REPORT OF THE

DEFENSE SCIENCE BOARD

TASK FORCE

ON

COMBAT IDENTIFICATION

MAY 1996

OFFICE OF THE UNDER SECRETARY OF DEFENSE
FOR ACQUISITION & TECHNOLOGY
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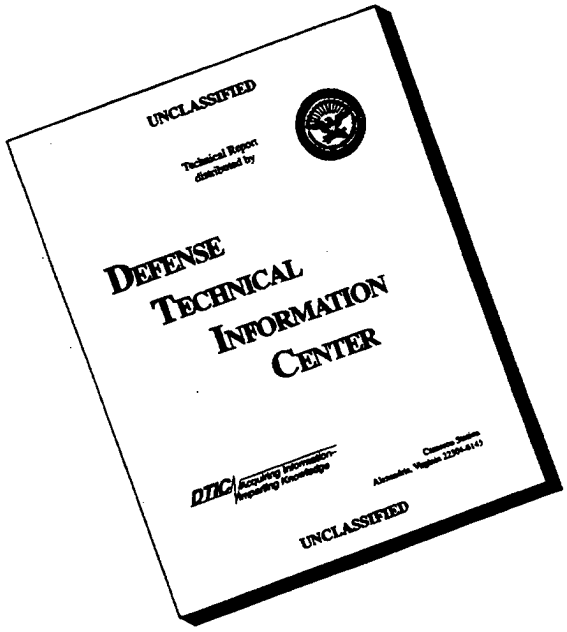

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DEFENSE SCIENCE
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10 SEP 1996

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE (ACQUISITION & TECHNOLOGY)

SUBJECT: Report of the DSB Task Force on Combat Identification

I am pleased to forward the final report of the DSB Task Force on Combat Identification, which was chaired by Dr. Robert R. Everett. You asked the task force to review the proposed Combat ID framework relative to situational awareness, the budgetary climate, non-cooperative identification technologies, doctrine, and Allied interoperability.

The task force recommends strengthening the existing Combat ID organization by combining the Joint Combat ID Office (JCIDO) and the All Service Combat ID Evaluation Team (ASCIET) under a single Flag Officer. Additionally, an Integrated Product Team should be established to oversee necessary Combat ID decisions over the near-term and an additional $25 million per year should be made available for test support.

Craig I. Fields
Chairman

OFFICE OF THE SECRETARY OF DEFENSE
3140 DEFENSE PENTAGON
WASHINGTON, DC 20301-3140

DEFENSE SCIENCE
BOARD

Dr. Craig Fields
Chairman
Defense Science Board
3140 Defense Pentagon
Washington, DC 20301-3140

Dear Dr. Fields:

Attached is the report of the DSB Task Force on Combat Identification.

We conclude that there is no crisis in Combat ID calling for extraordinary action. We see Combat ID as a set of tools under the operational control of the Field Commander who must plan for and use his Combat ID resources and set his rules of engagement depending on the situation. We therefore believe that CID should not be separated but treated as an intrinsic part of joint service development. Accordingly, we recommend strengthening the existing CID organization by combining JCIDO and ASCIET testing under a dedicated Flag Officer, establishing an Integrated Product Team to oversee the actions necessary to support Combat ID decisions over the next few years, and making an additional $25M/year available for test support.

We will be, of course, happy to provide any further assistance you may desire.

Sincerely,

Robert R. Everett

RRE/seg

Attachment

Table of Contents

Background

Executive Summary

Preface

Section 1 Perspective and a Framework for the Combat ID Problem

Section 2 Fielded Combat ID Approaches and Recent History

Section 3 Special Topics Considered

Section 4 Summary/Findings and Recommendations

Appendix A Terms of Reference; Task Force Members

Appendix B CJCS Communication on Mark XII Mode 4 Reliability

Appendix C Joint Service Requirements for the DoD Combat Identification Task Force (Re: Mark XII)

Background

In the Fall of 1994, a DoD Combat ID Study was formed at the request of Dr. Paul Kaminski to do a Department wide review of combat ID. This DoD Study was led by Dr. Barry Horton, Principal Deputy ASD(C3I), and had broad military and government civilian participation. This DoD Study completed its efforts by the Summer of 1995, and the results are documented in the following reports:

1. Combat Identification Architecture Working Group Final Report, September 1995.

2. Combat Identification Architecture Working Group Appendices, September 1995 (Unclassified).

The nucleus of this Defense Science Board Task Force on combat ID was originally formed under Mr. Robert Everett's direction to serve as a Senior Advisory Group to the DoD Task Force mentioned above. At the request of Mr. R. Noel Longuemare, Principal Deputy Under Secretary of Defense Acquisition & Technology, this Senior Advisory Group was expanded and chartered as a Defense Science Board Task Force. The charter is provided in Appendix A along with the members.

This DSB Combat ID Task Force continued meeting through the Fall of 1995; the final briefing was presented to Mr. Longuemare on 24 October 1995 and to Dr. Kaminski on 12 December 1995.

Executive Summary

The Defense Science Board Task Force was formed to review the current state of combat Identification as well as to act as Senior Advisors to the DoD Combat ID Study. Although we looked at the individual developments now underway and under consideration, we spent most of our effort on trying to gain a broad understanding of the nature of combat ID in order to reach conclusions about what should be done.

Our basic conclusion is that there is no crisis in combat ID calling for extraordinary action. Fratricide is a serious long term problem which can never be entirely prevented but which must be reduced to a practical minimum in any given situation. There is a tradeoff between the need to attack a dangerous enemy and the need to avoid attacking friends and neutrals. The real need is to minimize casualties while attaining military objectives, and minimum casualties is usually not the same as minimum fratricide. This familiar problem is now receiving increased attention, however, due to changes in the nature of expected conflicts, including highly mobile joint service operations, limited conflicts with reduced tolerance for both military and civilian casualties, and long-range highly lethal weapons.

Combat ID does not result from a single device or process but results from the combination of many sources. Knowledge about the location and activities of friendly and enemy forces (situational awareness) comes from plans, reports, surveillance (often enhanced by distinctive uniforms and insignia) and necessarily includes identification. New technology for surveillance, processing, navigation, and networking is greatly increasing our ability to create and distribute accurate, timely situational information smoothing out the difference between situational awareness and combat ID. Systems such as CEC are providing fire control quality information, including ID, to forces which can shoot even when they cannot see, while airborne surveillance platforms such as AWACS and JSTARS are collecting location and activity data over wide areas of land, sea and air. GPS is providing accurate navigation to all platforms resulting in much greater likelihood that people and platforms are where they are supposed to be or where they report they are. Shooters who have been dependent on on-board combat ID devices to make up for poor situational information can therefore be much more confident they know what is going on around them.

The Task Force believes that combat ID in the future should be made up a set of tools, both direct and indirect, surveillance and networking, cooperative and noncooperative which should be applied to fit the particular circumstances. It is not necessary, for example, to equip everyone alike. The most effective shooters and the most valuable friendly targets should be given the most extensive combat ID capabilities. A plan for variable equipage would permit a limited number of sets of expensive combat ID equipment to be used only where needed most. Very expensive equipment such as advanced non-cooperative target recognition capabilities in radars could be added only to major surveillance platforms with the resulting identifications distributed on the communication net.

Steadily improving tactical communication systems, such as JTIDS, offer possibilities for dual use as question-answer and don't-shoot-me systems. The Task Force

strongly recommends that all new C^4I systems, especially communications, be examined to see what contributions they might make to combat ID.

The available combat ID tools will be under the operational control of the Field Commander who must plan for and use his combat ID resources and set his rules of engagement depending on the situation. Rules of engagement cannot be permanently set but depend on the nature of the conflict, on whether the action is in friendly, enemy, or mixed territory, on whether in cities full of civilians or over open territory, the equipage and procedures of allies, and so on. The Commander must have full knowledge of his combat ID tools and be well trained in their use. Effective combat ID, like all of C^4I and Surveillance/Reconnaissance depends therefore on good joint service system design, tests and exercises, appropriate doctrine and training. Such activities offer the best promise for both near and far term improvements.

The Task Force is aware of the rising interest in joint service system design and training and believes that combat ID should not be separated but treated as an intrinsic part of the development of joint service equipment and doctrine. This full evolution will take some time, however, and we believe that in the meantime combat ID should be made a part of exercises and simulations whenever possible and that special combat ID testing, such as ASCIET (All Service Combat ID Evaluation Team), be continued and strengthened.

The Task Force considers Mark XII to be a critical element of both combat ID and Situation Awareness. We agree with the current plan to consider but defer major improvements to Mark XII, to cooperate with our NATO allies, but to emphasize making sure that existing Mark XII equipments really work and that operators are well trained in their use. Our report comments on various other combat ID proposals under consideration. We believe that present levels of investment are reasonable at least for the next few years. We were told that Situation Awareness investments are 10 to 20 times greater than combat ID investments when narrowly defined. We believe this is the right emphasis. We strongly urge however, that more funds be made available to support ASCIET tests. A more aggressive development program for non-cooperative ID techniques would also be highly desirable if additional funds can be made available.

We looked at the existing combat ID organization and recommend that coordination of combat ID activities would be significantly strengthened by combining JCIDO (Joint Combat ID Office) and ASCIET testing under a dedicated Flag Officer. We found that a number of important combat ID decisions are coming up in the next few years for which all the necessary test and analysis data may not be available. We recommend the formation of an Integrated Product Team (IPT) reporting to USD(A&T) and VCJCS to make sure that the necessary actions are planned and carried out. We see this as a temporary measure in the expectation that a broader solution to the joint service system design problem will be forthcoming.

Finally we recommend that an additional $25M/year be made available for support of the IPT, the JCIDO, and the ASCIET tests.

While serving as Advisory Committee to the partially concurrent DoD study, the DSB Task Force made a number of inputs and critiques which were reflected in the DoD Combat ID Study reports previously cited. Those reports cover much specific detail about combat ID techniques and programs and should be consulted for that material. In the DSB effort, the problem was addressed from a broad but comprehensive perspective. Also, Defense Department organization issues concerning combat ID were addressed as well as the technical side.

Section 1 of this report presents a framework for understanding the overall nature of the combat ID problem. This framework may serve some use in its own right and is needed to provide a context for the recommendations.

In Section 2, the currently deployed combat ID approaches for the air, sea, and ground victim areas are discussed. A summary of the recent history of combat ID is also presented.

In Section 3, a number of special topics are discussed which the Task Force thought deserved additional attention.

Section 4 includes the Summary and Recommendations.

Section 1: Perspective and a Framework for the Combat ID Problem

The Combat ID Problem

- Not a Crisis — Fratricide a Serious, Long Term Problem
  - Historical: 10 - 20% of Fatalities/Injuries
  - Minimum Casualties not Necessarily Minimum Fratricide
- Characteristics of a Safety Problem
  - Event Driven
- Several Trends Motivate Increased Attention
  - Highly Mobile, Joint Service and Coalition Warfare (Air and Ground)
  - Long Range, High Lethality Weapons
  - Overwhelming Blue Advantage Situations Very Likely
    Reduced Tolerance; Improved Attributability
  - War Zones with Civil Activity; Common Red/Blue Assets

A strong consensus of the Task Force was that combat ID should not be viewed as a crisis, but rather as a serious long-term problem of increasing concern. It seems unlikely that fratricide will determine the outcome of conflicts in the foreseeable future; however, it is obvious that any casualties are terrible in nature and that those due to fratricide may be considered even less acceptable than those due to enemy action. In addition to the direct loss of personnel and equipment, fratricide can have serious side effects, important examples are loss of morale and potential loss of aggressiveness due to a fear of fratricide and loss of public support at home.

An important point concerning fratricide is that enemy induced casualties (red-on-blue) and fratricide casualties (blue-on-blue) are not independent. This is explored further in the next chart where the goals of the combat ID designer are discussed.

Combat ID is essentially an element of combat safety. Like any safety problem, when accidents occur, there tends to be an uproar and often as time passes, the interest in the problem wanes. This will be illustrated further in a brief discussion of combat ID history later in this report. One motivation for treating combat ID as a serious long-term problem, is to try to "smooth" the event driven capability improvements activities into a longer term, more cohesive framework.

Several items are listed in the chart which motivate increasing attention to combat ID and a more systematic attack on the problem.

Mobile Warfare

The most serious fratricide problems tend to occur at seams and boundaries (blue-blue or blue-red). Since aircraft by nature have always had the ability to dynamically change boundaries, combat ID for the air victim has received

proportionally more attention. The increased mobility and dispersion of ground warfare has exacerbated the ID problem on the ground. In the naval case, littoral warfare can lead to situations with increased small ship ID problems (military and civil) and increased problems of overland aircraft ID (red, blue and civil).

Beyond-Visual-Range Weapons

The continuing and expanding use of highly effective, beyond visual range weapons in all phases of warfare, including the ground-to-ground arena, minimizes the role the human eye plays in ID directly and requires increased "remote sensing" of the targets to provide clues to ownership.

Overwhelming Blue Advantage

The overwhelming blue force situation tends to make the public less tolerant of blue-on-blue casualties. In many past wars, the actual amount of fratricide and who caused it has not always been clear. However, when modern weapons and surveillance are employed, finding out who did what is becoming less difficult.

