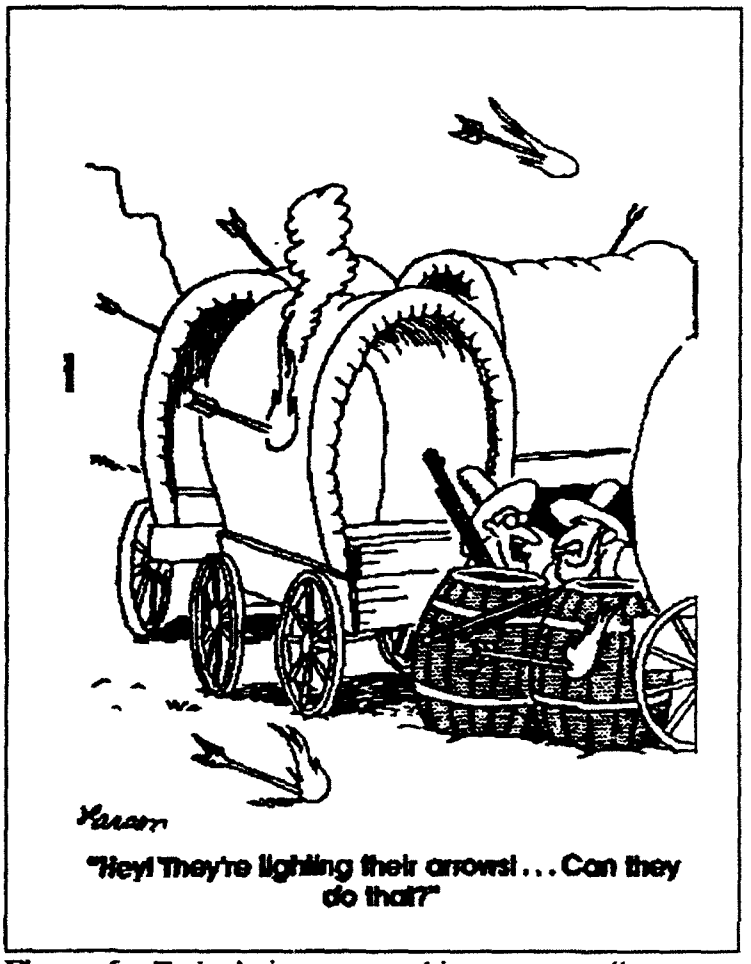


Figure 6. Today's imagery architecture paradigm could go up in flames with new post-Cold War requirements.

figuratively go up in flames. The fact that the wheels of progress are slowly turning and many people are moving the imagery monolith toward a joint, integrated architecture is heartening. Momentum toward that goal must be maintained, and efforts must be consolidated into a single master plan. Some "sovereignty" must be given up by each of the services, theaters, and functional commands primarily in systems funding and acquisition; but compromise will also be necessary in forging a comprehensive imagery strategy and doctrine. A joint, integrated imagery architecture is feasible, but it requires unprecedented cooperation from each of the services and equal cooperation from the theater and functional CINCs.

The elements of a joint integrated imagery architecture are present all around us. While there are efforts at producing joint integrated segments within imagery intelligence, there is not yet a ***consolidated*** effort overseen by a single organization that encompasses the entire spectrum of imagery activity. A starting point is the commonality in the separate services' visions for their own architectures. The best organization to bring them together is the CIO, which has begun to investigate portions of what is outlined in this paper; but it needs the power to complement its authority, and it must expand its horizons into areas such as producing a joint DCI and SECDEF imagery budget, focusing imagery R&D, forging alliances with communications organizations, and coordinating the direction of all imagery organizations toward a common objective. It must build a master plan that goes far beyond systems and standards. The key areas of strategy (to include acquisition, resource management, and burden sharing), doctrine, and systems must be addressed together. There are many old paradigms that should be and will be replaced, but the benefits for each part of the imagery architecture must be provable and cost efficient. The old ways of doing

business must give way to newer, more efficient, and less costly ways of satisfying imagery requirements. A joint, integrated architecture is the only way to accomplish these goals. New technologies or upgrades for older systems cannot be fielded simply because a newer technology is available. Innovative means to compensate for inevitable imagery shortfalls, such as burden sharing, must be implemented. It must be recognized that building the architecture is a long-term endeavor, requiring diligent management of resources and vigilant configuration control. Building the architecture must be deliberate and contrived, but with built-in flexibility for dealing with changes in requirements for imagery intelligence as a whole, and for changes in technology that will help meet those requirements. The goal of a seamless joint integrated imagery architecture is feasible. It will require unprecedented cooperation of the services and the various theaters to implement. Even then, it is only a piece of the pie. The national architecture and national imagery agencies must be brought into the picture. None of this can be accomplished without consideration of national requirements and priorities. Nonetheless, bringing the service architectures (to include the theaters) together is the largest piece of the pie, and will go a long way toward achieving one architecture that can meet the needs of all the parties involved.

Recommendations.

A summary of recommendations follows:

General.

1) An overall joint ***intelligence*** strategy must be developed, of which IMINT is a part.

2) The joint imagery strategy must support the tenants of the National Security Strategy and the Military Strategy of the United States.

3) The joint imagery strategy must not only address requirements, but must support incorporation of state-of-the-art technology, maintain the industrial base, streamline acquisition, reconcile GDIP and TIARA resource management, and integrate foreign systems for burden sharing.

4) The Congress must see the strategy as necessary for the defense of the US as well as a part of the administration's strategy for meeting the domestic agenda (jobs and the economy).

5) The architecture must be joint and interoperable among all services, theaters, commands, and agencies involved in imagery. Standard interfaces must exist for forces in each theater so that they may easily "plug in," no matter the theater to which they are deployed.

6) The architecture must strive for interoperability with allies.

7) The architecture must incorporate the tenants of joint and service-unique warfighting doctrine. It should include planning for imagery support of deploying forces as outlined in the JSCP and for flexible deterrent options within each theater.

8) The architecture should have a regional warfighting focus, and thus a theater focus (based on regional contingencies and low probability of global conflict).

9) The architecture should avoid cuts in numbers of national and theater imagery collection and processing systems. Numbers of tactical systems can be adjusted according to the size of the force they must support.

Technology/R&D.

1) The architecture must incorporate technology as a force multiplier.

2) The architecture must ensure a robust R&D program during a period of declining budgets by taking cuts first in unnecessary infrastructure, combining similar service programs, and using joint funding of programs whenever possible.

3) Test and evaluation programs should be consolidated and centrally managed in conjunction with the R&D effort. Consistency and commonality in test methodologies and equipment should be a goal.

4) Each developing imagery or imagery-related technology should undergo a cost/benefit analysis to determine whether to procure or upgrade systems. A large increase in capability to increase national security or enhance the capability of the tactical commander to make decisions should determine whether to buy or put a particular technology on-the-shelf.

5) Commercial or government off-the-shelf technology should be used whenever possible to meet a requirement.

6) The CIO should coordinate a comprehensive R&D program for imagery systems (not necessarily as program manager) to include R&D by the NEL, NRO, service labs (JDL), systems commands, and industry through an imagery technology panel. The purpose would be to address duplication and overlap in imagery programs and to share requirements and ideas. Imagery technologies not already incorporated in Project Reliance should be identified and added to the project (infrared systems, digital storage, softcopy exploitation, artificial intelligence, and secondary dissemination).

7) **Adopt a strategy of influence rather than control** concerning proliferation of overhead and other imagery systems. Explore selling U.S. imagery technology or providing private industry assists for selected nations to develop their own imagery systems (space based and air breathing platforms).

Industrial base.

1) DoD should ensure that imagery technology is made available for use by the commercial sector whenever possible.

2) The CIO should commission a study to define the imagery associated industrial base. Use the study as a basis to formulate a strategy to ensure the appropriate industries are available for reconstitution of the imagery architecture or for surge production if necessary.

3) As a part of the above study, define critical imagery technologies in concert with the JDL and CIO in collection requirements management, collection, exploitation, dissemination, and communications.

4) Be prepared to sell imagery technology to selected foreign buyers as a means to ensure survival of the industrial base and maintain interoperability in allied or coalition operations.

5) Maintain contacts with industry on ongoing development of future technologies of interest to the imagery community such as neural networks for automatic change recognition and holographic storage mediums.

6) The CIO should maintain a database on the results of the industrial base study consisting of industries and their imagery related technologies based on the potential application of the technologies to imagery.

7) Forge agreements with industry to allow cost savings on technologies developed by private industry but with initial R&D done by DoD.

Resource management.

1) The TIARA program should consist of budgeting programs, rather than general accounting aggregations, that can be readily compared with GDIP programs.

2) The services should reconcile their GDIP and TIARA imagery programs early in the budget planning process.

3) The DCI and SECDEF should jointly develop a reconciled and mutually-supportable imagery budget by meeting under CIO auspices during the budget cycle by:

* Combining DCI and SECDEF guidance;
* Combining NFIP (GDIP) and TIARA budget timelines; and
* Submitting reconciled, aggregate intelligence (imagery) budget rather than two separate budgets.

4) The CIO should be given real budget authority as imagery functional manager to ensure configuration control over the imagery architecture. It should include the ability to consolidate, merge, cancel, or modify imagery programs based on adherence to standards or unneeded duplication.

