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Report to the Chairman, Committee on Armed Services, House of Representatives

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AIRCRAFT DEVELOPMENT

The Advanced Tactical Fighter's Costs, Schedule, and Performance Goals

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National Security and
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The Honorable Les Aspin
Chairman, Committee on
Armed Services
House of Representatives

Dear Mr. Chairman:

This report, which was prepared at your request, addresses the status of the Advanced Tactical Fighter's costs, schedule, and performance goals. We briefed members of your staff on the major points detailed in this report on September 29, 1987. A separate classified version of this report has been issued (GAO/C-NSIAD-88-8).

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of the report. At that time we will send copies to interested congressional committees; the Secretaries of Defense and the Air Force; the Director, Office of Management and Budget; and other interested parties.

Sincerely yours,

for Bill W. Thurman

Frank C. Conahan
Assistant Comptroller General

Executive Summary

Purpose

The Air Force is developing an Advanced Tactical Fighter (ATF) for its air superiority mission to be the follow-on to its present fighter, the F-15. The Congress is concerned about whether the program will meet its objectives since trade-offs are often necessary among cost, schedule, performance, and reliability objectives.

The Chairman of the House Committee on Armed Services requested that GAO report on the status of the ATF's development and prospects of meeting its cost, schedule, and performance goals. He also requested that GAO review the Navy's development of the Advanced Tactical Aircraft (ATA) and report on the Air Force's and Navy's progress and/or problems in sharing common technologies and the potential for cross-service use of the aircraft. This report addresses the ATF's development and cost, schedule, and performance goals. GAO plans to address ATF/ATA issues in a subsequent report.

Background

The ATF program was initiated in November 1981 to meet the evolving threat in the mid-1990s. The Air Force plans to buy 750 ATF aircraft at a total estimated cost of $64.3 billion (then-year dollars).

The ATF's primary mission is air superiority. The Air Force believes air superiority must be gained and maintained to the extent that friendly forces can conduct operations without prohibitive interference from the enemy air forces.

The Air Force expects to incorporate many new technologies and capabilities in the ATF. The Air Force's goals for the aircraft require substantial increases in maneuverability; decreases in detectability, take-off and landing distances, and maintainability; and new capabilities such as ability to cruise at supersonic speeds for long distances. The ATF program has elevated supportability and affordability to a co-equal status with performance.

Results in Brief

The program is currently in an early phase of development, with two contracting teams working toward building and testing prototype aircraft and avionics prototypes that will be operated and tested on the ground, independent of the prototype aircraft. Evaluation of these test results will not be available until late 1989 and beyond.

While many critical decisions that could affect one or more of the program's cost, schedule, and/or performance goals remain to be made, the

Air Force has taken actions to reduce their impact. For example, the acquisition strategy is designed to move toward early demonstration of a more complete system through early prototyping of the aircraft and avionics. Also, certain demonstration and validation tests will continue into full-scale development. These tests are intended to provide more data and confidence in the prototype designs. These measures are positive. There are, however, potential risks to the program schedule involving the adequacy and relevancy of testing and the parallel development of major subsystems.

Principal Findings

Schedule

Test results to commit to the scheduled low rate initial production decision in October 1992 will come from the continued testing of the prototype aircraft and the avionics ground prototype and other measures. These measures are positive, but there is risk in the schedule because a developmental aircraft with a fully integrated avionics system is not scheduled to be flight tested until after the low rate production decision.

The ATF's development includes separate but interrelated and parallel efforts of three major subsystems—airframe, engine, and avionics. Problems or delays in the development of one or more of these subsystems (all of which incorporate emerging technologies) could necessitate a schedule revision. For example, a recent revision of the prototype's first flight schedule illustrates the sensitivity of the ATF schedule to problems and disruptions in the parallel development programs. In this case, the schedule was revised to accommodate a possible delay in the delivery of engines to the airframe contractors. If this delay actually occurs, the number of prototype flight test hours available to support the low rate production decision will be reduced.