War Zones with Civil Activities

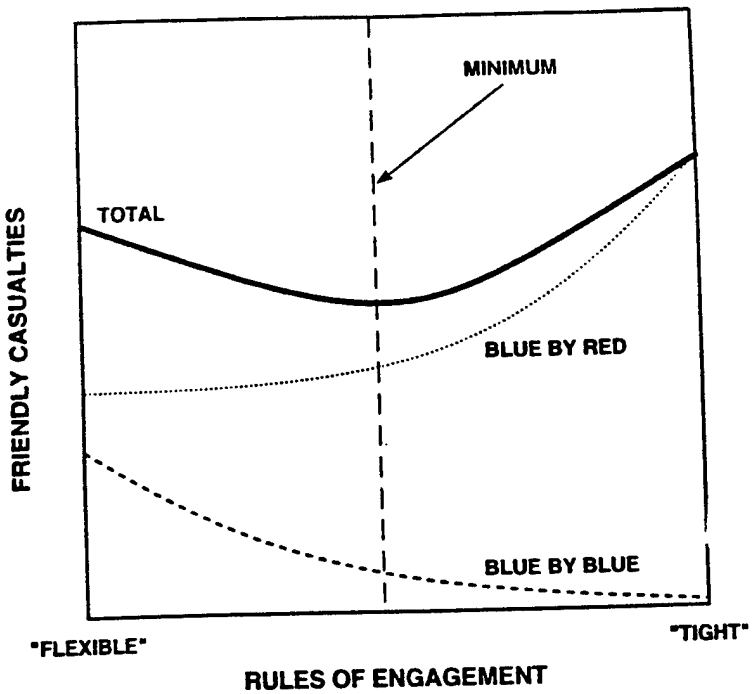
The burden on combat ID capability is taxed considerably by the relatively unfocused nature of many hostile situations. The airliner shoot down by the Aegis cruiser Vincennes in the Gulf is a good example. Other situations of this nature include the likelihood of many civil watercraft in littoral regions, and the potential for fighting in built-up areas occupied by civilians. Some operational military officers gave the view that it is these unfocused hostile situations (i.e., not full scale war) that cause them the most concern in deciding when to shoot.

The increasing numbers of civil and neutral targets in operating areas demands augmenting current IFF (identify-friend-or-foe) which sort targets into only two categories, those who reply friendly and those who do not reply (indicating not a friend, but not necessarily a hostile).

Common Red/Blue Assets

Regional warfare is such that both sides may be using the same hardware, viz Mirages, F-16's, etc. This fact puts increasing demands on the techniques used for identification.

Minimizing Fratricide



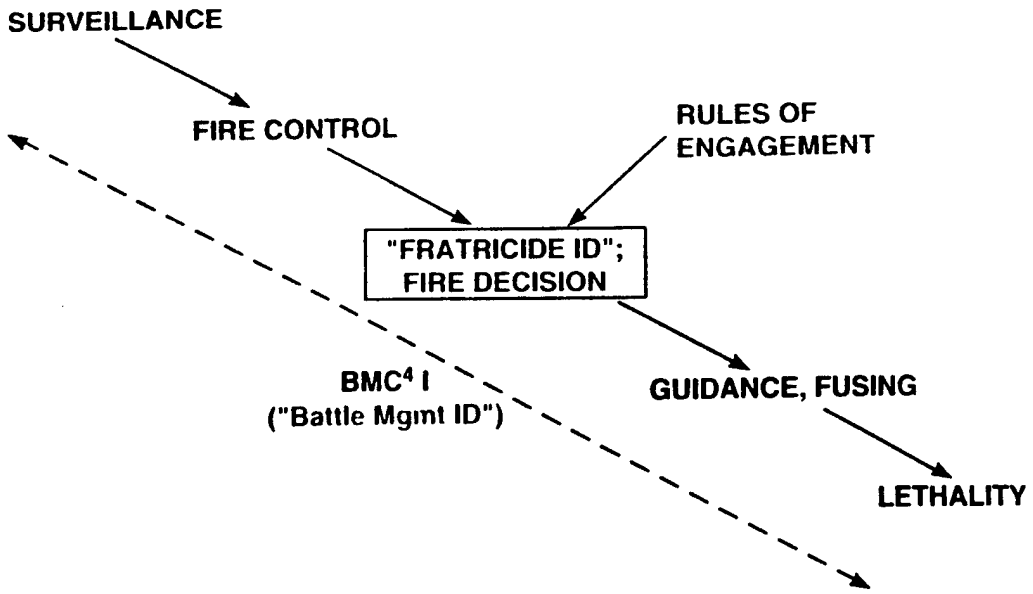
These curves illustrate a very important underlying concept in combat ID - that is, minimum casualties is not necessarily the same as minimum fratricide.

The x-axis represents the rules of engagement with which the blue force commander chooses to fight. At one extreme no blue firing is permitted, assuring no fratricide; but, not surprisingly, heavy casualties due to red fire. At the other extreme, the blue side fires at all targets resulting in very high blue-on-blue casualties. Total casualties are minimized when the blue commander chooses intermediate rules of engagement.

Of course, these curves are not explicitly available to a military commander, rather he must use his judgment to select, and modify, the rules of engagement according to the battle situation (which is variable in space and time).

This figure can also be used to articulate the goal of the combat ID system designer and user. The shape of the blue-on-blue curve is under their control; the better the combat ID capability is, the more aggressive blue can be in using fire power and still keep fratricide down. In terms of the curves, better combat ID capability pushes the blue-on-blue curve down and to the left. This permits the commander to loosen the rules of engagement thus reducing blue casualties caused by red. The minimum total casualty point thus drops and shifts to the left with improved combat ID.

THE TARGET ENGAGEMENT PROCESS



The purpose of this chart is to illustrate that the ID process is in the middle of the engagement chain. The investment in ID should be balanced with other elements of the chain to avoid the ID process from becoming a "choke" on the application of firepower.

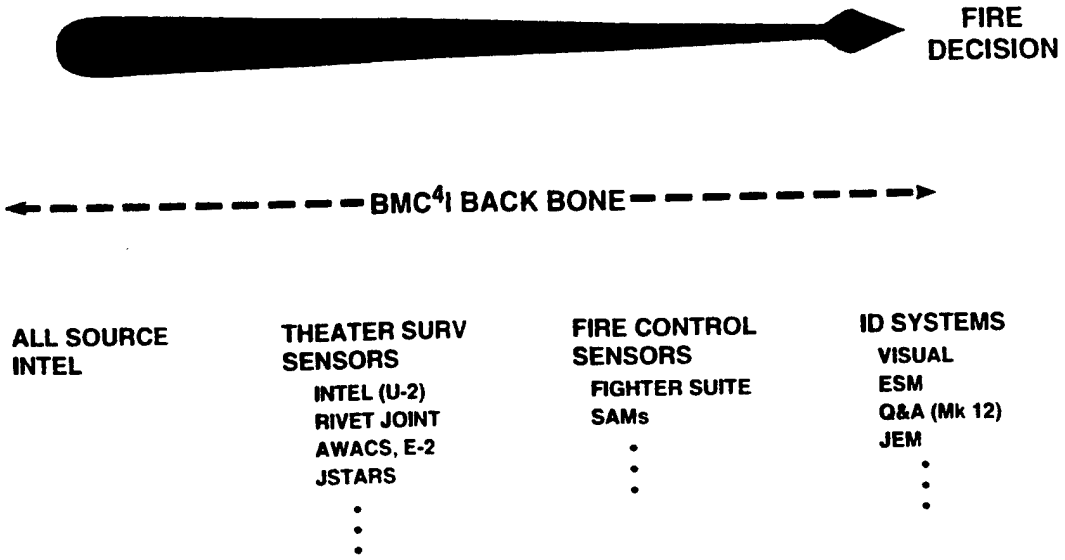
The chart also illustrates that ID is useful in combat for much more than controlling fratricide. In fact, much of the early investment in ID was for battle management purposes so that the military commander could control and purposely plan and execute the battle with good knowledge of his forces. The use of uniforms and insignia are cases in point.

Battle Management ID accuracy requirements, in position and time, are generally not as demanding as those for Fratricide ID.

In some cases, ID systems, e.g., the IFF system on aircraft, are used for both battle management (or situation awareness) and fratricide control. This same IFF system is used for civil aerospace management as well through unencrypted modes.

The distinction between ID requirements for battle management and fratricide will not be carried further in this report. It is worth noting that ID methods that help both causes are, perhaps obviously, of more interest to the military. The improvement in netting systems is a good example of an area which is contributing to both combat ID and battle management needs.

THE SITUATIONAL AWARENESS SPECTRUM
WHERE, WHEN, WHO



The term "situation awareness" has many meanings and connotations; "what, where, who" will be used here. It is clear that if perfect situation awareness were available, and distributed to all shooters, then the ID problem would be solved. The idea that combat ID is a focused and precise level of situation awareness may be a useful observation.

The chart illustrates that the information needed to commit to a fire decision can come from many sources. The improvements to the netting systems in the BMC^{4}I backbone and increasing combat ID demands on the surveillance and fire control sensors are key paths to improved combat ID at a reasonable cost (since the majority of these systems' cost can be attributed to improved war fighting versus combat ID alone). Promulgation of combat ID requirements early in the design cycle needs increased attention so that retrofit cost penalties are not incurred.

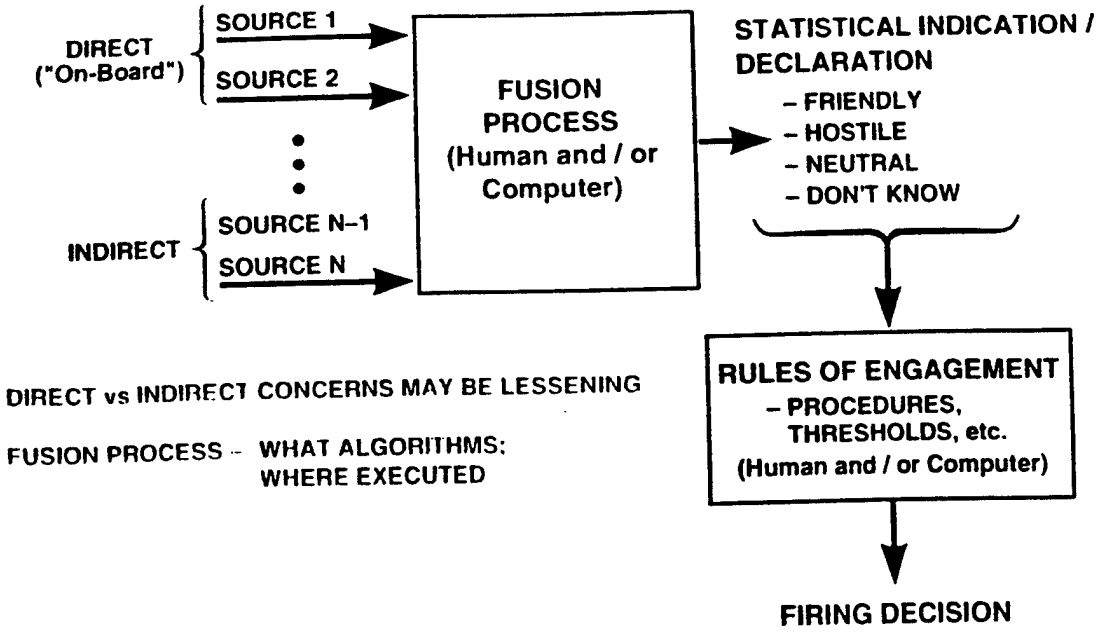
At the fire decision end, some of these capabilities may be focused more narrowly on combat ID. One example is the JEM (Jet Engine Modulation) technique for sensing the type of aircraft being tracked via the radar Doppler spectrum. Note that this ID technique would likely be cost prohibitive if the radar investment were not already there for war fighting reasons.

The question-and-answer (Q&A) techniques, such as aircraft IFF, and ESM (electronic support measures) have multiple uses.

Although not included in the figure, future blue weapon seeker sensors (and on-board processing) should be considered for combat ID support. Seekers with imaging capability and extensive on-board processing for clutter and countermeasure rejection will

be early candidates for providing combat ID support. The potential for "decoying" of your own weapons to control fratricide needs further exploration; the seeker would seem to be the most likely sensor to be purposely decoyed by a blue target to prevent fratricide.

THE COMBAT ID PROCESS



This flow diagram presents a logical description of the combat ID process. The overall concept is that one to several sources of ID information, which will be referred to as "layers"* , that each have some probability of providing correct ID are combined (current word is "fused") to provide an overall statistical declaration of the target identity. The rules of engagement, which might include thresholds for the statistical indications, are then used to give a firing decision. The term "direct" ID source is used to indicate that sensors organic to the shooters platform provide the information, versus indirect which come from off-board.

In the past, the human eye has often been the most prominent ID source and the human mind has been used to combine information sources and make the firing decision. In many cases, the human mind still retains the role of merging, pattern recognition and deciding, although, several additional methods of providing ID information have been developed (and will be discussed later). As ID techniques become more numerous and sophisticated, the burden on human merging and deciding is becoming excessive and automated procedures must be pursued.

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* The committee found it useful to think of combat ID as a layered defense - firings on undesired targets being equivalent to a "leaker" through the combat ID layer or layers. Following this analogy, reduced fratricide is achieved by adding more combat ID layers at increasing complexity and cost to the combat ID system.

Combat ID architectural options include the spectrum from distributing data and merging it at the shooting platform to centralized data merging and distributing the ID declaration.

Traditionally, military operators have been resistant to the use of indirect sources because reliably functioning communication nets with low latency are required; also direct sources permit more autonomous operation. The improvement in nets and war fighting architectures that utilize the net intrinsically[1] are reducing the direct versus indirect distinction.

The rules of engagement for air-to-air during the Gulf War serves to illustrate the uses of multiple sources. The required sources to reach a firing decision were: no IFF report (i.e., absence of friendly), Positive Hostile Indication (e.g., ESM), and Off-board Source (e.g., AWACS, E-2C). Some aircraft could not participate in the battle because the required rules-of-engagement could not be met with the available equipage, e.g., the F-18.