5) Oversight of NFIP and TIARA by a single, joint Congressional committee rather than the two existing committees.

6) The CIO should have overview authority of CINC's initiative/discretionary funds used for imagery systems or programs to prevent duplication and to exercise configuration control over the imagery architecture.

7) The CIO should maintain a single data base of GDIP and TIARA imagery programs to promote reconciliation between the two.

8) Multi-year budgeting with annual review should be a goal to bring resource management in line with the acquisition cycle (requires a fundamental change in resource management).

9) The CINCs should submit **consolidated** imagery requirements and shortfalls to be incorporated into Defense Planing Guidance and service budgets. This means **detailed inter-theater planning**.

Acquisition.

1) Organize so that each service staff continues to work requirements and funding issues (with maximum use of joint program offices), while a professional **joint acquisition staff** supervises the programs and systems acquisition cycle.

2) Procure new technology only after that technology is thoroughly tested.

3) Insist on concurrent engineering practices (design concept, development, manufacturing, fielding, and support are a single process).

4) Shorten development time:

* Provide clear, concise requirements and a cutoff date for incorporation of newer technology, so that additional changes will be upgrades;
* Limit program reviews to how the money is spent and success at meeting stated requirements; and
* Provide program managers authority to proceed past agreed upon milestones.

Burden sharing.

1) Make imagery burden sharing a part of the imagery strategy for allied, U.N. and/or coalition operations.

2) Leverage alliances, bi-lateral, and multi-lateral defense agreements to negotiate mutual imagery and communications support agreements.

3) Act immediately to assist selected nations who wish to buy commercial imagery systems and negotiate use of those systems. Upon successful negotiations, act make those systems a modular portion of the U.S. imagery architecture.

4) Adopt a policy of influence rather than a policy of control in order to assist those nations wishing to build their own imagery architecture and foster interoperability and mutual support.

5) Negotiate now for mutual support agreements with those nations already having an imagery capability (space-based and air breathing).

6) Exercise resulting agreements.

7) Parcel out exploitation and dissemination to allies for their regions of the world (combined exploitation, possibly in the UK, Germany, Japan, or employ foreign personnel in combined exploitation centers partially funded and manned by foreign governments.

8) Explore the possibility of a U.N. combined intelligence center, incorporating an imagery segment (possible U.N. systems and ground stations for overhead imagery, manned and operated by international cadres.

Doctrine.

1) Develop an imagery doctrine from service and joint doctrine.

2) Ensure the first two tenants are jointness and interoperability.

3) Apply the principles of war to imagery and imagery systems.

4) Develop tactics, techniques, and procedures for imagery support.

Organization.

1) Within each service, construct an imagery architecture working group consisting of service staff (intelligence personnel and imagery users from operational backgrounds), service systems commands, budget personnel, TENCAP, communications personnel, service laboratory representatives, and other service users. Theater CINCs should be able to participate by being kept informed, sending representatives when they feel their interests would be served, and commenting on the process and the substance of the group's progress.

2) The CIO should construct an imagery architecture panel as the forum for bringing the service architectures together. It should consist of the services, DIA, CIA, DMA, NRO, JCS, and other organizations with an interest in the joint, integrated imagery architecture. The theater CINCs should be able to participate as in 1 above.

3) Because of unneeded redundancy and the need for the CINCs to provide imagery support directly to component forces, DIA should no longer do imagery exploitation. DIA imagery analyst billets and exploitation assets should be given to the JICs, including the NMJIC and future deployable JICs (possibly born of the JDIP-C). DIA should continue in its other roles in overseeing the service's S&T efforts (tasking), manage the development of some joint imagery systems, and reconcile theater requirements.

4) DIA should be the central repository of DoD digital imagery, accessible by theater JICs and other DoD and national agencies, facilitating the concept of the user "pulling" only the imagery he wants, rather than the distributor "pushing" quantities of imagery that may or may not be needed.

5) JICs should continue to be the imagery "hub" of each theater. Imagery incoming to theater in support of the CINC, a JTF, or components should first go to the JIC, unless the JIC or JTF has worked out temporary alternate means.

6) JICs should be the central digital imagery repository for the theater, with access given to the JTF or components, just as DIA is the central repository for the theaters (in 4 above).

7) Fuse service and DIA TENCAP organizations under a single joint TENCAP office to support joint and inter-theater applications of systems.

8) Joint Combat Camera should become a part of the architecture for special tasking and for dissemination. It should maintain a digital imagery database accessible by at least DIA, if not the JICs and other imagery agencies.

9) Intelligence planning for imagery (and other intelligence disciplines) support to forces must be incorporated into the JSCP planning and for FDOs.

Collection requirements management.

1) Incorporate collection management for multi-spectral imagery (LANDSAT/SPOT) into current architecture for national collection management.

2) Collection requirement management systems (RMS, CRMA, et al) should incorporate the capability to manage multi-spectral requirements.

3) A method to "count down" tactical, theater, and national collection against each other. The best method would be to electrically transmit a national systems target collection message for the next 24 hours that could be compared with the Air Tasking Order and potential tactical imagery targets. If a national system is scheduled to collect against a target and the parameters of the collection will satisfy the tactical requirement, then the tactical commander has the option of retargeting tactical imagery assets to other areas. The CRMA, which has a message reading capability, has the best potential as the software application to provide this service (modifications may be necessary).

4) DIA must ensure that the CRMA and the Requirements Management System (RMS) must have an automated interface. Another possibility is to merge the two programs at some future point to avoid having a multi-billion dollar, imagery only RMS system.

Collection.

1) Ensure the development and fielding of the ATARS system (the only digital, near-real-time system under development). Air Force and the Marine Corps currently have no active tactical imagery reconnaissance capability.

2) The NRO should work design and operation of national systems based on DoD and agency requirements. The E/D Study is a step in the right direction.

3) Tactical collection assets should remain under the authority of the tactical commander to be used at his discretion unless tasked by the CJTF (per the ATO). Although the DoD and DCI Directives establishing the CIO give that organization some authority to task collection assets, the CIO should make its requirements known through the theater JIC or the JTF, with the JTF being the final decision maker on tasking.

Processing and exploitation.

1) Procedures and responsibilities for exploitation and dissemination of national imagery must be worked out between the JICs and the deployed component JSIPS (and DIA if it remains in the exploitation business; see paragraph H.4 under Organization). This is even more important if a deployable JIC is moved to the CJTF's AOR.

2) Tactical commanders should generally have first priority on exploitation tasking by JSIPS,

service exploitation systems, and the JIC.

3) A rapid positioning capability should be available for all national imagery coming into theater. JSIPS should be modified to use formats for tactical imagery rapid positioning (not preprocessing the imagery into the JSIPS format). This would save money in the long run. The Common Mapping Standard may be a good choice of format to use.

4) Service schools should incorporate BDA standards developed by the Military Targeting Intelligence Committee into their curriculum.

5) Develop an affordable alternative to the IDEX softcopy system by using off the shelf components, not building compete redundancy into the system, and providing a capabilities package that will meet exploitation requirements without adding unneeded "bells and whistles" (i.e., an austere system).

6) Drop the CARS program. Build the JDIP-C (which incorporates CARS) into a deployable JIC.

Dissemination.

1) Negotiate an agreement among the services, theaters, and functional commands on standard crypto and keys, communications paths for imagery dissemination systems. INCA should apply their experience in ICARIS and LINCS.

2) Build a joint secondary dissemination system with selectable communications paths and compression ratios to provide flexibility in dissemination and image resolution.

3) Expand the file server concept in the various theaters and provide standards for directories, file naming conventions, and query structures between theaters under the auspices of the CIO.

Communications.

1) Make communications the first priority for funding and development for the imagery architecture.

2) Leverage foreign as well as U.S. commercial satellites for communications.

3) Coordinate disparate efforts to enhance imagery communications under CIO auspices. This includes LINCS, Trojan Spirit, DoD SATCOM, and commercial SATCOM, as well as separate service R&D.

4) Push for a comprehensive communications architecture to complement an intelligence architecture, and thus the imagery architecture.

GLOSSARY

AFSATCOM: Air Force Satellite Communications

AOR: Area of Responsibility

ARG: Amphibious Ready Group

ARPA: Advanced Research Projects Agency (same as DARPA)

ASAS: All Source Analysis System

ASD/C3I: Assistant Secretary of Defense for Command, Control, Communications and Intelligence

ATARS: Advanced Tactical Airborne Reconnaissance System

ATO: Air Tasking Order

BDA: Battle Damage Assessment

CAMS: COMIREX Automated Management System

CARS: Contingency Airborne Reconnaissance System

CCP: Consolidated Cryptologic Program

CENTCOM: Central Command

CHBDL: Common High Bandwidth Datalink

CIA: Central Intelligence Agency

CIAP: Command Intelligence Architecture Program or Central Intelligence Agency Program

CIO: Central Imagery Office

CINC: Commander in Chief

CJTF: Commander Joint Task Force

CMS: Community Management Staff

CMST: Collection Management Support Tool

COE: Common Operating Environment

COMIREX: Committee for Imagery Requirements and Exploitation

COMSAT: Communications Satellite

CONUS: Continental United States

COTS: Commercial Off-the-Shelf

CPBS: Capabilities Programming and Budgeting System

CRM: Collection Requirements Management

CRMA: Collection Requirements Management Application

CVBG: Carrier Battle Group

DARPA: Defense Advanced Research Projects Agency

DIA: Defense Intelligence Agency

DISA: U.S. Defense Information Systems Agency

DCI: Director of Central Intelligence

DIWS: Digital Imagery Workstation

DMA: Defense Mapping Agency

DoD: Department of Defense

DSCS: Defense Satellite Communications System

DVITS: Digital Video Imagery Transmission System

EHF: Extremely High Frequency

EUCOM: European Command

FBI: Federal Bureau of Investigation (Department of Justice)

FCIP: Foreign Counterintelligence Program

FDO: Flexible Deterrent Option

FIST: Fleet Imagery Support Terminal

FLTSATCOM: Fleet Satellite Communications

FSTC: Foreign Science and Technology Center

GDIP: General Defense Intelligence Program

HF: High Frequency

HPSCI: House Permanent Select Committee on Intelligence

HUMINT: Human Intelligence

IAS: Imagery Architecture Study in the context of the imagery architecture studies or Intelligence Analysis System in the Context of the Marine Corps intelligence fusion system.