Performance Goals

The Air Force is striving to incorporate technologies and capabilities into the ATF that have never been incorporated before on an air superiority fighter. For example, the expected highly integrated avionics and the supersonic cruise and short take-off and landing capabilities are new for a high performance air superiority fighter.

The highly integrated avionics is dependent upon recent developments in microelectronic circuitry, a new approach to system design, and on

new system software. The supersonic cruise capability is dependent upon developing a higher thrust engine capable of reaching supersonic speeds without afterburners.

Cost

To hold down the cost of the ATF and to keep the program affordable, the Air Force reduced the ATF's original unit flyaway cost goal from $40 to $35 million in fiscal 1985 dollars. The average unit total cost in then-year dollars is estimated at $85.8 million. The program's total cost currently is estimated at over $64 billion in then-year dollars. The ATF's estimated cost is subject to change as better cost data become available. The prototyping effort will provide better information concerning the cost to produce the ATF. Total production quantities could increase, and unit costs could decrease if the Navy replaces the F-14 with the ATF or an ATF variant.

Recommendations

GAO's report describes the status of the ATF's development and assesses the prospects of it meeting its cost, schedule, and performance goals; it contains no recommendations.

Agency Comments

The Department of Defense concurred with the findings presented in GAO's report.

Contents

Abbreviations

ATA	Advanced Tactical Aircraft
ATF	Advanced Tactical Fighter
GAO	General Accounting Office
ICNIA	Integrated communications, navigation, identification avionics
INEWS	Integrated electronic warfare system

Introduction

The Advanced Tactical Fighter (ATF) is being developed as a follow-on to the F-15 and as the Air Force's next generation air superiority fighter. The aircraft is expected to incorporate new technologies and new and expanded capabilities, including supersonic cruise, more maneuverability, shorter take-off and landing distances, longer range, low detectability, and greatly improved reliability and maintainability. The heart of the ATF is expected to be its highly integrated avionics system, which is to provide much of the capability for detecting, identifying, and engaging the enemy at ranges beyond the pilot's vision.

The ATF is to be a single seat, twin-engine supersonic fighter armed with AIM-120A Advanced Medium Range Air-to-Air Missiles, AIM-9 Sidewinder missiles, and a 20 mm gun. Its design concept includes use of advanced materials, an airframe that is not easily detected, new engines, and advanced avionics.

The Air Force plans to buy 750 ATFs at a total estimated cost of $64.3 billion in then-year dollars.[1] The Air Force and Navy have signed a memorandum of understanding on the potential cross-service use of the ATF and the Navy's Advanced Tactical Aircraft (ATA), which is also under development. If the Navy decides to procure the ATF, or an ATF variant to replace F-14 aircraft, the total production quantity could increase to over 1,000 aircraft. According to preliminary contractor estimates, if the Navy procures the ATF, the Air Force's procurement cost could be reduced by over $2 billion due to the increased quantity. Moreover, the Navy could avoid an estimated $6 to $7 billion in research and development costs for the F-14 replacement.

The Air Force has established a $35 million (fiscal year 1985 dollars) unit flyaway cost[2] goal and plans to achieve an initial operational capability in the mid-1990s. The program is managed by the Aeronautical Systems Division of the Air Force Systems Command at Wright-Patterson Air Force Base, Ohio.

[1]Then-year dollars measure the cost of goods and services in terms of prices current at the time of purchase.

[2]Unit flyaway costs include engineering, tooling, labor, material, quality control, propulsion, avionics, armament, and engineering change order costs.

Advanced Tactical Fighter Acquisition Strategy

The strategy for acquiring the ATF and moving it through the three stages of development—concept exploration, demonstration and validation, and full-scale development—has changed since the program was initiated in November 1981. One of the more significant changes is the inclusion of prototyping[3] in the demonstration and validation phase. The Air Force's initial strategy was to avoid the cost of a "fly-off" of ATF prototype aircraft, but the strategy was modified in response to a recommendation of the President's Blue Ribbon Commission on Defense Management.