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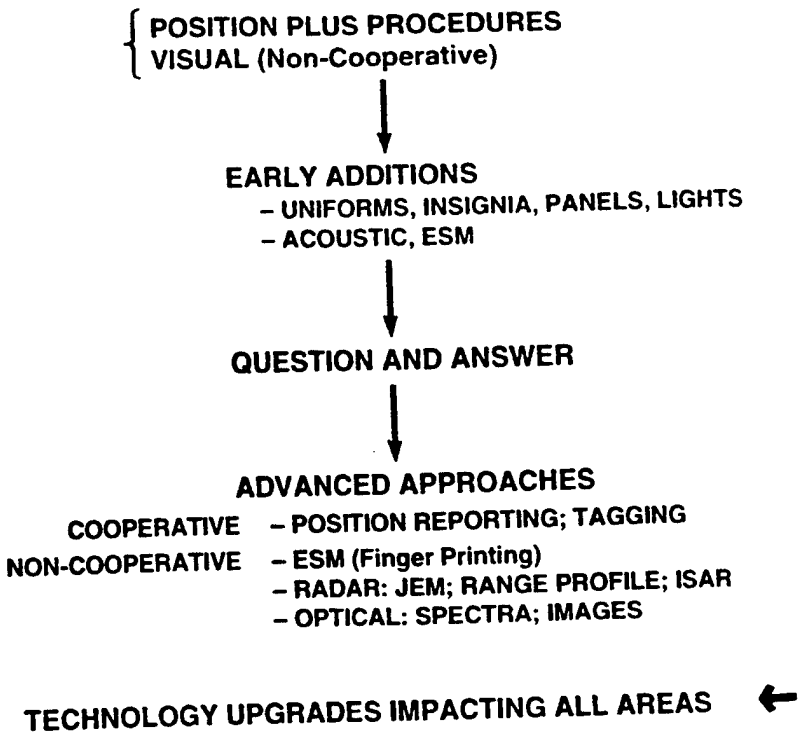
[1]The Navy cooperative-engagement-capability (CEC) is a high capacity, low latency system that puts fire control quality data on the net (versus cueing quality). This permits potentially "blinded" members of the net to use their weapons against a target their organic sensors cannot see. Clearly, identification assistance via the net is also implied.

TYPICAL EVOLUTION OF COMBAT ID LAYERS



In addition to showing the typical methods used to provide combat ID, the sequence shown is representative of the order that ID capabilities are added to a combat ID architecture.

The initial layer of position and procedures plus visual may be obvious since these are also the rudimentary elements of fighting capability. Note that position may be "relative" position, e.g., "the enemy is in front of us, we shoot anything in front of us." In fact, ground combat forces still rely on highly refined methods using relative position. This is necessary because many ground vehicles, including tanks, have no integrated compass or other method to provide absolute direction.

The next layer titled "early additions" relies heavily on enhancing the human eyes ability to recognize targets. This can be the form of the eye-brain recognition of patterns on optical targeting and imaging systems such as FLIRS and IRST's. In some cases, the human ear has been used in ID and for many years ESM, electronic support measures, has been used to help with ID.

The question-and-answer (Q and A) layer of combat ID is just that - and most commonly is performed by electronic inquiry "are you a friend?"; the term IFF is often used for such systems. Note that the reply, if it comes, indicates that the target is a friend (of course "spoofing" is a potential concern). The Q and A systems divide the target population into two classes 1) friendly reply and 2) absence of friendly reply. The value of the Q and A layer of combat ID is dependent on what fraction of the "undesired" target set is equipped with reply devices (transponders).

Some elements and features of question - and answer systems are:

1. Shooters need interrogators, and friends (those protected) need a transponder to receive and reply (of course the Q and A status of a target can be passed on the net).

2. To avoid enemy interrogations of the systems or spoofing (generating false friends), encryption is needed. Consequently, security keys must be kept by all interrogating and replying systems (including allies and coalition partners). The primary concern of enemy exploitation is not so much giving away ID as it is giving away an easy method to do surveillance and perhaps fire control.

3. These systems can play an important role in overall battle management since they can be broadly interrogated by surveillance systems to help in providing overall blue-force situation awareness.

4. Question-and-answer systems are generally easy to implement (from a technical viewpoint) because friends have agreed to cooperate in the process. These systems tend to provide a binary answer (friend or no reply) which can be easily interpreted by the operator, e.g., light on, light off.

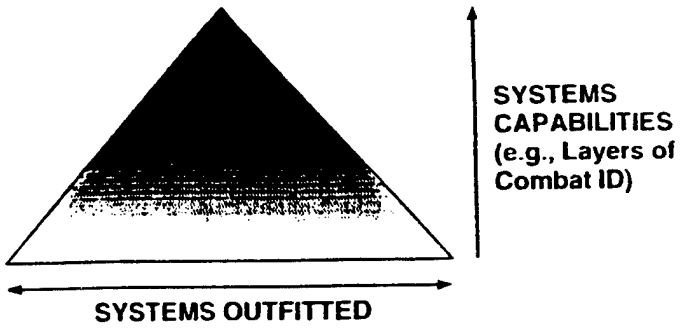
The "advanced approaches" category is broken into two areas, cooperative and non-cooperative. Non-cooperative techniques have the fundamental advantage that those being identified do not have to make any modifications to facilitate ID. Consequently, non-cooperative approaches fit into the category of providing "positive hostile" information (rather than "absence of friend"). Achieving positive hostile capability is still a statistical process; these techniques are based on classifiers that utilize target features to partition the observed target set into multiple classes, viz MIG 29, F-16, F-15. Non-cooperative approaches are an active research and development area and are addressed as a special topic later in this report.

Position reporting is receiving increased attention because of the increasing availability of accurate position at low cost, e.g., GPS, and because nets are improving to communicate this information. The thought that all new links should contain position information in the header of any communication could be quite helpful to combat ID. Low latency is a demanding requirement for these approaches.

Advanced ESM systems, although dependent on a target emissions, can be very powerful in sorting out the emitters identity. Such approaches may be most needed where red and blue are using similar equipment, viz the association of a specific radar transmitter with a given tail number because of peculiar lines in the spectrum.

Jet Engine Modulation (JEM), range profiling of the target, SAR (Synthetic Aperture Radar) and ISAR (Inverse Synthetic Aperture Radar) imaging techniques all hold promise; these techniques are usually implemented via the fire control sensors or the cost would be prohibitive. The underlying basis for all these approaches is a multi-dimensional classification process which must be used to compare the observed target to a stored set of reference templates.

VARIABLE EQUIPAGE IS A COST EFFECTIVE STRATEGY



- **HIGH PERFORMANCE BLUE SHOOTERS SHOULD RECEIVE PREFERENCE FOR MOST CAPABLE ID SUITES**
  - **HIGH VALUE BLUE TARGETS SHOULD RECEIVE COMPLEMENTARY PRIORITY**
- **WIDE ZONE OF INFLUENCE SENSORS SHOULD HAVE HIGH PERFORMANCE ID (and Communication) SYSTEMS**
  - **e.g., AWACS, E-2C, AEGIS, PATRIOT**
  - **MOST LIKELY PLATFORMS FOR "EXPENSIVE" ID TECHNIQUES**
- **"TEMPORARY APPLIQUÉS" MAY BE COST ATTRACTIVE**

The notion of variable equipage is as important to combat ID as it is to other war fighting capabilities; it is also a requirement for cost effective strategies for incrementally improving combat ID. The Task Force found that greater appreciation for this notion would be helpful in the combat ID community; sensible cost conscious strategic planning for combat ID cannot be done without variable equipage as a basis.

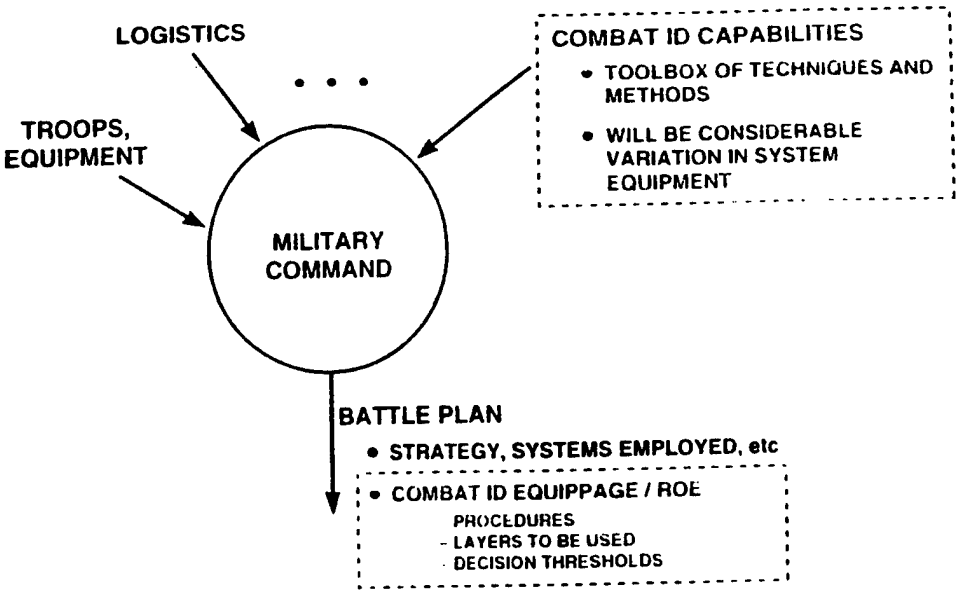
This variable equipage perspective also applies to question-and-answer like the Mark 12 IFF systems. Of course, backward compatibility must be maintained but improvement decisions should not assume that the total force must be upgraded.

High performance blue shooters (the most likely source of fratricide) and high value blue targets (the highest "regret" sources in fratricide) should receive proportionally greater combat ID investment.

With concurrent improvement in netting capabilities, cost effective improvements in combat ID require that the wide zone of influence sensors improve their combat ID capabilities and distribute the information. In some cases of "expensive" ID techniques, viz advanced ESM and advanced radar sensing techniques, such capabilities may not be realizable technically or financially on a more distributed basis, e.g., on a fighter aircraft or small ships. The battlefield surveillance role of the Longbow helicopter will also fall into this "wide zone" thought process as the digitized battlefield connectivity is realized.

Temporary appliques have played an important role in combat ID over history and though not perfect solutions may be very cost effective, e.g., colored flags; toy "clickers" in the Normandy invasion. Applique approaches in a modern context may apply to battlefield question-and-answer approaches where the inventory of reply devices (transponders) could be reduced by providing for use only on those vehicles likely to be in a fratricide situation in a given action.

BATTLE PLANNING WITH A COMBAT ID PERSPECTIVE



COMBAT ID IS NOT A FIXED, RIGID RULE SET

- NEED A GOOD ID TOOL SET AND THOROUGH TRAINING

This chart tries to set a broad context and perspective on combat ID and summarizes many of the points already made.

Of course this chart is drawn from a combat ID centered perspective, but it is clear to this Task Force that if combat ID is to be improved in any global way this subject must receive a bigger "place-at-the-table" in each of the following areas:

1. Overall war fighting plan development

   Overall combat ID capability is very closely tied to concepts of operation and rules-of-engagement, especially in a joint war fighting context. Higher performance combat ID architectures will be increasingly complex where choices of how many combat ID layers to invoke and choices in ID thresholds must be made. Varying combat ID rules in space and time during a military operation may offer advantages.

   More thinking at the joint level is needed in the rules of engagement area to help guide combat ID requirements development. The rules-of-engagement process for combat ID seems to be somewhat ad hoc both at the planning and training level at the current time in many areas.

   Citing one example, the rules-of-engagement for air-to-air combat in the Gulf war which prevented the F-18's from participating may have driven the largest single, current investment in combat ID, the retro-fitting of Mark 12 IFF interrogators into 450 F-18's at a cost of more than $200M.

One thought is that combat ID requirements may be set according to combat ID "condition" levels (similar to alert levels). These condition levels could provide guidelines for rules-of-engagement and combat ID techniques layer requirements from peace time to full scale war in a few levels.

2. Training

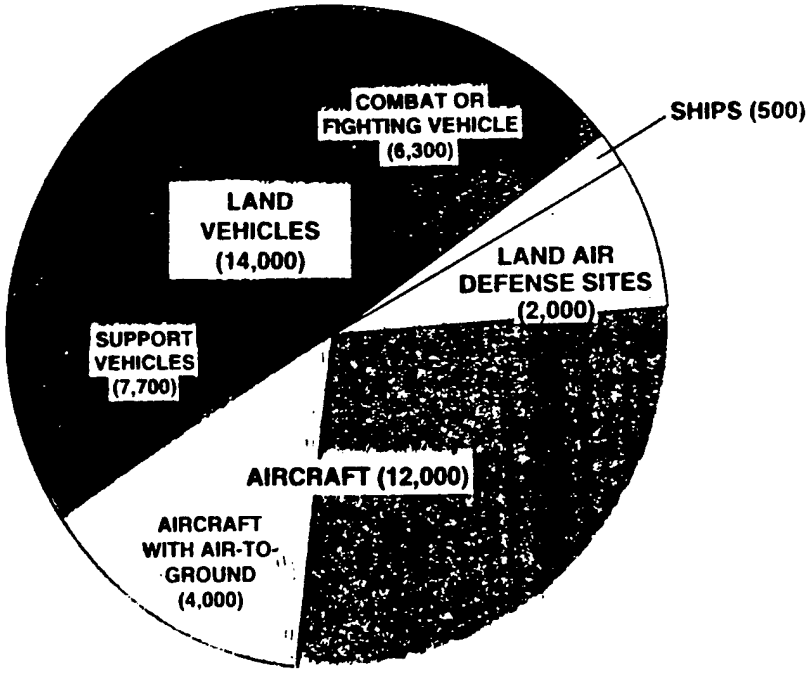
The effective implementation of a complex process such as combat ID requires thorough testing and training. If combat ID is to be viewed as an important element of war fighting, then it must be considered as an integral planned-in part of all levels of war fighting exercises.