IDEX: Imagery Digital Exploitation System

IEW: Intelligence and Electronic Warfare

IMINT: Imagery Intelligence

INCA: Intelligence Communications and Architectures (a branch of IPSG under ASD/C3I)

INR: State Department Bureau of Intelligence and Research

INT: Intelligence (usually signifying HUMINT, SIGINT, IMINT, or MASINT)

IOC: Initial Operating Capability

IPDS: Imagery Processing and Dissemination System (Army JSIPS)

IPSG: Intelligence Program Support Group

ITAC: Intelligence Threat Analysis Center

JCS: Joint Chiefs of Staff

J-DIPC: Joint- Deployable Imagery Processing Concept

JDISS: Joint Deployable Intelligence Support System

JDL: Joint Directors of Laboratories

JIC: Joint Intelligence Center

JIPC: Joint Imagery Production Complex

JSIPS: Joint Services Imagery Processing System

JTF: Joint Task Force

JSCP: Joint Strategic Capabilities Plan

JWICS: Joint Worldwide Intelligence Communications System

LANDSAT: U.S. commercial multispectral imaging satellite. The next system will be owned and operated by DoD and NASA.

LANTCOM: Atlantic Command

LEASAT: Leased Satellite (commercial satellite leased by the Navy)

LINCS: Long-Range Imagery Networked Communications

LVDS: Low Volume Dissemination System

MAG: Maritime Action Group

MAGTF: Marine Air Ground Task Force

MASINT: Measurements and Signatures Intelligence

MIB: Military Intelligence Board

MILSTAR: Military Strategic and Tactical Relay

MIPE: Mobile Imagery Processing Equipment

MVS: Mission Verification System

NEL: National Exploitation Lab

NFIP: National Foreign Intelligence Program

NIESP: National Intelligence Emergency Support Program

NITF-S: National Imagery Transmission Format-Standards

NMJIC: National Military Joint Intelligence Center

NPIC: National Photographic Interpretation Center

NRO: National Reconnaissance Office

NSA: National Security Agency

NTCS-A: Naval Tactical Command System- Afloat

OSD: Office of the Secretary of Defense

PACOM: Pacific Command

PPDB: Point Positioning Database

R&D: Research and Development

RDT&E: Research, Development, Testing and Evaluation

RMS: Requirements Management System

SAG: Surface Action Group

SATCOM: Satellite Communications

S&T: Science and Technology when in the context of service laboratories; Scientific and Technical when used in the context of service intelligence agencies.

SECDEF: Secretary of Defense

SHF: Super High Frequency

SIDS: Secondary Imagery Dissemination System

SIGINT: Signals Intelligence

SPOT: French commercial multispectral imaging satellite

SSCI: Senate Select Committee on Intelligence

STAR: Satellite Tracking and Reporting

TARPS: Tactical Air Reconnaissance Pod System

TENCAP: Tactical Exploitation of National Capabilities

TIARA: Tactical Intelligence and Related Activities

TRANSCOM: Transportation Command

TREDS: Tactical Reconnaissance Exploitation Demonstration System

TRIGS: TR-1 Imagery Ground Station

UAV-CR: Unmanned Aerial Vehicle-Close Range

UAV-MR: Unmanned Aerial Vehicle-Medium Range

UAV-SR: Unmanned Aerial Vehicle-Short Range

UK: United Kingdom

UFO: UHF Follow-on Satellite

UHF: Ultra High Frequency

UNAAF: Unified Action Armed Forces

U&S: Unified and Specified

VLDS: Very Large Data Storage

UN: United Nations

APPENDIX A

MEMORANDUM FOR CORRESPONDENTS: DECLASSIFICATION OF THE EXISTENCE OF THE NATIONAL RECONNAISSANCE OFFICE

The following is the press release from the Department of Defense:

"The Department of Defense today declassifies the existence of the National Reconnaissance Office (NRO).

The NRO is organized as an agency of the Department of Defense and funded through a program known as the National Reconnaissance Program (NRP). It is the single, national program to meet US government intelligence needs through spaceborne and assigned airborne reconnaissance.

The mission of the NRO is to ensure that the US has the technology and spaceborne and airborne assets needed to acquire intelligence worldwide, including to support such functions as monitoring of arms control agreements, indications and warning and the planning and conduct of military operations. The NRO accomplishes the mission through research and development, acquisition, and operation of spaceborne and airborne data collection systems. The Secretary of Defense has the ultimate responsibility, which is exercised in concert with the Director of Central Intelligence, for management and operation of the NRO and the Director of the NRO reports to the Secretary. The Director of Central Intelligence establishes the collection priorities and requirements for the targeting of NRP operations and the frequency of coverage, approves along with the Secretary of Defense the NRP budget, provides security policy guidance for the NRP, and guides and participates in the formulation of the NRP through the Director of the NRO. The Director of the NRO has responsibility for executing the NRO's programs, which the Director accomplishes through the Department of Defense and Central Intelligence Agency.

The director of the National Reconnaissance Office is the Honorable Martin C. Faga. He is also the Assistant Secretary of the Air Force for Space and Director of the Defense Support Project Office (DSPO). The NRO deputy director is Mr. Jimmie D. Hill who is also the principal deputy assistant for space. The NRO deputy director for military support is Rear Admiral Daniel P. March, USN, who also serves on the Joint Staff as Deputy Director for Operations (J-3), national systems support. Their offices are located in the Pentagon.

Beyond confirming the existence of the NRO, other matters will remain classified, including those dealing with operations, methods, scope of activities, facilities, and personnel. The National Reconnaissance Office has established a public affairs staff within its Offices of External Relations. They can be reached at the Pentagon, Room 4C1000, telephone (703) 979-6472."[85]

Department of Defense

DIRECTIVE

May 6, 1992

NUMBER 5105.56

SUBJECT: Central Imagery Office (SA)

References: (a) Title 10 of the United States Code

(b) National Security Act of 1947

(c) Executive Order 12333, "United States Intelligence Activities," December 4, 1981

(d) DOD Directive 5240.1, "DOD Intelligence Activities," April 25, 1988

(e) DOD 5240.1-R, "Procedures Governing the Activities of DOD Intelligence Components That Affect United States Persons," December 3, 1982.

(f) DOD Directive 7750.5, "Management and Control of Information Requirements," August 7, 1986

A. PURPOSE AND APPLICABILITY

1. This Directive establishes a Central Imagery Office (CIO) within the Department of Defense to ensure that United States Government intelligence, mapping, charting and geodesy, and other needs for imagery are met effectively and efficiently in a manner conducive to national security, consistent with the authorities and duties of the Secretary of Defense and the Director of Central Intelligence under references (a), (b), and (c).

2. This Directive applies to the Office of the Secretary of Defense, the Military Departments; the Chairman of the Joint Chiefs of Staff and the Joint Staff; the Unified and Specified Combatant Commands; the Defense Agencies; and DOD Field Activities.

B. MISSION

The CIO shall provide support to the Department of Defense, the Central Intelligence Agency, and other Federal Government departments and agencies on matters concerning imagery relating to the national security.

C. ORGANIZATION AND MANAGEMENT

The CIO is hereby established as a defense agency of the Department of Defense under reference (a) and is hereby designated as a combat support agency. The Assistant Secretary of Defense for Command, Control, Communications, and

Intelligence shall exercise overall supervision over the Central Imagery Office. The CIO shall consist of a Director of the Central Imagery Office and such subordinate organizational elements, including the central imagery tasking authority required by Section E.1.d., as the Director establishes within the resources made available.

D. RESPONSIBILITIES AND FUNCTIONS

The Director of the CIO shall:

1. Organize, direct, and manage the CIO and all assigned resources;

2. Manage the establishment of national imagery collection requirements consistent with guidance received from the Director of Central Intelligence under reference (c);

3. Ensure responsive imagery support to the Department of Defense, the Central Intelligence Agency, and, as appropriate, other Federal Government departments and agencies, including by coordination of imagery collection tasking, collection, processing, exploitation, and dissemination.