In early 1986, the Commission issued a report recommending that new major weapon systems using new technology, like the ATF, be prototyped early in development. The Commission believed early prototyping was needed to determine the extent to which a given technology might improve capability and to provide a basis for making realistic cost estimates.

As a result of this recommendation, the Air Force changed its acquisition strategy. Instead of awarding four demonstration and validation contracts to develop and demonstrate only key/critical subsystems, as originally planned, two airframe contractors were selected to develop and demonstrate flying prototype aircraft and ground-based avionics prototypes with one contractor to be selected for full-scale development. Consequently, the revised strategy moved toward demonstrating a more complete system.

The revision extended the demonstration and validation phase by 17 months, from 33 to 50 months, and provided for flying test aircraft about two years earlier than the initial strategy. Consequently, the revised strategy could provide data on a given technology's capabilities and cost about two years earlier than the original strategy.

Currently, two contracting teams led by Northrop Corporation and Lockheed Corporation are involved in the demonstration and validation of the ATF. Each team is working toward building and flight testing two prototype ATF aircraft, a flying avionics test bed, and a separate avionics ground prototype. Further, the two propulsion contractors—General Electric Corporation and Pratt & Whitney Division, United Technologies Corporation—are competitively developing prototype engines. The

[3]A prototype is the first complete and working article of a new technology or design intended to serve as the pattern or guide for subsequent designs that would be incorporated in a weapon system.

engines are to be flight tested in each of the airframe contractor's prototype aircraft. Current plans provide for awarding a single full-scale development airframe contract in December 1990, to be followed by the award of a full-scale development engine contract.

As shown in table 1.1, $557.1 million has been appropriated for the ATF program through fiscal year 1987 and $536.8 million has been requested for fiscal year 1988.

Table 1.1: Funds Appropriated or Requested for the ATF Through Fiscal Year 1988

Dollars in millions

Fiscal year	Appropriated	Cumulative appropriation
1983	$20.0	$20.0
1984	34.1	54.1
1985	90.8	144.9
1986	152.2	297.1
1987	260.0	557.1
1988	536.8 (requested)	

The value of the current demonstration contracts is shown in table 1.2. The contracts are to be funded in increments as the program progresses.

Table 1.2: Value of ATF Demonstration and Validation Contracts

Dollars in millions

Contractor	Target price
Northrop	$691.0
Lockheed	691.0
Pratt & Whitney	208.0
General Electric	207.6
Total	**$1,797.6**

Objectives, Scope, and Methodology

The Chairman, House Committee on Armed Services, requested us to report on the status of the ATF's development and prospects of meeting its cost, schedule, and performance goals. He also requested that we review the Navy's development of the ATA and report on (1) the Air Force's and Navy's progress and/or problems in sharing common technologies and (2) the potential for cross-service use of the aircraft. This report addresses the ATF's development and cost, schedule, and performance goals. The ATF/ATA issues will be addressed in a subsequent report.

We reviewed and compared the cost, schedule, and performance objectives of the ATF program with the Air Force's plans to meet those objectives, and compared the stated ATF requirements with the Air Force's estimates of expected ATF capabilities.

We obtained data from Air Force officials in Washington, D.C.; the Tactical Air Command, Langley Air Force Base, Virginia; and the ATF System Program Office at Wright-Patterson Air Force Base, Ohio. We also visited and obtained data from the competing ATF development contractors—Lockheed and Northrop—and the competing ATF engine development contractors—General Electric and Pratt & Whitney. Our work was conducted from August 1986 to August 1987 in accordance with generally accepted government audit standards.

The Department of Defense concurred with the findings presented in our report. Technical comments provided by the Department were incorporated in the report, as appropriate.

Prospects of the ATF Meeting Its Schedule Goals

The Air Force's plan provides for competitive testing of two avionics ground prototypes beginning in late 1988 and two prototype aircraft in late 1989. Selection of the winning contractor team is to follow, with full-scale development of the winning design to begin in December 1990. The full-scale development phase is scheduled to last over 5 years with an estimated cost of over $7 billion in 1985 dollars. This phase includes continued testing of the winning prototypes and a 32-month developmental and initial operational test and evaluation program that will begin in November 1992 with the delivery of the first development aircraft. In October 1992, the Air Force plans to make a commitment to low rate production.

