Executive Summary
Marine Corps Command and Control Systems Intra/Interoperability

The Naval Research Advisory Committee (NRAC) was tasked I December 1985 to undertake a study of Marine Corps Command and Control (C2) systems interoperability. According to the terms of reference, as revised 20 March 1987, this study was to examine the C2 requirements of Marine Corps forces in the near and mid-term and to make recommendations, as appropriate, to enhance Marine Corps C2 system intra/interoperability capabilities. The Panel, which was organized to address these issues, concentrated its efforts on the Marine Tactical Command and Control System (MTACCS). The Panel traced the history of this integrated C2 automation concept since its 1969 inception, and examined current systems status, capabilities, and future plans. The program's management structure, intra/interoperability documentation, as well as system interface requirements were analyzed I some detail. Two interim assessments were presented to the Marine Corps leadership in May 1987 and February 1988, respectively.

The Panel finds that the original MTACCS goal of an integrated tactical C2 system correctly anticipated needs of Marine Corps commanders for automated decision aids based on enhanced battlefield information pressing, display, and communication. This need has become acute in recent times because of two trends, both of which are expected to continue I the foreseeable future. First, advances in sensor systems are contributing to enormous increases in the volume of tactically significant information. Second, increasing mobility of tactical forces is confronting commanders with shrinking decision times.

While MTACCS was a very farsighted concept, its implementation posed an extreme challenge given the technology available in the early 1970's. The goals set for MTACCS have not been realized to date. The system architecture has changed significantly during the past 20 years, including the separation of Marine Corps information systems into Tactical Data Systems (TDS) and Automated Information Systems (AIS). The latter, largely administrative in nature, are not considered part of the tactical C2 architecture. While personnel and logistics support were originally part of MTACCS, these functions are now included in the AIS category even though they are intended for field deployment. To date, only a limited number of planned tactical data systems have been fielded; e.g., certain elements of the Marine Aviation C2 System, the Digital Communication Terminal (DCT), and the Position Location Reporting System (PLRS). Some elements of the Marine Air-Ground Intelligence System (MAGIS) have also been developed. On the other hand, development of a key element, the Marine Integrated Fire and Air the other hand, development of a key element, the Marine Integrated Fire and Air Support System (MIFASS), was canceled in 1987 because of cost and performance problems. It appears that the requirements originally included in MIFASS and the Tactical Combat Operations (TCO) system will be addressed by a new combined program called the Fire Support and Maneuver (FIREMAN) system.

Although efforts are continuing to achieve the MTACCS objectives, the strong central coordination envisioned in the beginning has been lacking. As a result, serious intraoperability deficiencies exist in the current baseline. Many essential TDS interface requirements are inadequately defined or satisfied. Interface requirements between TDS's and deployed AIS's remain undefined. Moreover, it is unlikely that existing or planned tactical communication systems will have adequate capacity, connectivity, robustness, and multi-level security to support future battlefield information systems. Current intra/interoperability documentation efforts also fall short of essential requirements. The documents are reactive rather than directive in nature, and are not always internally consistent. Indeed, intra/interoperability standards have not been enforced uniformly.

The Panel believes that problems encountered in developing the desired integrated tactical C2 system have been caused primarily by weak configuration management control over MTACCS and its associated systems as evidenced, for example, by a persistent open-ended requirements process. Requirements escalation has been driven by rapid growth in the assessed threat, as well as by the unprecedented pace of technological progress. Unfortunately, the generation of system requirements and specifications has generally not been subjected to adequate systems-engineering discipline, especially in regard to performance simulation. The participation of operating forces in establishing requirements has also been too limited. In the absence of centralized configuration management, the integrated C2 system originally envisioned has evolved into a number of relatively independent subsystems whose individual capabilities have responded to changing requirements without sufficient consideration of impact on overall systems performance.