4. Task imagery collection elements of the Department of Defense to meet national intelligence requirements, including requirements established by the Director of Central Intelligence in accordance with references (b) and (c), except that the Director of the CIO shall advise an imagery collection element on collection of imagery to meet such national intelligence requirements when the collection element both (a) is assigned to or under the operational control of the Secretary of a Military Department or a commander of a unified or specified command and (b) is not allocated by the Secretary of Defense to meet national intelligence requirements.

5. Advise imagery collection elements of the Department of Defense on the collection of imagery to meet non-national intelligence requirements;

6. Establish, consistent to the maximum practicable extent with the overall functional architectures of the Department of Defense, the architectures for imagery tasking, collection, processing, exploitation, and dissemination within the Department of Defense, and, to the extent authorized by the heads of other departments or agencies with imagery tasking, collection, processing, exploitation, and dissemination functions establish the architectures for imagery tasking, collection, processing, exploitation, and dissemination within those departments or agencies;

7. Establish, in coordination with the Director of the Defense Information Systems Agency as appropriate, standards for imagery systems for which the Department of Defense has responsibility and ensure compatibility and interoperability for such systems, and, to the extent authorized by the heads of other departments or agencies with imagery systems establish standards and ensure compatibility and interoperability with respect to the systems of those departments or agencies,

8. Serve as the functional manager for a Consolidated Imagery Program within the National Foreign Intelligence Program consistent with applicable guidance

received from the Director of Central Intelligence in accordance with references (b) and (c);

9. Serve as the functional manager for the Tactical Imagery Program within the budget aggregation known as the Tactical Intelligence and Related Activities;

10. Evaluate the performance of imagery components of the Department of Defense in meeting national and non-national intelligence requirements, and to the extent authorized by the heads of other departments or agencies with imagery tasking, collection, processing, exploitation, and dissemination functions evaluate the performance of the imagery components of those departments or agencies in meeting national and non-national intelligence requirements;

11. Develop and make recommendations on national and non-national imagery policy, including as it relates to international matters, for the approval of appropriate Federal Government officials;

12. Support and conduct research and development activities related to imagery tasking, collection, processing, exploitation, and dissemination, consistent with applicable law and Department of Defense directives;

13. Protect intelligence sources and methods from unauthorized disclosure in accordance with guidance received from the Director of Central Intelligence under references (b) and (c);

14. Ensure the compliance of the CIO with references (a), (b), (c), (d) and (e) and other applicable laws and Department of Defense directives;

15. Establish standards for training personnel performing imagery tasking, collection, processing, exploitation, and dissemination functions;

16. Advise the Secretary of Defense and the Director of Central Intelligence on future needs for imagery systems;

17. Ensure that imagery systems are exercised to support military forces; and

18. Perform such other functions related to imagery as the Secretary of Defense may direct.

E. RELATIONSHIPS

1. In performing assigned functions, the Director of the CIO shall:

a. communicate directly with the heads of Department of Defense components concerning imagery matters as appropriate;

b. maintain liaison with Executive branch entities on imagery matters as appropriate;

c. to the extent permitted by law, make use of established facilities and services in the Department of Defense or other governmental agencies, whenever practicable, to achieve maximum efficiency and economy, with special emphasis on maximizing use of the existing personnel, facilities, and services of the Defense

Intelligence Agency, the Defense Mapping Agency, the National Security Agency, and, to the extent authorized by the Director of Central Intelligence, the Central Intelligence Agency; and

d. establish within the CIO a central imagery tasking authority to execute the imagery collection tasking authority of the Director of the CIO.

2. The Secretaries of the Military Departments, the Chairman of the Joint Chiefs of Staff, and the heads of other Department of Defense components shall support the Director of the CIO in the performance of the Director's functions, including by:

a. ensuring compliance with national intelligence tasking issued under paragraph D.4 above;

b. ensuring compliance with the architectures and standards established by the Director of the CIO under paragraphs D.6, D.7, and D.15 above;

c. assisting the Director in his role as functional manager for the Consolidated Imagery Program and the Tactical Imagery Program under paragraphs D.8 and D.9 above; and

d. submitting imagery collection requirements to the Director.

F. DELEGATIONS OF AUTHORITY

1. The Assistant Secretary of Defense for Command, Control, Communications and Intelligence is hereby delegated the authority to issue instructions to Department of Defense components to implement this Directive. Instructions to the Military Departments shall be issued through the Secretaries of the Military Departments. Instructions to the commanders in chief of the unified and specified commands shall be issued through the Chairman of the Joint Chiefs of Staff.

2. The Director of the CIO is hereby delegated the authority to obtain reports, information, advice, and assistance, consistent with reference (f), as necessary, in the performance of the Director's assigned functions.

G. ADMINISTRATION

1. The Director of the Central Imagery Office shall be appointed by the Secretary of Defense on the recommendation of the Director of Central Intelligence.

2. The Director of the Central Imagery Office shall obtain administrative support, including personnel, budget execution, and contracting services, from the Defense Intelligence Agency and, to the extent permitted by law and approved by the Secretary of Defense and the Director of Central Intelligence, the Central Intelligence Agency.

3. Resources for the Central Imagery Office shall be provided through the National Foreign Intelligence Program and the budget aggregation known as Tactical Intelligence and Related Activities, in accordance with applicable planning, programing, and budgeting system processes.

H. EFFECTIVE DATE

This Directive shall take effect immediately.

Secretary of Defense

APPENDIX C

FRAGMENTATION OF IMAGERY RESOURCES MANAGEMENT

REASONS FOR FRAGMENTATION OF IMAGERY RESOURCE MANAGEMENT

1) There are two major portions of the intelligence budget: the National Foreign Intelligence Program (NFIP) and the Tactical Intelligence and Related Activities (TIARA) Program, each with its own sub-programs. NFIP and TIARA use different budgeting systems to support the budgeting process. The NFIP uses the Capabilities Planning and Budgeting System (CPBS) and TIARA uses the Planning, Programming, and Budgeting System (PPBS).[86]

2) While the NFIP is fenced and centrally managed as an intelligence budget by the DCI, there is ***no central management office for TIARA***. The funds are spread throughout DoD and managed independently. TIARA programs actually compete with other combat and combat support programs.

3) The services and national organizations still work within their own budgets, each of which has its own rankings and priorities, all of which are submitted by organizations competing furiously for less and less money.

4) The CIO has been given the mission to reconcile NFIP (GDIP for DoD imagery programs) and TIARA imagery programs, but has not been given any real budget authority as the imagery functional manager aside from program review . Duplication and adherence to standards can be monitored, but adherence to a single architecture cannot be directly enforced.

5) There are still oversight structures within DoD that in part duplicate (and thus complicate) the CIO's job of reconciling the two programs. One such organization is the Intelligence Program Support Group (IPSG) under the Assistant secretary of Defense for Command, Control, Communications and Intelligence (ASD C3I).

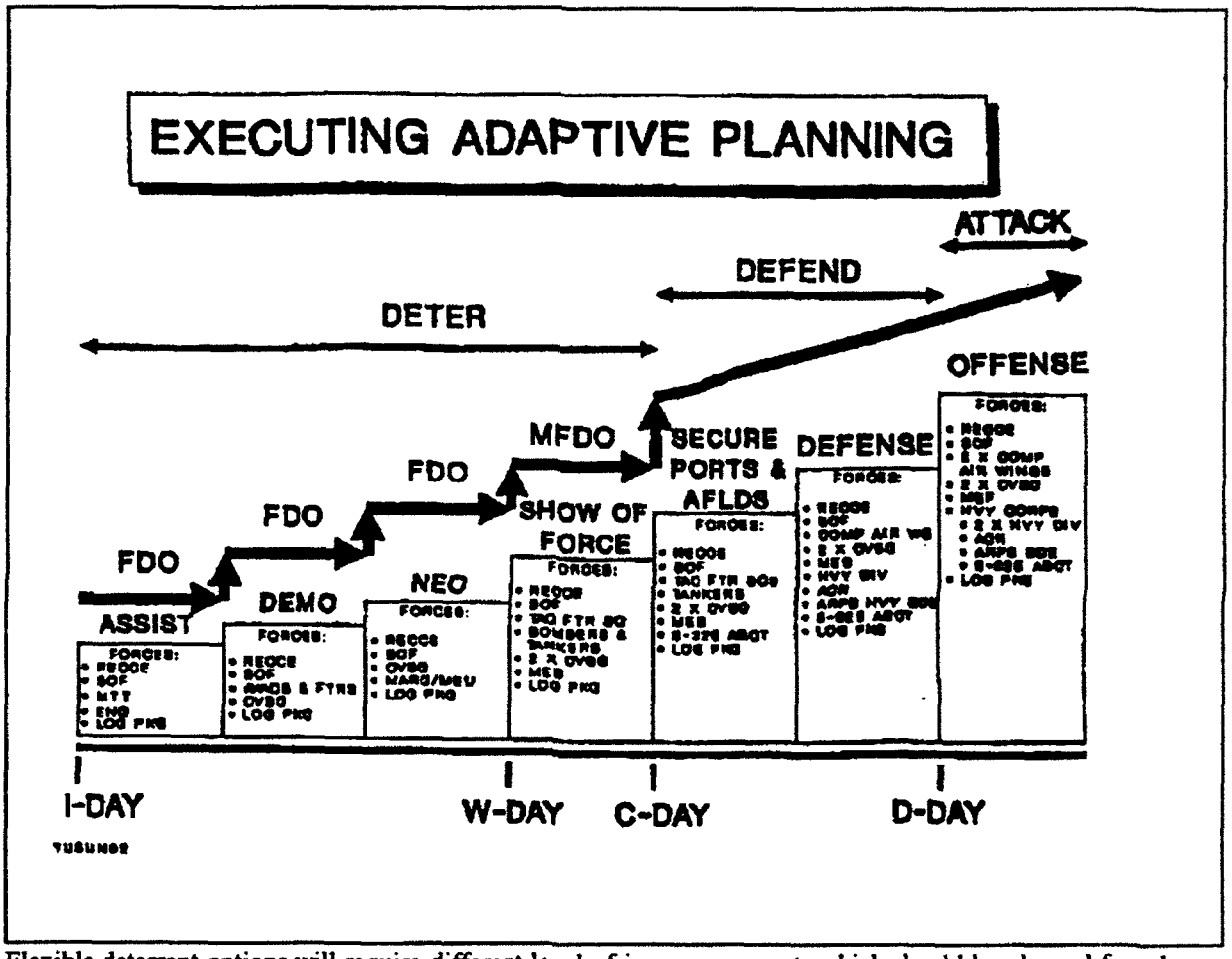
6) The separation of the NFIP (GDIP) and TIARA programs is not always crystal clear. In a significant number of cases, programs or systems cross the line between national and tactical support. There are many cases where TIARA funds support an NFIP program or vice versa. If a system somehow supports the tactical commander, even though it is a national system, TIARA can fund it. If a tactical system supports the national leadership, NFIP can fund it.