Because evaluations of test results from the first flights of the aircraft and the avionics ground prototypes will not be available until late 1989 or later, it is not possible to determine at this time whether the overall program master schedule is achievable. However, the program schedule has areas of risk involving the relevancy of testing in support of low rate initial production and the parallel major subsystems' development effort that could limit the amount of testing to be accomplished before the commitment to low rate production.

Adequacy of Testing to Support Initial Production Decision

Department of Defense Directive 5000.3 states that appropriate test and evaluation is a key requirement for decisions to advance a program from one phase to the next in the acquisition process. More specifically, the directive requires that a production representative system be tested before moving into the production phase to confirm that all significant design problems have been identified; that solutions to these problems are available; and that the system is effective and suitable for its intended use. While the directive recognizes the testing and evaluation in support of a low rate initial production will necessarily be limited, it also provides that the system tested must be sufficiently representative of the expected production system to ensure that test and evaluation supports the production decision.

According to the program schedule, the first flight of the aircraft evolving from full-scale development is scheduled for November 1992, about 1 month after the Air Force's decision on low rate initial production. Furthermore, a developmental aircraft with a fully integrated avionics system is not scheduled to be flight tested until after the low rate production decision.The Air Force recognizes that results of the flight tests of the full-scale development aircraft will not be available to support the

low rate initial production decision. However, it plans to provide as much data as possible to support the decision by

- continuing the flight tests of the winning prototype aircraft beyond the demonstration and validation phase into the full-scale development phase,
- testing the avionics functions on the prototype aircraft as they become available,
- testing the avionics ground prototype beyond the demonstration and validation phase into the full-scale development phase, and
- upgrading the avionics ground prototype into a complete avionics system integration lab about a year before the initial production decision.

Thus, with the data on the airframe design collected from the extended prototype flight tests and the data on avionics capability gained from the flying avionics test bed during demonstration and validation phase and the system integration lab, the Air Force expects to attain the necessary support and confidence to commit to the scheduled low rate initial production decision.

Parallel Development Efforts Involve Risk

The ATF program involves three separate but interrelated parallel development programs of its major subsystems—airframe, engine, and avionics. Problems or delays in the development of any of the three subsystems, which incorporate emerging technologies, could necessitate schedule revisions.

The impact of a possible delay in engine deliveries on the prototype flight test program illustrates the sensitivity of the master ATF schedule to problems and disruptions from the parallel subsystem development programs. The prototype's first flight was originally scheduled for October 1989 but was revised to show a range from October 1989 to March 1990. This revision was made to reflect a possible delay in the availability of the prototype's engines from the propulsion contractors to the airframe contractors. Neither propulsion contractor would contractually commit themselves to an October 1989 delivery date but retained this date as a goal. Hence, a possible delay in this major subsystem was reflected in the master program schedule.

A delay in the prototype's first flight could also substantially reduce the number of prototype flight test hours that can be accumulated before the scheduled selection of the winning full-scale development contractor, as well as the low rate production decision. If the first flight is

delayed the full 6-months allowed in the schedule revision, the number of prototype flight test hours could be reduced by nearly 50 percent, from about 1,100 to 560 hours. Consequently, unless the schedule is extended, there will be less data available from the flight test program for selecting the winning contractor and supporting the low rate initial production decision. The Air Force, however, believes data from other testing activities will provide adequate information, as previously noted.

Prospects of the ATF Meeting Its Performance Goals

The Air Force established the ATF's performance goals based on the need to retain air superiority over an evolving and increasingly more capable Soviet threat projected for the mid-1990s and beyond. These goals require substantial increases in aircraft maneuverability; decreases in detectability, take-off and landing distances, and the cost to maintain the system; and new capabilities such as the ability to cruise at supersonic speeds for long distances. While performance has been a dominant force in past aircraft procurements, the ATF program has elevated supportability and affordability to a co-equal status with performance.