3. Requirements

The combat ID toolkit designer should present his requirements to weapon systems designers at an early stage, this includes requirements for both sensors and nets. In particular, advanced non-cooperative techniques will most likely be implemented via the fire control sensor; ID needs will compete for sensor time line and power resources with normal requirements of track, illumination, etc. Cost tradeoffs will obviously be required; the results of rules-of-engagement development and the results from training exercises can be used to help focus the investment strategy for new ID capabilities.

PLATFORMS INVOLVED IN COMBAT ID — CIRCA 2000

(Joint Combat ID Office, U.S. Only)



~28,500 TOTAL

The Joint Combat ID Office (JCIDO) has compiled the number of military entities which fall into the combat ID arena. The large number emphasizes the need to control combat ID costs by variable equipage and by approaches that are covered by the basic war fighting system to the extent possible.

The large number of ground vehicles gets particular attention when question-and-answer systems for the battlefield are addressed.

COMBAT ID AREAS

VICTIM	SHOOTER	KEY FEATURES
AIRCRAFT / HELO	AIRCRAFT / HELO SURFACE-TO-AIR	DYNAMIC BOUNDARIES HIGH VALUE VEHICLES INCREASING NEUTRAL PROBLEM COMMON RED / BLUE ASSETS
SHIP	SHIP AIRCRAFT / HELO	SMALL NUMBER; HIGH VALUE LITTORAL ZONE — SMALL SHIP THREAT; NEUTRALS
GROUND	GROUND BASED	LARGE NUMBER / TYPES OF VEHICLES RAPID DECISION ENVIRONMENT HISTORICALLY — PROCEDURES MANEUVER WARFARE INCREASING
	AIRCRAFT / HELOS	CLOSE AIR SUPPORT AND STRIKE MANEUVER FORCE INCLUDES HELOS

The final chart in this section provides a broad characterization of the combat ID areas. Combat ID is best structured in "victim centered" coordinates; this tends to be the pattern in which equipment is developed and is certainly the basis upon which the military services define their focus.

The areas where the shooter-victim interface is also a service interface often require increased attention, viz surface-to-air and air-to-ground. These interfaces involve both procedures and hardware in the case of question-and-answer systems.

In major operations, ground-to-ground casualties due to fratricide are historically the highest in total number by a significant margin. However in operations short of war, surface-to-air and air-to-air fratricide tends to dominate.

The air-to-ground regime has been historically and continues (Gulf War) to be a significant source of fratricide. Modern air-to-ground warfare includes helicopters in addition to fixed wing assets.

This committee did not address the very specialized area of submarine ID nor was significant effort spent on dismounted warfare.

The dismounted warfare area in large scale warfare has been handled by tactics, training and procedures, and this appears likely to continue for the near term future. The use of dismounted ID techniques in special operations (and very limited operations) is expected to be the "test bed" for this area of combat ID. Broader equipage of the dismounted force will depend on the usual effectiveness/cost tradeoff.

Section 2: Fielded Combat ID Approaches and Their Recent History

FIELDED COMBAT ID APPROACHES

	SITUATION AWARENESS TTP*; VISUAL	"EARLY" ADDITIONS	QUESTION AND ANSWER†		"ADVANCED" ADDITIONS	
			INTERROGATOR	TRANSPONDER	ESM	OTHER
AIR-TO-AIR	✔	INSIGNIA	F-14, 15, (18) AWACS E-2	ALL MILITARY AIRCRAFT MOST CIVILIAN AIRCRAFT	SOME	JEM RANGE RES.
SURFACE-TO-AIR	✔	INSIGNIA	ALL SHOOTERS e.g., PATRIOT AEGIS STINGER GCI CIVIL AIR	ALL MILITARY AIRCRAFT MOST CIVILIAN AIRCRAFT	SOME	JEM OPTICS
AIR-TO-SEA	✔	INSIGNIA	(See Air-to-Air) NAVY HELOS	MOST SHIPS AND SUBS	SOME	ISAR
SEA-TO-SEA	✔	INSIGNIA; SIGNALS	SURFACE COMBATANTS	MOST SHIPS AND SUBS	SOME	SOME
AIR-TO-GROUND	✔	INSIGNIA PANELS ARPA LIGHTS				
GROUND-TO-GROUND	✔	UNIFORMS INSIGNIA				

* TTP — TACTICS, TRAINING AND PROCEDURES † 1030 / 1090 MHz ONLY FIELDED SYSTEM

Following the victim centered format and the general notion of combat ID layers, the existing combat ID capabilities can be set in an overall framework.

Historically, the ID of air victims and sea victims has received the most attention. The ground victim has traditionally been handled by TTP (Tactics Training and Procedures), visual and the "early" addition category. Note that the panels and ARPA lights (a.k.a. Bud Lights) are considered early additions from the perspective of ID technology, but did not occur until during and after the Gulf War.

The largest single investment in combat ID is the 1030 MHZ interrogate, 1090 MHZ reply question-and-answer (Q&A) system; sometimes traditionally referred to as IFF and associated with aircraft. This system is very widely used by all services, our allies and the civilian community for identifying aircraft and ships and submarines. The system is heavily utilized for situation awareness and battle management as well as fratricide control. This system has unencrypted and encrypted modes for civilian and military use. The 1030/1090 MHZ system is by far the largest sunk investment in combat ID, several billion dollars; the system is discussed as a special topic later in the report.

The "advanced" additions column is defined to the extent that an unclassified presentation permits. Many of these advanced approaches fall into the non-cooperative category where the target being identified is not required to make specific changes to accommodate ID; most are implemented through use of sensors developed for other purposes, e.g., fire control. Advanced ESM techniques offer high capability as a combat ID layer if the target radiates (friend or foe).

Key national level questions in combat ID are:

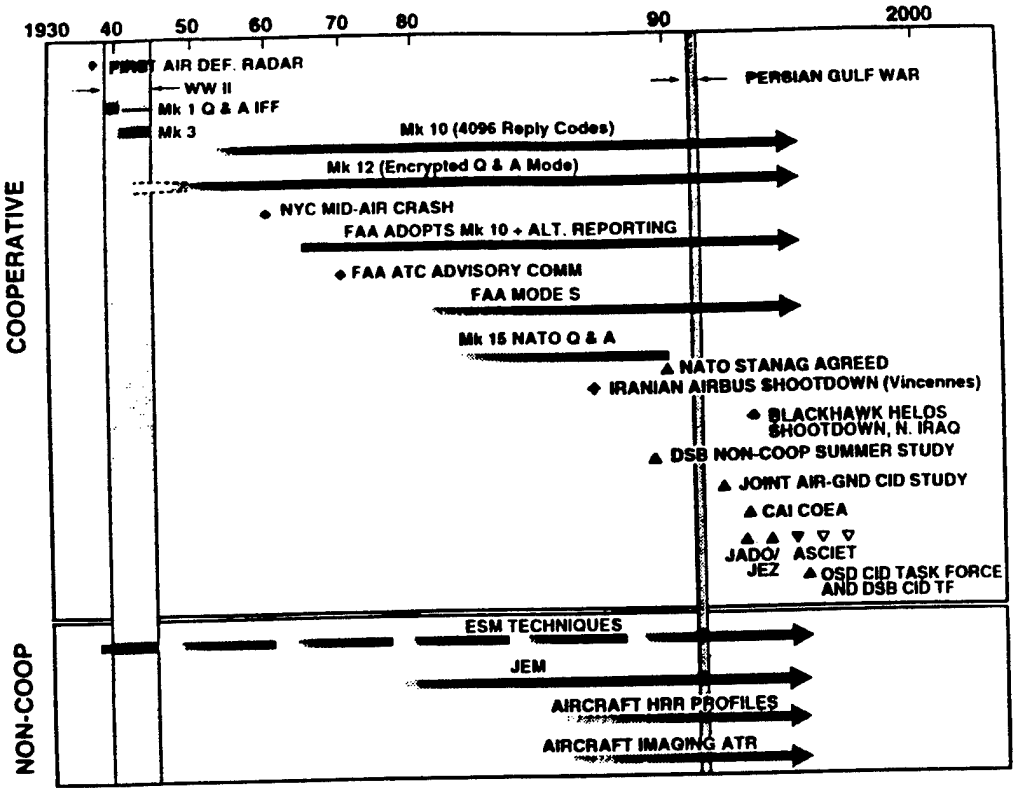
1. To what extent will the improvements in situation awareness solve combat ID shortfalls?

2. What is the role of the widely deployed 1030/1090 MHZ question-and-answer system in meeting future combat ID needs? How much investment should be put into operability improvements and upgrades?

3. Should a question-and-answer system be deployed for the ground victim area (or is improved situation awareness via the digitized battlefield sufficient?)

4. At what investment level should the "advanced" additions level be pursued, particularly non-cooperative approaches. What role do these approaches play for the ground victim area, now and in the future?

EVOLUTION OF AIRCRAFT CID TECHNIQUES



A brief history of combat ID techniques for aircraft is shown here. Radar development in World War II needed a method to identify targets that could now be seen at very long ranges in all weather conditions. The first ID needs were for battle management, not fratricide, and were implemented at the radar frequency. The aircraft carried transponders that were triggered by the surveillance radar frequency and the responses showed up on the radar displays outrange of the skin reflection return.

Eventually, interrogation at the radar frequency was given up in favor of interrogating at 1030 MHZ and replying at 1090 MHZ, which among other advantages permitted a universal transponder and additional information to be communicated in the reply, including the aircraft ID number (Mark X). The early systems were not encrypted, but by the 1960's encryption was being employed (Mark XII) by the United States forces; some countries of the world still employ the unencrypted Mark X.

Following a mid-air crash over New York City in the late 1950's, the civil aviation community adopted unencrypted 1030/1090 MHZ as their baseline system and added an altitude reporting mode shortly thereafter (Mode C). The civil community continued to push 1030/1090 MHZ development through the development of Mode S which permitted aircraft to be specifically addressed by an interrogation code and increased the information that could be sent back in the reply. Later the 1030/1090 MHZ system was used as the basis for the traffic alert and collision avoidance system (TCAS) which is now required on the world's civil airliners. Contention between the civil aviation and the military over the best use of the limited 1030/1090 MHZ bandwidth is an on-going issue.

Considerable effort was put into the development of a new system to replace the 1030/1090 MHZ (Mark XII) military mode; this was referred to as the Mark XV program. Mark XV was studied in cooperation with NATO, but the United States terminated its involvement in the program in the early 1990's.

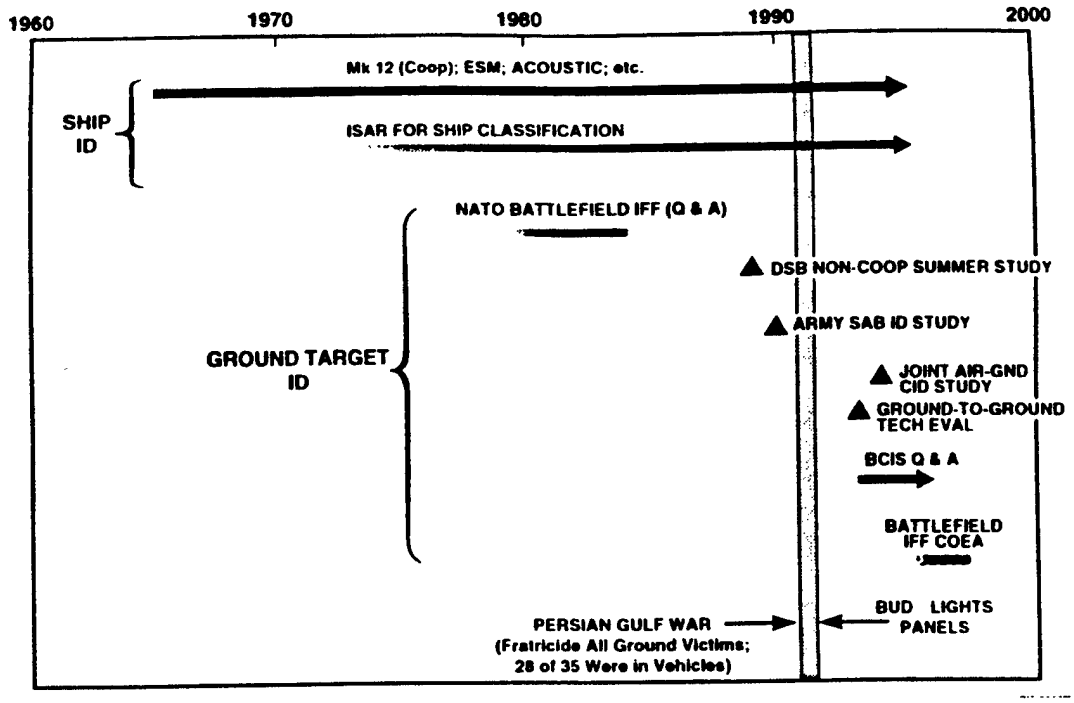
The history of non-cooperative ID techniques is shown in summary fashion in the lower part of the chart. Of course visual ID played a big role when conditions permitted and acoustics was useful within sensor and propagation limits. The interest in positive hostile techniques for aircraft increased in interest as the sorting of neutrals became an increasing concern by the late 1980's. The Iranian airliner shoot down by the Aegis cruiser Vincennes in 1988 was one of those trigger events discussed earlier.