7) The differences between many national and tactical programs and systems have blurred. Desert Shield and Desert Storm were illustrative of this phenomena. Throughout the crisis commanders were provided intelligence normally associated with national support, such as imagery and SIGINT from national technical means, and came to depend on it to make tactical decisions. The national leadership was constantly looking for tactical information, such as gun camera film or prisoner debriefs, to help make decisions or give them insight into the conduct of operations. Communications technology has made this possible.

8) Congressional oversight consists of two separate committees with inconsistent authority to mark the intelligence budget. The Senate Select Intelligence Committee (SSCI) has authority only over NFIP. The House Permanent Select Intelligence Committee (HPSCI) has authority over NFIP and TIARA.

APPENDIX D

FLEXIBILITY IS REQUIRED AS A PART OF IMAGERY DOCTRINE.[87]



Flexible deterrent options will require different level of imagery support, which should be planned for when allocating forces.

APPENDIX E

EXAMPLES OF MAJOR JOINT COLLECTION REQUIREMENT MANAGEMENT SYSTEMS

SYSTEM	ACRONYM	IOC	LEVEL	REMKS
COMIREX Automated Management System	CAMS	In service	1) National 2) Theater 3) DoD & service intel centers	To be replaced in FY 95 by RMS. Imagery only.
Requirements Management System	RMS	FY 95	same as CAMS	Completed Critical Design Review. To replace CAMS. Imagery only.
Collection Requirements Management Application	CRMA	FY 93 (possible interim CRM system until RMS is on line in FY 95).	Theater & components	Originally was CMST (Navy version). Multi-INT. May combine best of CMST & Swifthawk.
Collection Requirements Management Tool	CMST	In service	Theater & components	Navy version is version 1.0 of CRMA. To be phased out. Multi-INT.
Swift Hawk	N/A	In service	Theater & components	To be phased out for CRMA. Multi-INT.

APPENDIX F

EXAMPLES OF MAJOR JOINT COLLECTION SYSTEMS*

SYSTEM	ACRONYM	IOC	TASKED BY	SERVICE USE	REMARKS
U-2 and associated cameras and imagery systems	N/A	In service	1. National 2. Theater 3. Components may task via theater. 4. Services may task via national.	Air Force Program. Other services use product.	Few systems. Wide area coverage capable.
LANDSAT	N/A	In service	1. Theater 2. Components 3. Services 4. Commercial users. Tasking has been done via EOSAT.	All services use product for mission planning systems	DoD & NASA combined to purchase LANDSAT in 1992. Improved system to be launched in 1996.
Advanced Tactical Airborne Reconnaissance System	ATARS	1. FY 94 Marines 2. FY 99 Navy 3. FY 95 Air Force	1. CJTF 2. Components 3. CIO may forward requirements	Navy/USMC:77 Air Force: 50 525 for UAV-MR	Development delays and funding problems make this a turbulent program.
Unmanned Aerial Vehicle Close Range	UAV-CR	FY 98[88]	Tactical unit :division, brigade, battalion	System numbers:[89] 1. Army: 54 2. USMC: 111	Real time tv and FLIR video
Unmanned Aerial Vehicle Short Range	UAV-SR	FY 94[90]	1. Army: Corps/division 2. USMC: MEF	numbers:[91] 1. Army: 27 2. USMC: 18 3. Training: 3	Real time tv and FLIR video
Unmanned Aerial Vehicle Medium Range	UAV-MR	Navy/USMC: FY 97 Air Force: FY 98	Battle Group, MEF, Corps, Wing	numbers:[92] 1. Navy: 215 2. USMC: 50 3. Air Force: 260	Carries ATARS sensors. Near-real-time imagery processed by JSIPS
Unmanned Aerial Vehicle Endurance	UAV Endurance	To be determined	To be determined	numbers to be determined	Objective to procure a long duration near-real-time unmanned reconnaissance UAV
Pioneer Unmanned Aerial Vehicle	Pioneer UAV	In service	1. Army: one Company w/5 vehicles at Army Intel Center 2. Marines	1. Army 2. Navy 3. Marines	Real time TV video and FLIR. Navy to fly from amphibious ships

Note:
1) not all existing systems are represented in this chart
2) numbers of UAV's for each service may be revised

APPENDIX G

EXAMPLES OF MAJOR JOINT PROCESSING AND EXPLOITATION SYSTEMS*

SYSTEM	ACRONYM	IOC	LEVEL	SERVICE	REMARKS
Joint Service Imagery Processing System	JSIPS	FY 95 Air Force funding & procurement schedule under review[93]	1. Theater 2. Component	1. Army: 2 2. Navy:15 3. Marines:2 4. Air Force:2	Services to buy in different configurations.
Contingency Airborne Reconnaissance System	CARS	FY 94	1. Theater	This is an Air Force Program. Services would share products.	For U-2 processing (digital radar data). Not compatible with other collection systems.
Joint-Deployable Intelligence Processing Concept	J-DIPC	N/A (concept to be agreed upon)	1. Theater	DIA concept in response to tasking by Military Intelligence Board 25 JUN 92.	U-2R, CARS, JSIPS, and MIPE would be core of system. Concept to become Mission Needs Statement.
Imagery Digital Exploitation II	IDEX II	In service	1. National 2. Theater 3. Service Intel Centers	1. Army 2. Air Force Also in use by the theater JICs, CIA, NPIC, and DIA.	Digital softcopy imagery w/ online database support. CIO looking at IDEX/JSIPS interface to provide reference imagery to JSIPS and to move tactical imagery for IDEX exploitation.
Eagle Vision	N/A	Proposed system delivery for testing in FY 94, testing throughout FY 95, and contract award in FY 96.[94]	1. Theater	N/A	Proposed multispectral imagery deployable satellite ground receiving station, built in part by Matra MS2i of France, to be used for receiving LANDSAT and SPOT satellite imagery.

*Note: Not all existing systems are represented in this chart

APPENDIX H

EXAMPLES OF MAJOR JOINT DISSEMINATION SYSTEMS*

	ACRONYM	IOC	COMMS	REMARKS
Joint Deployable Intelligence Support System	JDISS	LANTCOM, PACOM, CENTCOM, EUCOM & DIA receive first version FY 93. Upgrades & additional systems through FY 99.[93]	DDN, theater comms for bulk data transfer (secondary imagery).	Automated intel support to deployed JTF. Besides imagery, will offer access to theater/component data bases, map overlay & annotation, access to theater message handling system.
Low Volume Dissemination System*	LVDS	FY 93	DDS, theater comms for national imagery.	Will serve as receiver for primary imagery.
Joint Worldwide Intelligence Communications System	JWICS	In service	High Capacity dedicated (T1 or 1.54 Megabits/sec) secure comms.	Multimedia connectivity for intelligence.
Fleet Imagery Support Terminal	FIST	In service	FLTSATCOM (UHF, SHF)	NITF-S and TACO 2 compatible.
Digital Video Imagery Transmission System	DVITS	In service	HF line of sight. Can be used with UHF or SHF comms.	NITF-S and TACO 2 compatible. Required by CENTCOM for component forces in theater.