Whether the Air Force and its contractors can meet all the performance goals is uncertain at this time. The program is still in an early stage of development with many trade-off studies and hardware demonstrations remaining to be made. The feasibility of the preferred and alternate technologies will be more certain with the completion of the trade-off studies and the hardware demonstrations.

The Mission—Air Superiority

Air superiority is the ATF's primary mission. The Air Force believes that other missions, such as close air support and battlefield interdiction, can only be successfully conducted once air superiority is achieved. The ATF is expected to provide the United States with an air superiority aircraft in the mid-1990s and beyond.

Air superiority means dominating the air battle to the extent that friendly air and surface forces can conduct operations without prohibitive interference by enemy air forces. The ATF's primary mission is to defend friendly airspace and to engage the enemy in its airspace. The ATF is needed to seek out and destroy high-priority enemy airborne targets, such as the Soviet look-down shoot-down interceptors, stand-off jammers, and large offensive attack formations, which could disrupt other U.S. tactical missions.

Why an ATF?

Because the Soviet Union and Soviet block countries have a significant quantitative advantage over the United States and its allies in fighter aircraft, the Air Force believes a technological or qualitative advantage is critical. The Air Force's need for the ATF is based on an evolving and increasingly more capable Soviet threat that it believes the current F-15 and F-16 fighters will not be able to sufficiently overcome in the 1990s, even with planned upgrades.

The threat revolves around the recent deployment of two new Soviet fighter aircraft, the MIG-29 FULCRUM and the SU-27 FLANKER, which are believed to have about equal performance to the F-15 and F-16, and two postulated follow-on Soviet aircraft with improved performance.

Goals for Improved Combat Capability and Supportability

Because the United States is outnumbered by enemy aircraft and is expected to remain so in the future, the Air Force believes that the ATF must possess a first-look, first-kill advantage—the ability to find and kill an enemy fighter before being targeted in return. This advantage implies and drives many of the other features desired in the ATF.

The first-look, first-kill advantage refers to the ability to find, identify, and track targets and launch missiles not only before the enemy but beyond the enemy's visual range while remaining undetected. To accomplish this, the Air Force believes the ATF will have to be hard to detect, have long-range offensive sensors, and possess an improved combination of higher speed and greater maneuverability. Low detectability is also a critical ingredient to achieving this first-kill advantage; however, because of the special access classification of low detectability or stealth, this report does not discuss this performance parameter.

While engaging the enemy beyond visual range is the preferred method of engagement for the ATF, the Air Force recognizes it needs the ability to engage the enemy in close-in combat or "dog fights." Superior maneuverability and acceleration are important features for this method of engagement.

The Air Force projects a need to fly long distances from operating bases to reach the battle. Current fighters require external fuel tanks to fly long-range missions. The goal for the ATF is to conduct long-range missions on internal fuel, eliminating or reducing the dependence on large stocks of external fuels tanks. A longer range will also correspondingly reduce the demand on tanker aircraft. Tanker capability is currently projected to be inadequate in any large-scale crisis or general war situation.

While performance has been a dominate consideration in past aircraft procurements, supportability is considered equal with performance in the ATF program. Whether the difficult trade-off decisions that remain to be made in the current demonstration and validation phase will sacrifice supportability for performance is uncertain at this time. Supportability for the ATF includes improved reliability and maintainability of the

weapon system, which allows it to be ready and available when needed and to sustain the attack through high sortie[4] generation rates.

Support for current fighters includes large amounts of supplies, test and servicing equipment, specialized work forces, and unusual and/or hard-to-handle materials that hamper mobility and the generation of high sortie rates while creating vulnerabilities to enemy attack. A typical fighter squadron currently requires 13 to 18 equivalent C-141 loads to deploy it to an established base. This includes at least three loads of avionics test equipment and an extensive amount of ground equipment, such as starting units, hydraulic power units, weapons loaders, air conditioners, liquid oxygen and nitrogen servicing units, power generators, and air compressors. Consequently, the Air Force has developed reliability, maintainability, and availability requirements for the ATF that would require less test and servicing equipment, a smaller work force comprising fewer maintenance specialties with corresponding reduction in intermediate level maintenance, and less airlift support aircraft.