No air victim fratricide occurred in the Gulf War. Since no significant air breathing threat developed, blue side surface-to-air assets could be held weapons tight against air breathing targets by the rules of engagement. Also, the air-to-air rules were fairly stringent, i.e., absence of friendly (Mark XII) plus a positive hostile plus a third party agreement. Most people agree that the air victim fratricide by the ground and sea based forces could have been a serious issue if red aircraft had forced release of the blue surface weapons. The return of aircraft from overland into the coverage of the Navy forces in the littoral region would have been a particular concern.

The JADO/JEZ (Joint Air Defense Operations/Joint Engagement Zone) tests which occurred in the early 1990's produced very high "fratricide" levels. These tests were conducted to evaluate the possibilities of having SAM's (viz Patriot) and fighters use the same engagement zones. The fratricide levels were so high (>30% in some cases) to not be taken seriously in an absolute sense. Once again it was proven that if a very complex concept such as JEZ is not practiced and refined, the results would not be satisfactory. The JADO/JEZ tests stimulated some focus on combat ID and helped form the basis for the ASCIET tests the first of which was conducted in September 1995.

The Blackhawk helicopter shoot down over Iraq in 1994 is the most recent fratricide accident. Note that two of the more notorious ID failures of recent times were not associated with war situations, but rather with one case which might be called hostile environment operation, the Vincennes, and the other in policing a no-fly zone (Blackhawk). This reiterates the need for combat ID capability developers to consider the multiplicities of situations in which ID is needed; rules-of-engagement options and combat ID architectures can be tailored to the various situations if the proper pre-planning and training has been done.

OTHER (Non-Aircraft) CID TECHNIQUES



The modern history for ship victim and ground victim combat ID is less detailed. Ships employ the 1030/1090 MHZ question-and-answer system as previously discussed.

There was a NATO Battlefield IFF effort in the late 1970's and early 1980's. This included looking at several different technologies for question-and-answer. Some versions of the MK 15 effort for aircraft also considered accommodating ground vehicle requirements in the same system (these variants were at S-band , ~ 3000 MHZ).

All the fratricide during the Gulf War involved ground victims and 27 out of the 34 deaths were persons in vehicles. Ground-based shooters (tanks and TOWS) accounted for 23 of these victims and the other 11 were from air-to-ground weapons. Lights and panels which would show up readily in air-to-ground targeting FLIRS were rushed into development and initial use during the course of the war. Subsequently, additional procurements have been made.

Ground victim problems during the war triggered significant activity. The BCIS (Battlefield Combat ID System) was selected by the Army from a series of "ad hoc" tests to look at ways to use systems built from current components to help with ID. The BCIS system is a question-and-answer approach and operates at 35 GHz; this system will be addressed further later in this report.

COMBAT ID PROCUREMENT PLAN
FYDP 1996 – 2001; MILLIONS

	[illegible]		[illegible]		[illegible]		[illegible]
AIR-TO-AIR	Mk 12 F/A 18 AWACS	$216 < $10	AWACS	$139	USAF	$32	$397
SURFACE-TO-AIR	Mk 12 SHIPS	$87	SHIPS (SLQ-20)	$97			$184
AIR-TO-SURFACE							
SURFACE-TO-SURFACE	BCIS (R&D Only)	$87			SHIPS (Thermal Imaging)	$32	$119
TOTALS		$400M		$236M		$64M	$700M

To develop a first level picture of combat ID spending, the FYDP (Five Year Defense Program) was reviewed for items that could be considered to be in the combat ID category. These numbers may not be precise, or completely inclusive, but do provide an acceptable representation of the current plans. The grouping in the chart was done for simplicity in format.

The F/A 18 investment of $216M covers retrofitting of the Mark 12 IFF interrogator into 450 aircraft. Roughly, $10M is planned for improvements in the Mark 12 system in the AWACS fleet; these improvements include monopulse implementation and improved signal processing to increase angle accuracy and processing reliability.

The Mark 12 investment for ships is understood to be development of a circular, electronically steered phased array antenna which would fit around the ships mast. In addition to providing improved tracking performance, this system could replace the multiple MK 12 antennas on some ships having multiple radars (interrogators have traditionally been deployed with individual radars.)

The BCIS (Battle-Field-Combat-System) is a 38 GHz Q&A system in the R&D phase; this system will be discussed further later in this report.

The ESM systems shown will serve combat ID as well as other functions.

The Air Force is pursuing non-cooperative techniques for additional layers of air victim combat ID.

In response to the small ship problem in littoral waters, the Navy is utilizing an Apache helicopter FLIR for this purpose.

SITUATIONAL AWARENESS PROCUREMENT PLAN (Partial)
FYDP 1996 – 2001; BILLIONS

	LINKS	C^2	NAVIGATION	SENSORS	TOTALS
AIR-TO-AIR	JTIDS $0.8	E2-C $2.2 MCE 0.3	GPS $0.4	AWACS RSIP $0.3	$4.0
SURFACE-TO-AIR	CEC 1.1	FAAD C^2 0.1 BMC^3 0.4		FAAD GBS $0.3	$1.9
AIR-TO-GROUND	IDM / ATHS 0.02			JSTARS $ 3.2 UAVs $1.7	$4.92
GROUND-TO-GROUND	DIGIT. BF. 0.5 SINCGARS 0.8 OTHER 0.4	C^2V 0.4			$2.1
TOTALS	$3.62B	$3.4B	$0.4B	$5.5B	$12.92B

In the spirit of the previous chart, an attempt was made to collect FYDP numbers for the situation awareness plan. Because of the broad use of the term "situation awareness," it was difficult to select what should be in this summary. A collective attribute of the items listed is that their management is carried in the Department of Defense under the aegis of C^3I.

The overall point to be made is that situation awareness has associated with it an overall budget much larger than that for combat ID. Cost effective development of more robust combat ID will depend on leveraging some of this relatively large situational awareness investment to meet combat ID needs.

Section 3: Special Topics Considered

OVERVIEW OF 1030 / 1090 MHz Q&A

- **1030 / 1090 MHz Q&A IS A DIGITAL COMM LINK WITH A LOW LATENCY, POLLING PROTOCOL**
- **TO DATE**

Mk 5	WORLD WAR II	
Mk 10 (1950s)	MODES 1,2	OLD MILITARY MODES
	MODE 3/A	16 BIT REPLY (ID Code)
	MODE C	16 BIT REPLY (Altitude Report)
Mk 12 (1960s)	MODE 4	ENCRYPTED 32 BIT QUERY
FAA (1970s)	MODE S	56 / 112 BIT ADDRESSED INTERROGATION 56 / 112 BIT REPLY, CAN INCLUDE ALTITUDE, GPS POSITION AND DATA LINK

- **FUTURE**

MODE 7/8 NEW MILITARY MODES UNDER DISCUSSION (STANAG)

The several billion dollar military investment in the Mark XII IFF systems dominates the current combat ID inventory. In addition, nearly half of the combat ID investment in the FYDP, over $300M, is associated with the Mark XII.

This digital communication link features a low latency polling protocol with short messages in a "bursty" message format with a few MHZ bandwidth. Low latency is a requirement for combat ID and the short message offers simpler implementation and less chance for overlap when using the polling protocol.

The civil and military rely on different modes to accomplish their objectives; the military must employ civil reply modes as well to meet civil air traffic control needs. As can be seen, historical evolution of the 1030/1090 MHZ link has been generally in the direction of increasing its communication capacity, i.e., message length.

The FAA made a significant shift in the use of 1030/1090 MHZ with the introduction of Modes S. Key features of Mode S are the ability to address an interrogation to a specific platform and the ability to increase the message length. The addressability permits operation in a much denser traffic environment since once a platform is located by polling protocols, it can be locked out of replying until specifically addressed. The specific addressing in addition permits the longer messages to be used by scheduling to avoid overlap. Mode S provides significant advantages to civil aviation control and many ways of exploiting the additional message capability are being considered, for example, sending weather information to the cockpit.

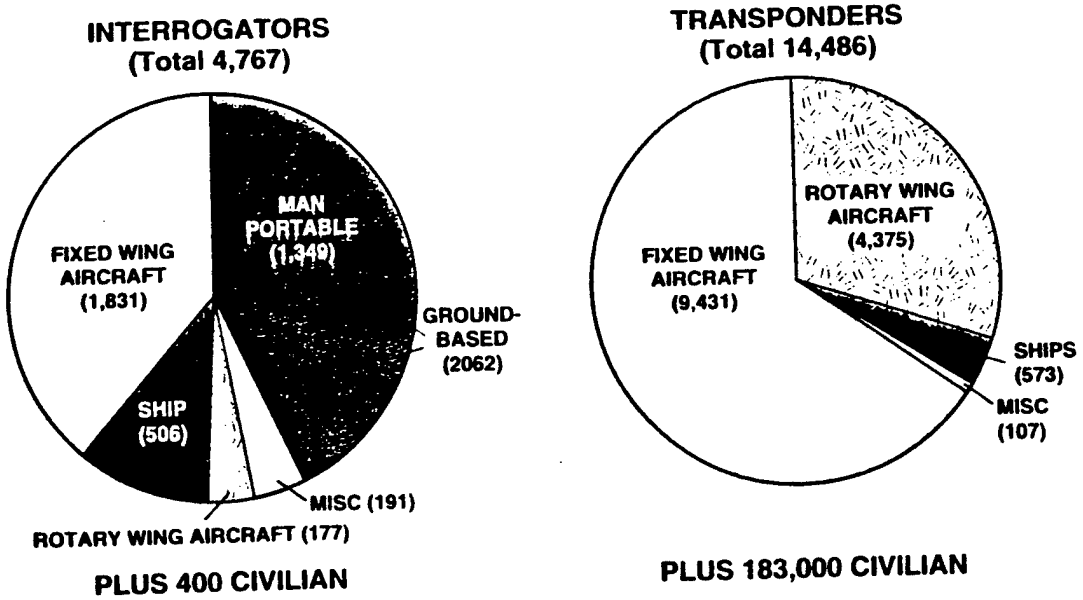
Mode S provided the basis for implementing the TCAS (Traffic Alert and Collision Avoidance System) which is widely deployed on civil airliners. Mode S has also been used to transmit the GPS squitter messages which provide platform position information on a regular basis without interrogation; the approach permits the civil air picture to be developed without interrogation and is similar in nature to the position reporting systems for combat ID.

Several controversies surround the use of 1030/1090 Q&A in the military:

- The system does not function very well - several conflicting stories were heard on this subject with vagaries as to why it does not perform well and how severe the problems are.
- The concern that the encryption is vulnerable to a relatively unsophisticated adversary.
- Should the military implement Mode S transponders? The civil aviation authorities in Europe have stated requirements for Mode S in their airspace by 1999.
- Should improved military modes, be added? New waveforms and new crypto are under consideration; the Europeans are interested in these new modes.

The size of 1030/1090 MHZ Q&A investment and the potential cost of major changes to this system make this area one of the "controversial " issues in combat ID.

DEPLOYMENT OF 1030 / 1090 MHz Q&A



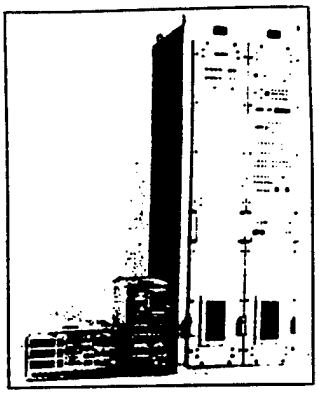
The deployment of 1030/1090 MHZ Q&A is presented here. All manned military airborne systems carry transponders (about 15,000 total) which reply to civil and military interrogation. Interrogators are typically much more expensive and vary from relatively simple short range systems for Stinger to more complex long range systems on AWACS, E-2C, Patriot and Aegis. The fighter and man portable (Stinger) units typically are only used for combat ID (i.e., fratricide prevention via interrogation just before firing). The other interrogator systems are utilized to support both fratricide control and general situation awareness for blue forces. The helicopters equipped with interrogators are Naval and the system is used for situation awareness.

The civilian deployment is characterized by relatively fewer, large, centralized, ground-based interrogators and a considerable number of transponders. All commercial aircraft are required to carry transponders and most civilian aircraft do so for safety and operational flexibility.

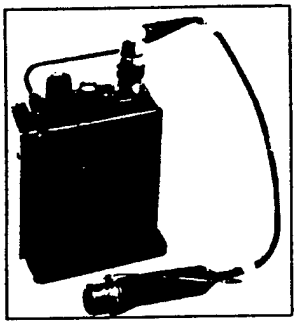
It is worth noting that 1030/1090 MHZ transponders on non-military aircraft is the only case in combat ID where a potential neutral victim has provided at his cost a means to identify himself. This fact should motivate the military to want to assure a high performance level for this system (or at least their interrogators!)