Note:
1) The LVDS is being considered as the National Input Segment to JSIPS
2) Not all existing systems are represented in this chart

APPENDIX I

EXAMPLES OF MAJOR COMMUNICATIONS SYSTEMS AND PROGRAMS*

SYSTEM	ACRONYM	IOC	REMARKS
Defense Dissemination System	DDS	In service	Wideband digital data for primary imagery
Defense Data Network	DDN	In service	Packet switching network consisting of the Military Network, Movements Info Network, DoD Intel Info System, DARPA Intercomputer Network
Defense Integrated Secure Network	DSNET	In service	Wideband secure comms. Will be used by RMS.
Imagery Communication and Requirements System Program	ICARIS	Tasked by Congress in FY 91	Architecture planning program
Defense Satellite Communication System	DSCS	In service	4 active, 2 spares. UHF/SHF voice & high data rate comms.
Commercial	INTELSAT, INMARSAT, LEASAT	In service	SHF capable available to DoD for lease.
Long Range Imagery Networked Communication System Program	LINCS	FY 93: EUCOM, CENTCOM, SOCOM FY 94: PACCOM, SOUTHCOM, FORSCOM FY 95: LANTCOM, STRATCOM, SPACECOM, TRANSCOM	Secondary Imagery Dissemination network for U&S Commands using tactical and commercial circuits
Defense Information Systems Network	DISN	In service	Administrative and tactical networks. Replaces 170 networks. Includes worldwide televideo conferencing.
National Military Intelligence Support System	NMIST	In service	Deployable, dedicated comms to DIA. Will transition to JDISS.

*Note: not all existing systems are represented in this chart

APPENDIX J

EXAMPLES OF UNIQUE ARMY IMAGERY SYSTEMS*

	SYSTEM	ACRONYM	IOC	LEVEL	REMARKS
Collection	Side Looking Airborne Radar (on OV-1D Mohawk aircraft)	SLAR	In service	Corps: 10 aircraft being phased out. To be replaced by JSTARS.	OV-1D will be phased out.
	Small Aerostat Surveillance System	SASS (or SBO for seaborne observation balloon)	In rework	Theater	Used in counternarcotics
	Airborne Reconnaissance Low Intensity	ARL	FY	Echelon above Corps: 1	IRLS, FLIR and daylight TV.
Processing & Exploitation	All Source Analysis System	ASAS	FY 93	Corps and Division	Database management, fusion analysis
	Imagery Exploitation System (now Modernized Imagery Exploitation System)	IES (now MIES)	IES in service with XVIII Airborne Corps at Fort Bragg and USAREUR in Germany. MIES IOC NOV 93	Corps and echelon above Corps (only 2 systems)	IES is interim solution prior to IPDS baseline[97] Used in Just Cause and Desert Storm. MIES improves maintainability, integrates lessons from Gulf War.
	Enhanced Tactical Users Terminal	ETUT	In service	All Corps and selected EAC MI Brigades	Receive secondary imagery from IPDS
	Tactical High Mobility Terminal	THMT	In service	Corps: to move to division as replaced by MITT	Receive secondary imagery from IPDS
	Mobile Integrated Tactical Terminal	MITT	FY 93 Ft Bragg & Ft Campbell FY 94 Korea & Ft Ord	Corps, Division, Brigade, Special Forces	Provides IMINT & SIGINT data. Five prototypes before full scale production.
	Tactical Radar Correlator	TRAC (now enhanced TRAC or ETRAC)	In service	Usually located with IPDS	Receives & processes U-2 ASARS imagery.
Communications	Integrated Data Transmission System	IDTS	In testing	Can be used by small combat unit up to division	Integration of VHF Single Channel Ground & Airborne Radio System (SINCGARS) and Mobile Subscriber Equipment Network (MSE). Manpack or larger (only up to 6kbps).
	Trojan Spirit	N/A	In service	EAC: 3 Corps: 3 Division: 3	Digital imagery receive/transmit capability. Fourteen circuits. Worldwide data base access.

*Note: not all existing systems are represented in this chart

APPENDIX K

EXAMPLES OF UNIQUE NAVY IMAGERY SYSTEMS*

	SYSTEM	ACRONYM	IOC	USED BY:	REMARKS
Collection Systems	Phototelesis	N/A	In service	Reef Point	Counternarcotics
	Handheld	N/A	In service	1.Each aircrew 2. Shipboard teams	Film based
	Forward Looking Infrared	FLIR	In service	1. F/A-18 2. A-6E 3. S-3B 4. P-3 B&C	The F/A-18, the A-6E, the S-3B, the P-3 all have FLIR systems which have incompatible output.
	Reef Point	N/A	In service	Theater	Specially configured P-3 that can carry a number of imaging systems
	UPG-73 radar	N/A	FY 98 (requires ATARS downlink to transmit data)	Navy, Marine airwings	F/A-18 radar to be used in strip map mode. Provides all weather imaging capability.
Processing & Exploitation	NTCS-A Imagery Exploitation Workstation	NIEWS	In service	All major combatants will have a version of NTCS-A.	Shipboard LAN that will link C3I functions, allows imagery transfer within a ship, carries SIDS application
	Digital Imagery Workstation	DIWS	FY 95	Aircraft carriers with the APS.	Exploitation workstation for APS and Navy JSIPS
	Digital Imagery Processing System	DIPS	In service at Navy S&T Center (1 system)	Office of Naval Intelligence.	One System in use by Office of Naval Intelligence in Suitland. Maryland.
	Afloat Processing System	APS	FY 95	Carriers, shore installations	Imagery related cruise missile route planning
Dissemination	Fleet Imagery Support Terminal	FIST	In service	Carriers, amphib ships, shore	Navy SIDS
Communications	Common High Bandwidth Data Link	CHBDL	FY 94	Carriers	Antenna/terminal to allow transfer of digital data
	UHF Follow-On Satellite	UFO	First launch in April 1993 failed to reach orbit	All FLTSAT and LEASAT users	Increased UHF bandwidth and EHF payload to complement MILSTAR.

*Note: not all existing systems are represented in this chart

APPENDIX L

EXAMPLES OF UNIQUE MARINE CORPS IMAGERY SYSTEMS*

	SYSTEM	ACRONYM	IOC	USER	REMARKS
Collection	Handheld	N/A	In service	MAGTF	Records on digital disk to eliminate film processing
Processing & Exploitation	Intelligence Analysis System	IAS with CRMA	FY 95	MAGTF	Intel fusion for MAGTF Commander. Interface with JSIPS.
	Imagery Interpretation Subsystem (II)	AN/TYQ-12	In service	Marine Air Wing	Replaces IAC (below). Two stations for interpretation of multi-sensor imagery in 8'X8'X20' shelter.
	Digital Terrain Analysis Mapping Center	DTAMS	In service	SRIG topographic platoon	Procured with local funds.
	Intelligence Analysis Center	IAC	In service	MEF	Interfaces with AN/TYQ-12. One shelter.
	MEF Multispectral Imagery Workstation	MMIWS	In service	SRIG topographic platoon	Can use DMA digital data
	Topographic Mapping Set	TMS	In service	SRIG topographic platoon	Replaces MMIWS. Digital output to include photo mosaics. Supports IAS and JSIPS.
Dissemination	PC-Laptop Imagery Transmission Equipment	PC-LITE	In service	MAGTF	Portable secondary imagery system.
Communication	Digital Wideband Communication System	DWCS	In service	MAGTF	Portable radio

*Note: not all existing systems are represented in this chart

APPENDIX M

EXAMPLES OF UNIQUE AIR FORCE IMAGERY SYSTEMS*

	SYSTEM	ACRONYM	IOC	UNIT	REMARKS
Collection Systems	F-16R	Falcon	FY 94	Wing, squadron	Will carry an ATARS pod. Procurement planned for 54.
Processing & Exploitation	Mission Verification System	MVS	FY 94	squadron: 14 to be procured (5 with data link interface to support JFACC and TAC)	Mission review, results validation, sensor performance & pilot feedback.
Communication	Sentinel Byte	N/A	In service	Wing	Imagery capable

Note: not all existing systems are represented in this chart

ENDNOTES

[1]Colonel Roy K.Jonkers (USAF Ret), American Intelligence Journal (Winter/Spring 1992): 5.

[2]National Defense University, Joint Warfare of the US Armed Forces, Joint Pub 1 (Washington, D.C.: U.S. Government Printing Office,11 NOV '92), 32. From Miyamoto Musashi, A Book of Five Rings, translated by Victor Harris (Woodstock, New York: The Overlook Press, 1982), 48.

[3]Yost, Graham, Spy Tech (New York: Facts On File Publications, 1985), 20.

[4]Yost, Graham, "The Spy Planes: Early Reconnaissance", Spy-Tech (New York: Facts On File Publications, 1985),11.

[5]The existence of the NRO was acknowledged in a 18 September, 1992 news release from the Department of Defense (see appendix A). News of the agency's existence has been printed in various newspaper accounts including:
a) Barton Gellman, "Remember, You Didn't Read It Here", Washington Post,19 September, 1992, p. 4.
b)Associated Press, "Secret Satellite Agency Finally Loses Its Cover", Chicago Tribune,20 September, 1992, p. 12.
c) Eric Schmitt, "Spy-Satellite Unit Faces A New Life in Daylight", The New York Times,3 November 1992, p. A16.

[6]The Command Intelligence Architecture Program (CIAP) was formerly the Theater Intelligence Architecture Program (TIAP).

[7]INCA is a directorate of the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (OASD C3I) Intelligence Programs Support Group (IPSG). It assumed responsibility for the CIAP program from DIA. Three documents in the CIAP program are prepared by each CINC: the Command Intelligence Architecture Document, the Command Intelligence Implementation Document, and the Command Intelligence Strategy Document. Along with management of the CIAP, INCA is responsible for the overall development and integration of intelligence architectures.