Despite serious implementation delays, including termination of MIFASS development, the ideas underlying the original MTACCS remain sound. Indeed, the Panel believes that the need or automated support of Marine tactical command and control will continue to grow. The Marine Corps recognizes this fact, and is in a position to benefit from experience gained in the MIFASS and TCO testbed programs. Taken as a whole, MTACCS experience can provide important guides to future progress. The principal critical "lessons learned" are:

(1) The importance of design freezes as a means of controlling requirements "creep".

(2) The strong interdependence of requirements, system performance, and cost.

(3) The crucial role of intra/interoperability as a determinant of C2 system performance.

(4) The importance of systems engineering, supported by simulation testing, especially during the planning phase of any complex system development.

Major organizational changes in the Marine Corps are currently being implemented which have the potential for improving the management of intra/interoperability issues. Other encouraging indications include the good progress being made in Marine aviation-

specific systems, and the excellent cooperation between the Navy and Marine Corps in addressing and resolving interoperability problems between the two Services.

Based on its findings, the Panel recommends that the Marine Corps take necessary steps expeditiously to address three generals areas of concern:

1) **Systems Engineering** : A comprehensive re-examination of tactical C2 system requirements should be conducted leading to an updated baseline definition. Within limits imposed by performance/cost tradeoffs, the new baseline should address near-term mission needs, while providing options for future incremental enhancements consistent with anticipated mission trends. Toward this end, the baseline definition should be based on an open architecture featuring standardized interfaces. It should also make maximum practical use of past investments, focus on what is achievable in the near term, and aim for maximum integration of TDS's, deployed AIS's, and tactical communication systems. The rebaselining effort should be supported by establishment of a system simulation capability.

Future mission requirements and emerging technological opportunities should be analyzed on a continuing basis. An evolutionary development strategy should be adopted and block upgrades provided as appropriate. Because of the crucial importance of standardized interfaces the Marine Corps should place added emphasis on participation in relevant DOD standards activities.

2) **Management:** A strong, centralized intra/interoperability configuration management and change control authority should be established with unambiguous responsibility for all TDS's, deployed AIS's (i.e., personnel and logistics support systems), and tactical communication systems. This critically important function must have access to adequate systems-engineering resources to assure and objective basis for decisions. In that regard, strengthening of the Tactical Systems Inter- and Intra-operability Program (TACIIP) would be a useful step. The establishment of a Correlation Control Group should also be considered.

The baseline documents (C2MP, TIDP, TIC, IMP, etc.) should be transformed into authoritative guides, and a management process be instituted for their timely, orderly updating. Improvements are also needed in management continuity for complex programs. Career planning and development for Marine Corps acquisition officers should be strengthened. Long-term technical support for program managers should be improved.

3) **Implementation Strategy** : Near-term efforts should concentrate n the required intra/interoperability documentation updates, implementing FIREARM system development, and planning for an enhanced tactical communications backbone.

The current cycle of documentation revisions should transform the baseline documents into the recommended authoritative guides. Coverage should be expanded to include intra/interoperability requirements for both TDS's and relevant AIS's.

In planning the FIREARM program, it is essential that this system be treated as part of the larger C2 system architecture specified in the recommended baseline re-definition. In particular, it is important that all system interfaces be defined at the outset. An evolutionary development approach should be aimed at early implementation of minimum essential functional capabilities and subsequent block upgraded. A "build a little"/ "test a little"/"field a little"/"build a little more"--approach should be followed. Use of "off-the-shelf" equipment and software should be encouraged where applicable. Knowledge gained in the Army ACCS program (e.g., AFATDS) should be applied to Marine Corps programs where technically appropriate.

Command and Control data communication requirements for all phases of MAGTF operations, including over-the-horizon assaults, should be re-evaluated. Interface and data-traffic load requirements should be analyzed. All critical system design constraints (such as data security/integrity and system robustness) must be defined. An architecture should be adopted which satisfies near term needs and can also support future growth.