MARK 12 IFF INTERROGATORS

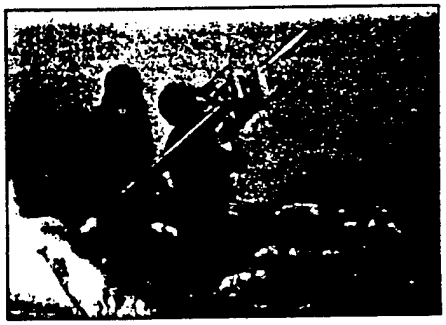
APX-76 ON F-14



UPX-24 ON AEGIS AND OTHER SHIPS



PPX-3 INTERROGATOR ELECTRONICS



MAN-PORTABLE STINGER SAM WITH PPX-3

Some representative MK 12 equipment is shown in this composite; the variation in equipment size and complexity is apparent. The difficulty of implementing an interrogator on a fighter radar is illustrated by the F-14 case; the IFF antenna is the double row of dipoles which are positioned in front of the X-band (~ 10 GHz) slotted antenna for the AWG-9 fire control radar. This complexity illustrates the reason for considerable expense in retrofitting interrogators into fighter radars, such as the F-18 previously discussed.

Observations on 1030/1090 MHZ Q&A (Mark XII)

- Will be a Primary ID System for Foreseeable Future
  - Large Investment; Over $300M in FYDP
  - General Shalikashvili Directive to Utilize Fully and Monitor Performance
- Current System Effective, But Has Some Limitations
  - Encryption Vulnerable; Waveform Reliability Concerns
- Conflicting Information on Mark XII Field Performance
- Controversy About Upgrade Costs Has Hindered Planning
  - New Military Modes (STANAG); Accommodation of Mode S
  - Time Phased Equipage is Cost Control Option
- Additional Situation Awareness Possibilities for Mark XII
  - AWACS Monitoring of Selected Ground Vehicles for Overall Blue Force Monitoring (Also JSTARS)
  - Mode S Use

The Task Force summary observations on 1030/1090 MHZ Q&A are given here. The overriding observation is that with the heavy sunk investment and continued spending planned, this system is going to be an important layer of combat ID for the foreseeable future. This view is supported by recent actions where General Shalikashvili following the Blackhawk shoot down investigation issued a directive to utilize and monitor the system performance (See Appendix B).

In most situations the Mark XII can be a reliable layer of combat ID. However, the encryption may be vulnerable to some levels of adversaries. A mode of operation that has Mark XII turned off due to crypto vulnerabilities, in some circumstances, does not negate its overall value. The time that the Mark XII layer is needed most to prevent fratricide is in an environment of dense blue shooters. (This is a situation where there is less concern that the red side is able to exploit the encryption for situation awareness use.) Conversely, when there are lots of red shooters around, turning off the Mark XII may be sensible since red side exploitation may, in this situation, be of more concern than fratricide. The general message here is not that robust crypto is not desirable, but rather that sensible use of this system can overcome for some of the crypto vulnerability concerns.

The Mark XII waveform uses simple amplitude modulation which makes multipath and interference more of a problem. Improved signal processing and/or new waveform designs being considered for Mode 7/8 upgrades could significantly improve these limitations.

The conflicting information on the current Mark XII performance is a source of concern. The general consensus in the Task Force was that a thorough evaluation of the system, on the bench and in the field, was needed to provide a basis for improving current performance and providing a solid foundation for planning the future of this system, whether it is upgraded or not.

The position negotiated by the United States and the NATO partners concerning Mark XII upgrades has the support of this Task Force (see Appendix C). A general summary of this position is that the United States agrees to participate in a STANAG (NATO Standardization Agreement) to define Mark XII upgrades. No commitment is made to the upgrades now, but the agreement is that any future upgrade will follow the modes defined in the STANAG. A similar stance is taken on Mode S with no commitment to its deployment at this time.

It would seem likely that Mode S transponders will eventually be employed on our military aircraft to support flexibility of operation in civil air space. This equipage would likely start on the general purpose aircraft first e.g., cargo, and eventually get to special purpose systems, e.g., attack helicopters. Evolving digital transponder technology may support retrofit of old systems at reasonable cost even with new modes.

It has already been observed that the Mark XII is utilized for many situation awareness needs. The AWACS systems interrogate Mark XII transponders on ships. There may be situations where some ground vehicles (e.g., one per platoon) could be equipped with applique Mark XII transponders to support blue force monitoring via current AWACS interrogation capabilities; the resultant improvement in overall blue force situation awareness could help overall combat ID by providing information on unanticipated interactions by groups of blue forces. The use of Mode S interrogation by systems like AWACS, E-2C, Aegis and Patriot may increase combat ID ability by helping to more fully identify civilians and neutrals, particularly in dense traffic environments.

JTIDS

- Adds Additional ID Layer for JTIDS Equipped Systems
  - "Don't Shoot Me" Reply After Position Inquiry
  - Low Latency Inquiry/Reply Needed in Protocol (Software Change)
- Retain Existing Mark XII Equipment
  - JTIDS Equipped Systems Have Additional Layer
- Advantages
  - Significantly More Robust (Crypto; Jamming) than Mark XII
  - Provides Growth Path for Military ID Independent of Civil ATC Needs
- Current Plans for JTIDS Implementation
  - F-14, -15, -16, -18, -22
  - Airborne, Ground and Ship C^2 Platforms

The use of modern communication nets to provide a combat ID layer has already been addressed in general terms. JTIDS is used here as an example of such potential capability.

Through the combination of time of arrival data and reported position, members of the JTIDS net can establish relative position. If two or more units on the net have absolute position independently, then all members of the JTIDS net can establish absolute position. The PPLI (Precision Participant Location and Identification) message format is used to accomplish these interactions.

The "Don't shoot me" implementation assumes a low latency reply (e.g., a few seconds) after a JTIDS net broadcast by a member of the net that he is going to shoot a target in a given position. If a low latency response is assured, then a quality combat ID layer is available to the net participants.

The JTIDS "Don't Shoot Me" is not looked at as a Mark XII replacement, but could compete with upgrades to Mark XII. The spread spectrum jamming resistance and improved crypto of the JTIDS system are attractive.

The Task Force supports a near term demonstration of the modification to assure low latency and validate this capability for "Don't Shoot Me" combat ID.

The Army is pursuing limited deployment of a radio net system on the ground called EPLRS (Enhanced Position Location Reporting System). Similar to JTIDS, this system also determines the position of participants in the net and, consequently, contributes to situation awareness and combat ID. The Air National Guard has expanded the EPLRS concept to include F-16's used for close-air support. This approach referred to as SADL (Situation Awareness Data Link) permits ground-based "friendlies" on the EPLRS net to be presented on F-16 Heads Up display along with the target. SADL shows promise as a capable, cost effective layer of combat ID for use in the air-to-ground arena.

Battlefield Combat ID

- Combat ID for the Battlefield is Considered a Shortfall
  - Previous Reliance on Techniques, Training and Procedures (TTP)
- The Magnitude of this Development/Deployment Could be the Most Important ID Effort for Near Future
  - 14,000 Vehicles Plus Allies
- Primary Options
  - Improved Situation Awareness
  - Question and Answer
  - Noncooperative
- BCIS (Directional, K_a-Band) is Most Developed Q&A Concept
  - Evaluation Featured in ACTD

There is a broad consensus in the combat ID community that the ground victim area needs attention. There is not strong agreement as to what approach to take to improve ground victim combat ID, and there is no acquisition budget commitment.

The two leading contenders for ground victim ID improvements are:

1. Improved Situation Awareness via the digitized battlefield investment which includes improved netting, position information, etc.

2. Question-and-Answer either from a more dedicated communication link (functionally similar to 1030/1090 MHZ for air-to-air) or via a more general purpose communication link (i.e., "Don't shoot me" implementation).

The use of non-cooperative techniques is not being ignored, but is considered more long-term for the ground victim case. Arguments run along the lines that the improved situation awareness will provide a "90% solution" at a lower cost; BCIS (Battlefield Combat ID System)* advocates maintain that BCIS is the "100% solution" and ready now and that the solution via the digitized battlefield is too far in the future.

The Task Force had a general consensus that BCIS deployment would be the best

*BCIS is a specific "dedicated" Q and A implementation under development. The frequency is 38 GHz; a non-scanning antenna is employed and the waveform is spread spectrum. The range of the system is about 5 Km in clear weather.

choice if an acquisition decision were at hand. Since this does not seem to be the case, then featuring BCIS in the upcoming ACTD was considered very appropriate. In addition, this extended evaluation period permits other options to be more fully evaluated, an opportunity which should be exploited.

Alternatives to the BCIS approach were more fully addressed in the DoD Study reports previously cited. Most of the options to BCIS try to make use, at least in part, of existing components, boxes, etc. Generally, these concepts include laser rangefinders and parts of the Mark XII IFF system already discussed extensively.

A question that can be asked is "why not just use the Mark XII system on ground vehicles for Q&A?" This would have the obvious advantage of using current inventory as well as allowing the air-ground and air-to-air interfaces to make multiple uses of the same equipment. Two principal reasons are given for not using the Mark XII:

1. The beamwidth of a reasonable sized, interrogator antenna on ground vehicles at L-band (1030/1090 MHz) is too large to discriminate targets in the dense ground environment. BCIS at 38 GHz has a beam width 35 times smaller for the same antenna size, viz approximately a 1° beam from a 0.5 m length antenna.

2. The propagation of L-band energy near the earth will suffer multipath to a degree that link-margins will be severely degraded and system performance limited.

Reason number 1) above is not in contention and makes a compelling case for the higher frequency. Reason number 2), based on a cursory consideration of propagation data presented did not seem convincing to the Task Force, especially since excess link margins can be large over the short ranges involved.

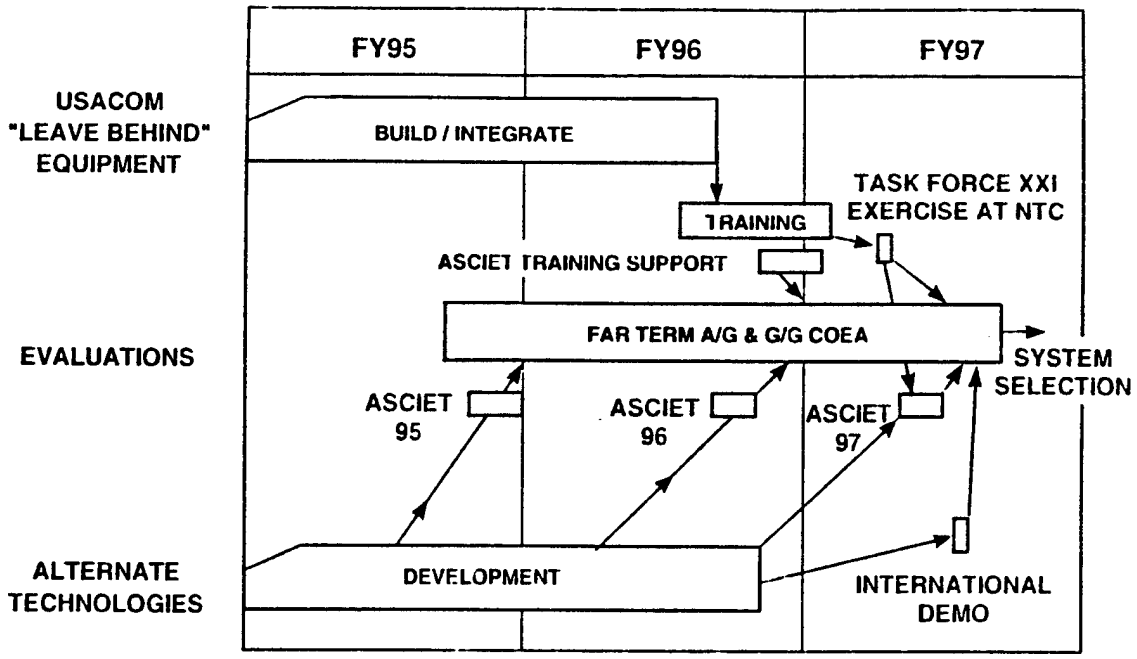
Hybrid concepts that utilize lasers to get the directional interrogation desired combined with a Mark XII reply have also been proposed. The Europeans have put forward laser systems; a low probability-of-intercept beacon system, as well as 35 GHz Q&A techniques.

If a Q&A system is widely deployed for the ground victim area, it is clear that significant thought should be given to what contributions this system can make to situation awareness, limited communication, etc. The evolution of the MK 12 IFF system previously covered should be used to guide the thinking in this area, and help structure decisions on the value of a widely deployed, special purpose Q&A system.

In the next chart there is a schedule presentation of activities related to ground victim combat ID.

COMBAT ID ACTIVITY SCHEDULE

(CID Architecture Working Group)



This schedule was produced by the Architectural Working Group of the DoD combat ID Task Force and pertains to ground victim combat ID.

The anticipated efforts in a combat ID ACTD (Advanced Concept Technology Demonstration) are included in this chart. The top line focuses on the acquisition of a limited number of BCIS units for evaluation in an Army Task Force XXI exercise at the National Training Center. The understanding is that Digital Battlefield capabilities available to Task Force XXI will also be evaluated for contributions to combat ID, e.g., "Don't Shoot Me" approaches.

Also, illustrated notionally is the development and testing of alternate technologies to BCIS, both domestic and international, with the ASCIET tests being utilized for evaluation. Meanwhile, air-to-ground and ground-to-ground COEA's are being conducted in parallel.

The Task Force has concern whether this disparate set of activities will be sufficiently focused to provide the basis of a sensible investment decision for ground victim combat ID in late FY97. This concern will be addressed further in the Task Force Recommendations.