[8]From a paper copy of a briefing slide(no title)given by Mr. Bill Lackman (Director Central Imagery Office) concerning the CIO's vision, mission, and functions, 1992, Central Imagery Office(CIO). Various wordings of this statement may be seen around the intelligence community.

[9]Boren, David L., "102nd Congress-2d Session", American Intelligence Journal, 13, No. 1 & 2 (Winter/Spring, 1992): 7.

[10]The problems experienced in Desert Shield and Desert Storm highlight the fact that in a global war scenario, as envisioned during the Cold War, imagery support may have been completely inadequate given increased volumes for tasking, exploitation, and dissemination and the existing communications capabilities at the time.

[11]Boren, David L., "102nd Congress-2d Session", American Intelligence Journal, 13, No. 1 & 2 (Winter/Spring, 1992): 7.

[12]The panel was hosted by the Committee for Imagery Requirements and Exploitation (COMIREX), chaired by Mr. Wayne Strand, who acted as the panel's Executive Secretary and provided administrative support. The panel Chairman was Mr. Bob Burnett. Other panel members were Major General Robert Rosenberg, USAF (Ret), Rear Admiral Thomas Brooks, USN (Ret), former Director of Naval Intelligence, General Bob Herres (Ret), former Vice Chairman of the Joint Chiefs of Staff, and Mr. Evan Hineman. The panel began deliberations on 18 December 1991 and made its recommendations to the DCI on 15 March 1992. The report incorporated the perspectives of the Army, Navy, Air Force, Marine Corps, OSD, DIA, CIA, NPIC, NSA, JCS,warfighters, and theater J2's on imagery management, resource management and acquisition, imagery support (Desert Storm, Just Cause), collection management, and existing architectures. The main recommendation was to form a National Imagery Agency to centralize management of IMINT, much as the National Security Agency (NSA) manages SIGINT.

[13]Gates, Dr. Robert M. "U.S. Congress, Joint Committee Hearings", American Intelligence Journal, 13, no. 1 & 2, (Winter/Spring 1992): 10.

[14]Participants in the meetings usually included Secretary of Defense Dick Cheney, the Director of Central Intelligence Bob Gates, the Executive Director for Community Affairs of the Intelligence Community Staff Richard Haver, the Chairman of the Joint Chiefs of Staff General Colin Powell, and the Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD C3I) Duane Andrews. Although comments were not asked of the services, the services attempted to push their views through their chains of command. The pace of the directive was so fast, however that a new draft would sometimes be out before comments could be approved through the chain of command (service staffs and planners) and sent to the Office of the Secretary of Defense via the Joint Staff. Even the staff for the Assistant Secretary of Defense (ASD) for Command, Control, Communications and Intelligence (C3I) was not fully involved. The Joint Staff position was the responsibility of J5 with the

assistance of J2 (J2 perceived a conflict of interest and relinquished responsibility to J5). Their position was to delay comment until the CINCs could be informed and have their comments incorporated. Again, the pace was so fast that this position was untenable. The CINCs, the Joint Staff, and the services had very little voice in the final outcome. The result, however was not found objectionable by most in DoD, the Joint Staff, or the services.

[15]Gellman, Barton. "Remember, You Didn't Read It Here", Washington Post, 19 September 1992, p. 4.

[16]Associated Press, " 'Secret' Satellite Agency Finally Loses Its Cover", Chicago Tribune, 20 September 1992, p.12.

[17]The COMIREX is a committee, previously under the Intelligence Community Staff, that functions primarily as an imagery policy making body and collections requirements management organization under the CIO. The COMIREX as the primary body is made up of representatives from the services, DIA, DMA, State Department, NPIC, CIA, NRO, and the heads of various subcommittees. They preside over the national side of imagery requirements.

[18]The term "end to end" is now a buzzword used in the imagery community to succinctly describe an architecture that requires collection requirements management, collection, exploitation, dissemination, communications, and training. In other words, it addresses all facets of imagery, not just one or a few of the areas mentioned above.

[19]Joint Chiefs of Staff, Doctrine for Unified and Joint Operations, JCS Pub 3.0 (Washington D.C.: Joint Doctrine and Allied Interoperability Division, Operational Plans and Interoperability Directorate (J-7), Joint Staff, 1990), I-3.

[20]Bill Lackman, from a briefing slide "CIO Vision Statement", Central Imagery Office briefing on the CIO,1992.

[21]U.S. Senate, Staff Report to the Committee on Armed Services, Defense Organization: The Need for Change, 99th Congress, 1st session, (Washington D.C.: U.S. Government Printing Office, 1985), 538; quoted in Gordon Adams, The New Politics of the Defense Budget (Carlisle: U.S. Army War College, 1992), 24.

[22]The White House, National Security of the United States (Washington D.C.: U.S. Government Printing Office, 1993), 13.

[23]DIA. Draft Systems Engineering Plan Integrated Imagery System (Washington D.C.: Defense Intelligence Agency, 1992), 1.

[24]Office of the Secretary of Defense, Annual Report to the President and Congress (Washington D.C.: U.S. Government Printing Office, 1993), 115.

[25]Richard Vitali, "The Role of the Joint Directors of Laboratories in Project Reliance", Army Research, Development, and Acquisition Bulletin, PB 70-92-6 (November-December 1992): 10.

[26]Ibid.,121.

[27]Ibid.,56.

[28]COCOM was established in 1949 and consists of 17 member nations which establish the list of goods and technologies subject to control. Members agree to establish effective export controls, and seek to harmonize national licensing practices. An address by the honorable Allen Wendt, the Senior Representative for Strategic Technology Policy, given before the World Affairs Council of Northern California on June 21, 1990 is good basic primer. It is published by the United States Department of State Bureau of Public Affairs.

[29]George Leopold, "Industry Awaits Clinton's Action on Dual-Use Technology", Defense News 7, no. 48 (30 Nov - 6 Dec 1992: 21.

[30]Federal Computer Week Staff, "Clinton Sparks Civilian Tech Revival", Federal Computer Week 7, no. 5 (1 March 1993): 1 and 45.

[31]Ibid.,45.

[32]The eight analytical sectors of the industrial base are: ships, aircraft, combat vehicles, space, communications and electronics, missiles, ammunition, and combat support.

[33]The 15 February 1993 edition of Federal Computer Week has two articles that give good examples of the link between federal labs and the private sector:
1) Carolyn Duffy Marsan, "Neural Networks Pay Off", Federal Computer Week 7, no. 4 (15 February 1993): 16. This article mentions work in neural networks by DARPA, the Office of Naval Research, Intel Corporation, Nestor, and Neuralware, Inc. among others.
2) Jerry Lazar, "Data Compresssion Eases Federal Storage, Networking Problems", Federal Computer Week 7, no. 4 (15 February 1993): 24. This article mentions NASA as letting a contract with Hughes Corporation for a system that can transmit more than one terabyte of satellite imagery daily. Other organizations working data compression include Harris Corporation, Martin Marietta, and the Office of Naval Intelligence.

[34]From an untitled briefing slide prepared by the Central Imagery Office Central Imagery Office, 1992.

[35]Timothy E. Neel,"Defense Implementation of Concurrent Engineering" (Research paper, Shippensburg University, 1990), 5.

[36]Ibid. Concurrent engineering practices were found by the Institute for Defense Analysis to reduce changes in early production 50%, reduce the development cycle 40-60%. reduce manufacturing costs 30-40% by integrating product and process designs, reduc. scrap and rework by 75%, and in many cases, resulted in a higher quality design (p. 11-12).

[37]Office of the Secretary of Defense, Annual Report to the President and Congress (Washington D.C.: U.S. Government Printing Office, 1993), 167.

[38]Office of the Secretary of Defense, Annual Report to the President and Congress,(Washington D.C.: U.S. Government Printing Office, 1992), 21.

[39]Office of the Secretary of Defense, Annual Report to the President and Congress, 25.

[40] Ibid., 27.

[41]Gordon Adams, The New Politics of the Defense Budget (Carlisle Barracks: U.S. Army War College, 1992), iii.

[42]The National Foreign Intelligence Program (NFIP)came into being under President Jimmy Carter in 1978. It is the responsibility of the Director of Central Intelligence and its composition is subject to review by the National Security Council. Activities to acquire tactical intelligence are excluded. It is divided into 12 programs or financial accounts (which do not equate to TIARA functional categories) that provide funds for various organizations,including DIA, CIA, NSA, State Department, Treasury, and others. The programs are: 1)the General Defense Intelligence Program (GDIP)from which national imagery programs affecting the services are funded; 2)the Community Management Staff (CMS); 3)the Central Intelligence Agency Program (CIAP); 4)the Consolidated Cryptologic Program (CCP); 5)and 6)two special reconnaissance programs in DoD; 7)DoD Foreign Counterintelligence Program (FCIP; 8)State Department Bureau of Intelligence and Research (INR); 9)Treasury Department Intelligence Program; 10)FBI Foreign Counterintelligence and International Terrorism Program; 11)Department of Energy Intelligence and Satellite Instrumentation Program; 12)and the National Intelligence Emergency Support Program (NIESP). NFIP uses the Capabilities Programming and Budgeting System (CPBS). The above information was taken from:

LCDR Dan Elkins, Financial Management of Intelligence Resources: A Primer (Washington D.C.: U.S. Government Printing Office, 1992), 9-11.