Non-Cooperative ID

- Fundamental Separator of ID Techniques
- Noncooperative Techniques Have Many Advantages
  - Potential Fratricide Victim Does Not Need to Make Any Changes to Facilitate ID
  - Positive Hostile (Beyond Absence of Friendly) Capability
  - No Crypto Key; No STANAG; No Stealth Impact
- Some Disadvantages
  - Tend to be Costly (Especially to Retrofit)
  - Typically, Statistical Based Classification - Automated Fusion
  - Many Techniques Have Limited Regions of Effectiveness
- Considerable Overlap with Other Defense Technology Areas
  - SIGINT
  - Ballistic Missile Defense Target Discrimination
  - Space Object Identification
  - Surface Target Recognition/Classification

As has previously been observed, many of the advanced layers of combat ID employ non-cooperative approaches. This trend is expected to continue and much of the research and development for combat ID techniques is focused on non-cooperative approaches.

The key feature of non-cooperative approaches is that the potential victim is not asked to make modifications to facilitate ID, i.e., all the burden falls on the ID sensor. All potential targets are treated as a whole, and the targets under consideration, viz friend, enemy, neutral, unknown, are separated, based on the specific features of each class.

Non-cooperative approaches are inherently "positive" hostile in nature (i.e., provide information other than absence of friendly), have the benefit of no crypto key needs, and do not interfere with the observables (e.g., stealth) of the target being identified.

The non-cooperative techniques are costly to implement in some cases, particularly in retrofit. In general, non-cooperative approaches are implemented via sensors that are being used for other purposes, e.g., fire control, surveillance, targeting, range finding, intelligence.

Additional drawbacks of many non-cooperative techniques is that a given approach may only apply in limited situations and often extensive data bases are required for the classifiers. How well the target classifier works, i.e., the ID sort, depends on how

extensive the JEM line data base is on potential targets including friends, foes and neutrals. Generally, a robust computational capability is required to retrieve data and do the classification, and good intelligence and/or modeling data is required to support the data base.

In many ways, combat ID is a relative "late comer" to the non-cooperative target recognition problem area. Ballistic Missile Defense has been a long-term driver on the development of many types of non-cooperative target recognition techniques and sensor technologies. The problem of determining the country of origin and function of space objects has also created a source of non-cooperative ID approaches. More recently, in surface strike and attack warfare, non-cooperative approaches are being used to classify surface targets. It is expected that technology transfer from these areas should increase as more emphasis is put on non-cooperative approaches for combat ID.

This Task Force gives strong support to continuing research, development and procurement of non-cooperative approaches. A better framework is needed to provide performance assessment and cost benefit analysis. The layered ID architectural approaches previously described, are well-suited to non-cooperative approaches, where the best techniques will likely have limited zones of applicability. It is important to note that there are techniques that have very limited performance zones, but which can provide high confidence ID where applicable. Implied in the discussion of the fusing process for these layers of combat ID is a selection of "weights" for each algorithm depending on its applicability to the current target and situation.

Increasing Role for AWACS in Combat ID

- Better Netting (JTIDS, CEC) to Distribute ID
- Improvements Programmed
  - Fix Stale Tracks; IFF Upgrades
  - ESM Addition
- Improvements Under Consideration
  - TIBS (Tactical Intelligence Broadcast Service) Capability; Improved INTEL Data Correlation
  - Improved Sensitivity ESM; Emitter Finger Printing
  - Automated Correlation of Air Tasking Order with Air Situation
  - Carry-on Commint Exploitation Capability
  - Capability to Interrogate on Mode S (MK 12) by Sector

The AWACS is an example of the role that large "centralized" assets can play in combat ID. Improvements in netting together systems such as AWACS should permit high quality ID distribution, and consequently, also strongly motivate upgrades to the centralized assets to support better ID.

Activities underway or under consideration for AWACS are listed in the chart.

In addition to AWACS, the E-2C, Aegis, and Patriot are also attractive candidates for improved ID capabilities. The role of JSTARS and Longbow in supporting ID for both battle management and fratricide needs further exploration.

In the case of Aegis and Patriot, both of these systems are being upgraded to provide defensive capabilities against TBM's (Tactical Ballistic Missiles); the Patriot lower tier and Aegis Area Defense are core elements of the Ballistic Missile Defense Organization efforts. In order to support these systems tactical ballistic missile defense provide "discrimination," i.e., the sorting of the warheads from the spent rocket bodies, decoys, debris, etc. The discrimination function requires the use of non-cooperative approaches, since "friends" are not involved in the sort and cooperative approaches are not possible. Many of these non-cooperative approaches, e.g., radar waveform upgrades to measure length, can easily serve both combat ID and TBM discrimination. Early consideration of this overlap, could help in the development of cost effective combat ID improvements in Patriot and Aegis.

GPS

- GPS A is Very Cost Effective Way to Determine Accurate Position
- Accurate Position is an Essential Part of Many Combat ID Techniques
  - Also Very Useful for Other Functions
- GPS has Vulnerability to Jamming in Some Scenarios

There are many ways to provide accurate location information, however, none compete with GPS for providing accuracy at low cost.

This Task Force felt strongly that GPS will play a role in any cost effective combat ID architecture. The essential caveat is that there should be layers in the combat ID architecture that are not dependent on GPS in case it is denied.

The GPS denial issue has many implications beyond combat ID and is receiving considerable attention in the community.

Comments on Training & Testing

- Combat ID is a Complex Process — Will Not Work Well Without Extensive Training and Testing
  - Test–Fix–Test Cycle Essential
- Army National Training Center Producing Positive Results
- ASCIET (All Service Combat ID Evaluation Team) Tests
  - Format
    - Annual Two-Week Joint Tests (First, Sept. 1995)
    - $10M/Yr (Services); GOSC Direction
  - Evaluate
    - Concepts of Friend and Foe ID
    - Current and Developing Technologies
    - Current and Developing Doctrine/TTP
    - Training

The area that the combat ID Task Force felt most essential to improving combat ID performance was the area of training. Training was also judged to be the method of choice to improve combat ID capability quickly. Improved training also would help focus shortfalls, help guide the development of new combat ID tools and help focus the development of rules of engagement, doctrine, etc.

The Task Force was made aware of significant combat ID improvements on ground warfare after the Army National Training Center increased the level of attention to combat ID in their exercises. Other services should be encouraged to follow this model in their individual exercises, e.g., Red Flag, and all joint exercises.

The ASCIET (All Service combat ID Evaluation Team) tests grew out of the JADO/JEZ (Joint Air Defense Operations/Joint Engagement Zone Tests). The ASCIET tests are planned to be annual; the first was held in September 1995 at Gulfport, Mississippi. These tests are organized and led by a multi- service organization currently headed by an Air Force colonel who reports to the combat ID General Officers Steering Committee (GOSC). The services each contribute to a fund which totals $10M for these annual tests. Service participants, laboratories and industry are invited to participate - essentially at their own expense.

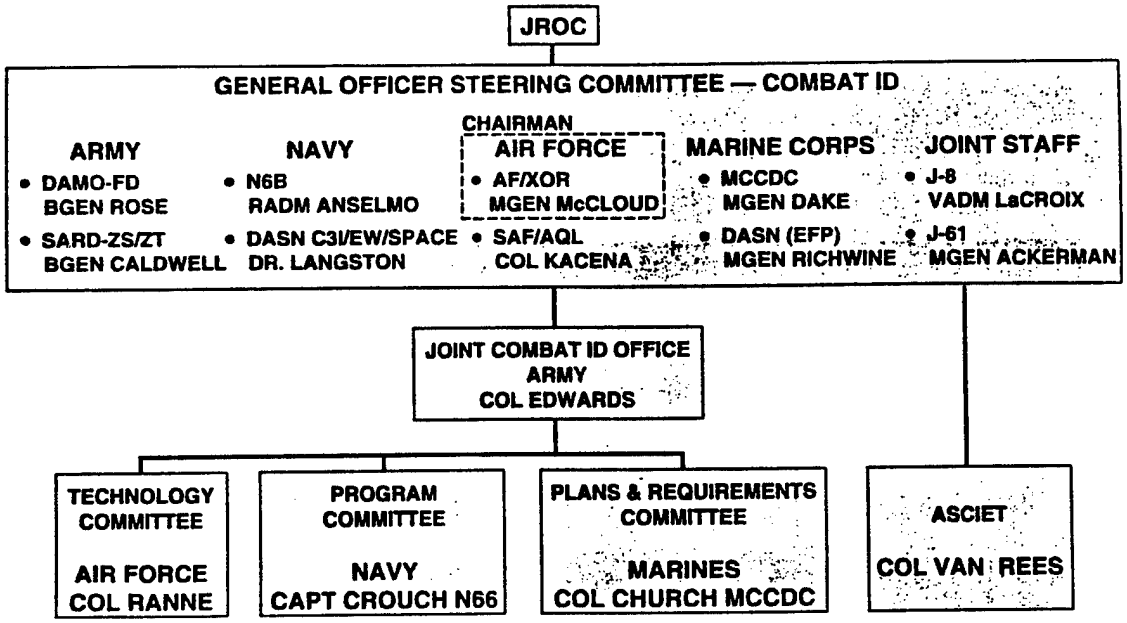
The 1995 tests focused on air victim combat ID although some attention was given to the ground-to-ground and air-to-ground areas in a limited context. The littoral environment at Gulfport permitted Aegis, Patriot, air-to-air superiority aircraft and other capabilities to be netted together via many data links including JTIDS and CEC. A very successful effort was undertaken by the ASCIET office to produce a rapid and detailed post-mission briefing - this approach was very effective in quickly illustrating combat ID system problems and their causes.

The Task Force felt the ASCIET tests represent a very positive forum for combat ID development. However, the scale of these tests is not matched to the broad objectives which are listed in the chart.

The scope of the ASCIET tests and the limited participation puts these tests more in the category of exercises rather than training. The training function requires broader participation in a longer term, more inclusive format. Similarly, the ASCIET test contributes to, but is of limited scope, in the doctrine and procedures area.

ASCIET tests should focus on evaluating ID technologies as well as doctrine and rules of engagement. The ASCIET testing format has limited effectiveness for training which would be best done in a larger, joint warfare environment such as that under the control of ACOM (Atlantic Command).

CURRENT COMBAT IDENTIFICATION ORGANIZATION



In response to congressional interest, the Department of Defense established in 1992 a joint combat ID organization under the JROC (Joint Requirements Oversight Council). ASCIET and the Joint Combat ID Office (JCIDO) report via parallel paths to the GOSC (General Officer Steering Committee). The chairmanship of the various positions rotates among the services.

The GOSC includes requirements, acquisition, and Joint Staff participation. JCIDO is charged among other coordination tasks with developing a prioritization of combat ID requirements.

Comments on the Combat ID Organization

- Combat ID is a Small, But Important, Part of Overall Joint Military Capability
  - Special Treatment Appropriate for Next Few Years
- Current Efforts (GOSC, JCIDO, ASCIET) are Giving Positive Results — But Limitations
  - Could be More Unified; Some Resource Problems
  - Corporate Memory Mechanism Limited
  - Contributor Input is not Balanced e.g., The Developer
- Possible Improvements:
  - Dedicated One Star to Direct Overall DoD Combat ID Activities
  - Integrated Product Team to Answer Budget Decision Questions in FY97, 98

The Task Force views combat ID capability as a relatively small but important part of joint military capability. Since combat ID capability development is lagging and needs increased attention, special treatment is appropriate for the next few years. In the future, when the DoD has reached improved levels of Joint Warfare development and training, combat ID as a separate area may not be appropriate.

The Task Force had concerns about the continued overall coordination of combat ID for the reasons listed in the chart. The ASCIET test situation has already been discussed. Similar to ASCIET, the resources available to JCIDO do not match the tasking if this organization is to maintain a central and strong long-term position in improving combat ID capability.

The Task Force feels that dedicated one star level leadership of national combat ID efforts (at least for the next few years) would help establish the importance of combat ID and would help coordinate the ASCIET and JCIDO activities.

A small integrated product team is also proposed bringing all parties together, including more acquisition participation, to help focus on the acquisition decisions coming up in the FY97, 98 time frame. This is discussed in more detail in the next chart.

Combat ID Integrated Product Team

- Primary Objective
  - Ensure That DoD-Wide Combat ID Activities Provide Information Needed to Support Acquisition Decisions in 1997–98 Time frame
- Charter Framework
  - Delineate Acquisition Decisions to be Addressed in 1997–98
  - Establish Overall Plan to Acquire Data Needed for the Decisions
  - Review and Approve:
    Key Features of COEA's (e.g., Scenarios; Threats; Meas. of Effectiveness)
    ACTD/ATD Content
    Interfaces Between Activities – Data Flow and Timing
  - Make Recommendations to the Operational Community Regarding Exercises/Demonstrations/Tests
    Put Emphasis on Data Needed to Support Acquisition Decisions

A representative charter framework for a combat ID Integrated Product Team is shown here along with the primary objective - ensuring that DoD-wide combat ID activities provide the appropriate information to support upcoming acquisition decisions.

The larger acquisition decisions expected relate to ground victim ID, Mark 12 upgrades, and adaption of communication links for improved combat ID capabilities.

Section 4: Summary/Findings and Recommendations

Summary/Findings

- Combat ID is not a Crisis – Growing, Long-Term Problem
- Multiple Layers, Variable Equipage Important Concepts in Combat ID Planning
  - Combat ID Requirements Should be Expanded; Sensors, Nets, etc.
- Mark XII is a Critical Combat ID Element and will be Around for Long-Term
  - Make it Work; More Effort into Planning/Upgrades
- Ground Victim Area has most Serious Combat ID Shortfall
  - Strong Support for ACTD/ATD to Evaluate Options
  - Commonality Issue is continuing Concern (Allies; Other Combat ID Areas)
- Comm Link Upgrades Offer Robust Q&A Possibilities with Migration Potential
  - e.g., JTIDS "Don't Shoot Me"
- Large Centralized Assets such as AWACS, E-2C, Aegis, Patriot Have Increasing Role in Combat ID
- GPS is Cost Effective for Combat ID – Avoid Total Reliance
- Noncooperative Techniques Have Many Advantages
  - Essential for Advanced Layers
- ASCIET Tests are an Important Element of Combat ID Effort
  - Objectives Very Broad; Resources not Matched
- The Multifaceted Nature of Combat ID Activities Results in Overall Coordination Concerns
  - GOSC; JCIDO; ASCIET; ACTD (DDR&E); COEA's (PA&E; Services)

The executive summary presented earlier in the report also serves as an overall discussion of this chart.

Recommendations

1. Continue the Current CID Budgets and Activities without Major Changes

2. Strengthen the Current Organizational Arrangements by:
   - Establishing an Integrated Product Team Reporting to the USD(A&T) and the Vice Chairman of the Joint Staff to Manage the Activities Needed to Support CID Decisions Over the Next Few Years
   - Putting the JCIDO and ASCIET Organizations Under a Dedicated Flag Officer (Also a Member of the GOSC)
   - Adding a Total of $25M/Year to Combat ID to Support ASCIET; JCIDO and Integrated Product Team Analysis Support

3. Give Priority to Support for the Following Activities if Resources can be Made Available (Beyond $25M Previously Discussed)
   - Evaluate Current MK 12 Problems and Develop Long-Term, Evolutionary NATO Compatible Upgrade Strategy Including Digital Versions; New Modes; Crypto; etc.
   - Evaluate Addition of a Q&A Mode to JTIDS Equipped Systems to Provide Another Combat ID Layer
   - Support a More Aggressive R&D Program for Noncooperative ID Techniques
   - Accelerate and Enhance Testing to Evaluate Options to Provide Combat ID for Surface Vehicles (Ground-Ground; Air-Ground)
     Provide at Least 100 BCIS Articles for ACTD

This Task Force saw no need to make major changes in the combat ID budgets and activities at this time. The investment in the Mark XII (which represents over $300M and is approximately one-half of the combat ID FYIP) should be reevaluated depending on the on-going performance assessment of this system. The investment in the ACTD to help focus the selection of a plan to improve ground victim ID is strongly supported.

The organization recommendations have been discussed in the earlier material. The Task Force sees the need for a broad based Integrated Product Team (IPT) to focus the diverse, combat ID activities across the DoD to provide the proper support and data needed for upcoming acquisition decisions. The multi-service and multi-developer nature of combat ID makes proper coordination difficult, some oversight team such as an IPT seems essential for the near-term at least.

The recommendation of a dedicated, Flag Officer level lead for combat ID in the military side is also intended to increase the level of attention on combat ID for the near-term. Flag rank would bring strength to the voice of combat requirements in broad military system requirements and would increase the coordination between the 0-6 level offices of JCIDO (planning, analysis function) and ASCIET (field tests and evaluation function). Increased attention to combat ID direction for the next few years should help determine whether stand-alone status should continue.

Appendix A: Task Force Terms of Reference and Membership

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-3010

ACQUISITION AND
TECHNOLOGY

JAN 10 1995

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference -- Defense Science Board Task Force on Combat Identification

DoD is facing major decisions that in the aggregate will establish the future direction of U.S. combat identification (CID) programs and have an impact upon the broader issue of situational awareness (SA). In current usage, CID is defined as the means to positively identify friendly, hostile, and neutral platforms to reduce fratricide due to misidentification, and to maximize the effective use of weapons systems. In SA, forces are kept abreast of general dispositions of friendly, neutral, and enemy forces in the context of factors such as terrain and weather. Both CID and SA contribute to enhanced combat effectiveness. Within a limited defense budget, a balanced approach comprised of and trading off among elements of both SA and CID must be sought. The Assistant Secretary of Defense (C3I) and I, in conjunction with the Vice Chairman, Joint Chiefs of Staff, have formed a DoD CID Task Force to address this issue.

As an adjunct to the DoD CID Task Force effort, I request that you form a Defense Science Board Task Force on Combat Identification to: review all aspects and environments (Air-Air, Air-Ground, Ground-Air, Ground-Ground) of the fratricide problem, review the range of potential CID solutions which the JROC and the Services have initiated and their potential in solving this problem, and provide an independent assessment of the overall architectural framework developed by the DoD CID Task Force. The DSB Task Force should evaluate how well this architecture will pull these efforts together, what areas require emphasis/ additional emphasis, and whether the long term strategy and plan for development and fielding of this comprehensive SA CID architecture, and the programs which support it, are sound, affordable, and maximize combat effectiveness in each environment. The Task Force should consider the following:

- Is the DoD proposed CID architectural framework affordable within the anticipated budget climate?

- Are the contributions of SA and direct ID balanced in an effective manner?

- Will the proposed threshold and objective capability of the SA and direct ID "backbone" have the potential to significantly reduce fratricide while maintaining or enhancing combat effectiveness?

- Does the CID framework provide a cost effective degree of commonality between the techniques for identifying friendly aircraft and armor?

- Is the use of existing or funded sensors and communications systems to reduce costs appropriately considered?

- Does the CID framework support multiple non-cooperative identification technologies?

- Is there sufficient flexibility to accommodate a wide range of future sensors and communications inputs and to respond to changes in technology or doctrine?

- Will the CID framework have the potential to achieve the necessary interoperability to minimize fratricide in Allied and coalition operations?

- Do present and projected Service programs map to the CID framework? If not, what changes are required?

The Task Force should review and provide recommendations on the validity of any Advanced Concept Technology Demonstrations (ACTD) that the DoD CID Task Force may propose. It should also include an assessment of the potential impact of its recommendations on military readiness for those recommendations where such an assessment is appropriate. The Task Force should submit a report on all of the above by March 1995, in time for the Spring NATO Conference of National Armaments Directors (CNAD) and Four Powers meetings.

The Assistant Secretary of Defense (C3I) will sponsor this DSB Task Force, providing funding and other support as may be necessary. Dr. Robert R. Everett will serve as Chairman of the Task Force. Mr. Charles B. Taylor will serve as the Executive Secretary and LtCol Scott Hammell, USAF will serve as the alternate Executive Secretary. CDR Robert C. Hardee, USN will serve as the Defense Science Board Secretariat representative. It is not anticipated that this Task Force will need to go into any "particular matters" within the meaning of Section 208 of Title 18, U. S. Code, nor will it cause any member to be placed in the position of acting as a procurement official.

Paul G. Kaminski

DSB TASK FORCE ON COMBAT ID

CHAIRMAN	
ROBERT EVERETT	CONSULTANT
DAVID BRIGGS	MIT LINCOLN LABORATORY
FRANK KENDALL	RAYTHEON
DENNIS MARQUIS	CONSULTANT
DONALD NEUMAN	MITRE
THOMAS QUINN	CONSULTANT
GEN. JOHN VESSEY	US ARMY - RETIRED

CHARLES TAYLOR, EXECUTIVE SECRETARY, OASD/C^3I

Appendix B: CJCS Communication on Mark 12 Mode 4 Reliability

* UNCLASSIFIED *

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M On . 94300/27636

CJCS WASHINGTON DC//

CINCUSACOM NORFOLK VA//

USCINCCENT MACDILL AFB FL//

USCINCEUR VAIHINGEN GE//

USCINCPAC HONOLULU HI//

USCINCSO QUARRY HEIGHTS PM//

USCINCSOC MACDILL AFB FL//

USCINCSTRAT OFFUTT AFB NE//

USCINCTRANS SCOTT AFB IL//

USCINCSPACE PETERSON AFB CO//

CSA WASHINGTON DC//

CNO WASHINGTON DC//

CSAF WASHINGTON DC//

CMC WASHINGTON DC//

UNCLAS PERSONAL FOR

CINCUSACOM, ADM MILLER; USCINCCENT, GEN PEAY; USCINCEUR, GEN JOULWAN; USCINCPAC, ADM MACKE; USCINCSO, GEN MCCAFFREY; USCINCSOC, GEN DOWNING; USCINCSTRAT, ADM CHILES; USCINCTRANS, GEN RUTHERFORD; USCINCSPACE, GEN ASHY; CSA, GEN SULLIVAN; CNO, ADM BOORDA; CSAF, GEN FOGLEMAN; CMC, GEN MUNDY FROM GEN SHALIKASHVILI

SJS-C/SJS-N

FILE

CDR H. E. Yeiser, USN
JB ORD, x49627

JOHN M. SHALIKASHVILI, CJCS

JSISC ALTERNATE MESSAGEFORM

* UNCLASSIFIED *

UNCLASSIFIED

02 03 RR RR UUUU

MSGID/GENADMIN/CJCS//

SUBJ/MARK XII IFF MODE 4 RELIABILITY//

RMKS/1. THE INVESTIGATION OF THE SHOOTDOWN OF THE UH-60 HELICOPTERS IN IRAQ AND THE CONTINUING JOINT REQUIREMENTS OVERSIGHT COUNCIL (JROC) REVIEW OF THE ADEQUACY OF OUR CURRENT COMBAT ID (CID) SYSTEMS HAVE ADDRESSED THE RELIABILITY OF THE MARK XII MODE 4 IFF. ACCORDINGLY, I REQUEST THAT YOU TAKE THE FOLLOWING ACTIONS TO INCREASE THE EFFECTIVENESS OF MODE 4 THROUGHOUT OUR FORCES:

(A) REQUIRE OPERABLE MODE 4 FOR EVERY EQUIPPED FIXED AND ROTARY WING AIRCRAFT SORTIE, WITH THE SOLE EXCEPTION OF MISSIONS WHERE THIS REQUIREMENT WOULD PRECLUDE THE ACCOMPLISHMENT OF ESSENTIAL TRAINING. OPERATIONAL CHECKS WILL BE ACCOMPLISHED BEFORE FLIGHT (GROUND TEST ASSETS PERMITTING), AND CONDUCTED THROUGHOUT EACH MISSION. INOPERABLE MODE 4 WILL RESULT IN RTB. SURFACE TO AIR MISSILE, AIR AND GROUND CC UNITS, AND MARK XII EQUIPPED SURFACE SHIPS AND SUBMARINES WILL CONDUCT APPROPRIATE MODE 4 CHECKS TO ENSURE PROPER FUNCTIONALITY.

(B) UNITS WILL REPORT MODE 4 RELIABILITY INFORMATION TO ENABLE COMPONENT AND CINC STAFF TRACKING AND ANALYSIS OF EMERGENT FAILURE OR UNRELIABILITY TRENDS.

INIT: _____

JCSISC ALTERNATE MESSAGEFORM

UNCLASSIFIED

UNCLASSIFIED

03 US RR RR UUUU

(C) WILL COORDINATE WITH YOUR STAFFS IN 6 MONTHS TO EXAMINE THE DATA COLLECTED AND DETERMINE CORRECTIVE MEASURES, IF APPROPRIATE.

2 ADDITIONALLY, COMBAT IDENTIFICATION, SPECIFICALLY MARK XII MODE 4 OPERATIONS, IS BEING ADDED AS A COMMENDED TRAINING ISSUE (CTI) FOR THE CY95 JOINT TRAINING MASTER PLAN. IT IS ESSENTIAL SUFFICIENT ATTENTION BE DEVOTED TO THE OPERATION OF THIS IMPORTANT ELEMENT OF COMBAT ID.

3. THESE ACTIONS ARE CRITICAL TO ESTABLISHING AS HIGH A PROFILE AS POSSIBLE FOR MODE 4 OPERATIONS IN ORDER TO OPTIMIZE SYSTEM PERFORMANCE AND WILL BE INCORPORATED INTO OUR JOINT TTP AT THE EARLIEST OPPORTUNITY.

4. WARMEST REGARDS.//

INIT: _____ JCSISC ALTERNATE MESSAGEFORM

Appendix C: Joint Service Requirements for the DoD Combat Identification Task Force (Re: Mark 12)

UNITED STATES MARINE CORPS
MARINE CORPS COMBAT DEVELOPMENT COMMAND
QUANTICO, VIRGINIA 22134-5001

IN REPLY REFER TO:

19 JAN 1995

MEMORANDUM FOR THE EXECUTIVE PANEL OF THE DOD COMBAT IDENTIFICATION TASK FORCE

Subj: JOINT SERVICE REQUIREMENTS FOR THE DOD COMBAT IDENTIFICATION TASK FORCE - ACTION ITEM

1. The Four Service position on a MK XII IFF upgrade requirement is to improve the current MK XII only through incremental upgrades. The baseline upgrade would use current form, fit, and function, commercial off-the-shelf equipment and non-development items that incorporate digital technology and improved cryptology and be implemented on a life cycle replacement basis and/or prioritized warfighting basis. This upgrade to digital technology will facilitate future growth to address Mode S and a new waveform (i.e. Mode 7) if and when they become military operational requirements. Today, the Services do not believe that Mode 7 is a military operational requirement nor do they believe that Mode S is a combat identification (CID) requirement.

2. The Services agree that the aging MK XII system needs modest improvements in light of increasing O&M costs and outdated cryptology. Service studies and the JROC have validated the requirement for an affordable, balanced approach to combat identification (CID) that incorporates a combination of cooperative ID, hostile ID, and situational awareness capabilities. Alternatives identified in the CAI COEA offered performance improvements but, only a marginal improvement in operational effectiveness over the current MK XII at considerable cost (estimated $3.5B program). An incremental upgrade to the current MK XII is the only affordable method of achieving a balanced CID approach, maintaining a viable friend ID capability while pursuing improvements to hostile ID and situational awareness.

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