[43]Tactical Intelligence and Related Activities (TIARA) consists of functional categories (which are not tied to the 12 NFIP accounts) that provide intelligence support to tactical forces. TIARA resources are scattered throughout DoD and independently managed by an array of military and defense agency organizations. Some of the TIARA categories include: 1) Tactical Warning and Attack Assessment; 2)Tactical Support Battlefield; 3)Tactical Support Ocean; 4)Intelligence Support Systems; 4)Training; 5)Military Reserve and National Guard Forces; 6)Manpower, Research and Development of intelligence and related capabilities; and 7)Defense-wide mission support. TIARA is worked through the Planning, Programming, and Budgeting System, as is the rest of the DoD budget. This information was taken from: LCDR Dan Elkins, Financial Management of Intelligence Resources: A Primer (Washington D.C.: U.S. Government Printing Office, 1992), 23-26.

[44]On the national intelligence side, the Community Management Staff (formerly the Intelligence Community Staff) under the DCI was empowered to attempt to reconcile the NFIP and TIARA programs. Within DoD, the Secretary of Defense approved a plan in March 1991 that included giving to the Office of the Secretary of Defense the responsibility for reconciling the NFIP and TIARA programs in total (the CIO does the same for just imagery). Portions of the NFIP (the GDIP and the FCIP)were given to ASD/C3I to manage. GDIP management was subsequently returned to DIA. LCDR Dan Elkins, author of Financial Management of Intelligence Resources: A Primer, describes the ASD/C3I structure as one in which several officials share responsibility for TIARA management and the NFIP/TIARA interface. Interfaces external to DoD are performed by the Principal Deputy Director for Intelligence. Interfaces internal to DoD are performed by the Deputy Assistant Secretary of Defense for Intelligence. The FCIP is managed by the Deputy Assistant Secretary of Defense for Counterintelligence and Security Countermeasures. Day to day oversight is provided by the Intelligence Programs Support Group to ASD/C3I and the above officials.

[45]This approach should not be limited to imagery, but should be considered for use across the intelligence spectrum.

[46]Headquarters, U.S. Air Force. Basic Aerospace Doctrine of the United States Air Force, Vol II (Washington D.C.: U.S. Government Printing Office, 1992), 34.

[47]Peter de Selding,"Satellite Images Unveil Secret Soviet Test Site", Defense News 7, no. 50 (14-20 December, 1992): 28.

[48]David Pugliese,"Canada Outlines Plans for Space-Based Radar Program", Defense News 7, no. 45 (November 9-15, 1992): 7.

[49]Johan Swahn, "International Surveillance Satellites-Open Skies for All?", Journal of Peace Research 25, no. 3 (September 1988): 233.

[50]Ibid.

[51]Vincent Kiernan and Andrew Lawler, "UAE Satellite Plan Rattles U.S.", Defense News 7, no. 46(16-22 November 1992): 3 and 42. The imagery system's resolution was reported to be less than one meter and the design of its components based on that of components used on U.S. intelligence spacecraft, causing some fear that the technology transfer would pose a security risk to the U.S.

[52]Barbara Starr,"U.S. Considers Satellite Exports", Jane's Defense Weekly 18, no. 24/25 (12 December 1992): 8.

[53]Debra Polsky,"IAI-TRW Team Gets Job On Drone From Pentagon", Defense News 7, no. 27 (6-12 July, 1992): 10.

[54]Headquarters, Department of the Army, The Army,Field Manual 100-1 (Washington D.C.: Headquarters, Department of the Army, September 1988), 6.

[55]Joint Chiefs of Staff, Joint Warfare of the U.S. Armed Forces, Joint Pub 1 (Washington D.C.: National Defense University Press, 1991), 5.

[56]Ibid., 6.

[57]Joint Chiefs of Staff, Unified Action Armed Forces, JCS Pub 2 (Washington D.C.: The Joint Chiefs of Staff, 1986), 1-3.

[58]Ibid.,3-47.

[59]Ibid.

[60]Joint Chiefs of Staff, Joint Warfare of the U.S. Armed Forces, Joint Pub 1, 3.

[61]Ibid., 3-49.

[62]Joint Chiefs of Staff, Unified Action Armed Forces (UNAAF), JCS Pub 2, 3-48.

[63]Ibid.,A-1 (appendix A: The Principles of War).

[64]Ibid,A-2.

[65]Ibid., A-2 to A-4.

[66]Joint Chiefs of Staff, Doctrine For Unified and Joint Operations, JCS Pub 3.0,III-5.

[67]Medical personnel are interested in the imagery architecture because they need to send x-rays and other medical imagery to and from deployed ships and submarines.

[68]Defense Mapping Agency, "DMA Positioning Initiatives", a briefing given at the JSIPS Users Conference, 28-30 September, 1992.

[69]Office of Naval Technology, From the Lab to the Fleet...A Decade of Transition: The First Ten Years of the Office of Naval Technology (Washington D.C.: Office of Naval Technology, 1990), 57.

[70]Headquarters, United States Marine Corps, Marine Corps Imagery Intelligence Plan (Washington D.C.: Headquarters, United States Marine Corps, 1991) 5-3.

[71]Ibid.,5-7.

[72]Patrick O'Connel, "Medium Range Unmanned Aerial Vehicle (UAV-MR)", a briefing by the UAV Joint Project Office and Naval Air Systems Command, Washington D.C.,1 May 1992, 4.

[73]Captain Stan Stockton, USAF, Background Paper On Joint-Deployable Intelligence Processing Concept (J-DIPC), written for Air Force INXYI, 4 November 1992.

[74]Colonel Robert H. Clegg, (USA), "Imagery Intelligence at Echelons Above Corps", Military Intelligence, 18, no. 2 (April-June 1992): 21.

[75]Beth Larson, "Imagery Archives/Fileservers Directory Standards", an internal CIO memo discussing the need for standardization of a new method of dissemination of secondary imagery within theaters, Washington D.C.,undated, 1992.

[76]Joint Chiefs of Staff, Unified Action Armed Forces (UNAAF), JCS Pub 2, 3-74.

[77]Ibid.

[78]Ibid.

[79]Mark Hewish, "Satellite Communications: More Bandwidth and Terminals Needed", Defense Electronics and Computing, no. 4, (1992): 108.

[80]Ibid., 111.

[81]Ibid., 110.

[82]Briefing slide by the Intelligence and Communications Architectures (INCA) Branch of the Intelligence Programs Support Group (IPSG) of ASD/C3I, "Long Range Imagery Networked Communications Systems Program (LINCS)", INCA, October 1991.

[83]Ibid.

[84]Gary Larson, "7 April Sunday", Far Side Calendar (Kansas City: FarWorks, 1991).

[85]Department of Defense, "Memorandum for Correspondents", concerning the declassification of the existence of the National Reconnaissance Office,

[86]The CPBS answers 3 questions for the DCI: 1) which regions of the world and threats should be targeted for intelligence collection and analysis; 2) which organizations should be funded to provide regional intelligence; and 3) which existing programs should be cut and by how much to fund new/future programs. PPBS has 3 distinct phases of planning, programming, and budgeting which support guidance from the Chairman of the Joint Chiefs of Staff, the National Military Strategy document, and the Joint Strategic Capabilities Plan. Both systems have timelines and goals during budget preparation which are independent and parallel (but do not duplicate) each other. Some parts of the DCI's Capabilities, Programming, and Budgeting guidance are based on elements of the Defense Planning Guidance issued by the SECDEF. Both are incorporated into the President's budget at roughly the same time. A good explanation of both processes is contained in LCDR Dan Elkins publication Financial Management of Intelligence Resources: A Primer, published by DIA.

[87]CINCPAC Staff, "Flexible Deterrent Options", paper copy of a slide, 1992.

[88]Headquarters, Department of the Army, Combat Commander's Handbook on Intelligence, FM-34-8 (Washington D.C.: Headquarters, Department of the Army, 1992), B-16.

[89]Barry Dillon, paper copy of slide from the "Unmanned Aerial Vehicle (UAV) Program" briefing, UAV Joint Project Office, 1992.

[90]Headquarters, Department of the Army, Combat Commander's Handbook on Intelligence, B-15.

[91]Barry Dillon, "Unmanned Aerial Vehicles (UAV)", briefing slide, 1992.

[92]Ibid.

[93]Major Stafford, USAF, Air Force INRP, "Point Paper on Air Force Joint Service Imagery Processing System (JSIPS)" with hand written changes, Air Force INXY, 20 Sep 1992.

[94]Captain Jim Jeffries, USAF, and Captain Dave Marone, USAF, project officers for project Eagle Vision, and Captain Paul Barton, USAF, program manager for Eagle Vision, "Eagle Vision: Candidate Nomination Proposal For A Deployabl Satellite Ground Receiving Station Built By Matra MS2i of France", paper copy of a briefing, 25 August 1992.

[95]LTCOL Bob Maynard, USAF, "JDISS: Joint Deployable Intelligence Support System", paper copy of a briefing, JDISS Program Office in Suitland Maryland, 1992. DSN 293-3373, commercial (301) 763-3373).

[96]IPSG, "Long-Range Imagery Networked Communications System Program", paper copy of briefing by the IPSG Intelligence and Communications Architectures Directorate, January, 1992.

[97]Michael Asada, "IES/MIES Status", paper copy of a briefing, Army Space Program Office, 1992.

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