Table 3.1 shows some of the key reliability, maintainability, and availability requirements for the ATF in comparison to the F-15 and F-16. As this comparison shows, the ATF is expected to have about half the combat turnaround time of the F-15 and F-16. Further, the ATF is expected to require about half the number of maintenance personnel and about half the number of airlift support aircraft. A definition of each of the following terms/requirements is provided in appendix I.

Table 3.1: ATF Reliability, Maintainability, and Availability Requirements Compared to Current Fighters

Requirements	ATF[a]	F-15	F-16
Integrated combat turnaround time	15 minutes	35 minutes	27 minutes
Break rate	8-10%	15%	12%
Fix rate	75% in 4 hrs. 85% in 8 hrs.	42% in 4 hrs. 74% in 8 hrs.	50% in 4 hrs 84% in 8 hrs
Average number of maintenance personnel per aircraft	8.7 people	20.6 people	19.6 people
Airlift support for 24 ATF squadron	6-8 C-141B equivalent	17.3 C-141Bs	14.6 C-141Bs
Total non-mission capable for maintenance rate	8 percent	11.8 percent	7.5 percent
Total non-mission capable for supply rate	2 percent	7.9 percent	5.3 percent

[a]As described in the Air Force's November 9, 1984, Statement of Operational Need for the ATF

[4]A sortie is the combat flight of a single aircraft from take-off to the end of its flight

Demonstration of Critical Technologies

The Air Force and ATF contractors are exploring and evaluating a number of technologies for enhancing the ATF's capabilities over current weapon systems, including supersonic cruise, short take-off and landing capability, functional integration of avionics sensors and displays, and lower detectability. Three key technologies needed to provide these capabilities are discussed in this section. Stealth technology is not discussed in this report due to its special access classification.

Propulsion and Vectoring Technology

Sustained supersonic cruise and short take-off and landing are two of the key performance goals that separate the ATF from current fighter aircraft. Among other things, both depend upon the development of a new propulsion system. Although the ATF will have afterburners, the capability to sustain supersonic speed involves the development of a new high thrust engine that can sustain that speed without the use of fuel inefficient afterburners. This capability, when combined with other ATF desired capabilities, requires the engine to operate at higher temperatures than current engines and to be lightweight and efficient.

Short take-off and landing distances and enhanced in-flight maneuvering are performance goals for the ATF. The Air Force's initial definition of take-off and landing distances would have required engine contractors to develop complex thrust reversing engine nozzles that are lightweight and yet capable of withstanding the augmented thrust of a fighter engine's afterburner. Moreover, if the engine was to meet the other goals of the program—supportability and affordability—the engine, including the nozzle, would have fewer parts, be durable, and be simple to maintain. While thrust reversing engine nozzles are a common feature on today's commercial jet airliners, they would be a new feature for a U.S. high performance air superiority fighter aircraft.

Because of technical complexities associated with the development of the nozzle, the Air Force relaxed the landing goals. According to the Air Force, contractors may still strive to demonstrate the thrust vectoring/reversing nozzle, but this feature is now optional.

Avionics Technology

At the heart of the ATF's ability to detect, identify, and engage the enemy beyond visual range of the pilot is its expected highly integrated avionics system. This system of functionally integrated sensors and displays is expected to be greatly different than the dedicated, unique "black box" systems of today.

Current avionics systems involve numerous unique hardware black boxes and software components that are dedicated to a single function. The maintenance of these systems requires the stocking of numerous unique spare parts, which results in high life-cycle support costs for the weapon system.

In contrast, the proposed ATF avionics system is expected to be a highly integrated system, using a family of common hardware and software modules that not only require fewer spare parts and provide lower life-cycle costs, but result in better reliability and maintainability and speedier data processing. Figure 3.1 on the following page shows how a number of discrete functions performed by dedicated black boxes will be consolidated into an integrated system.

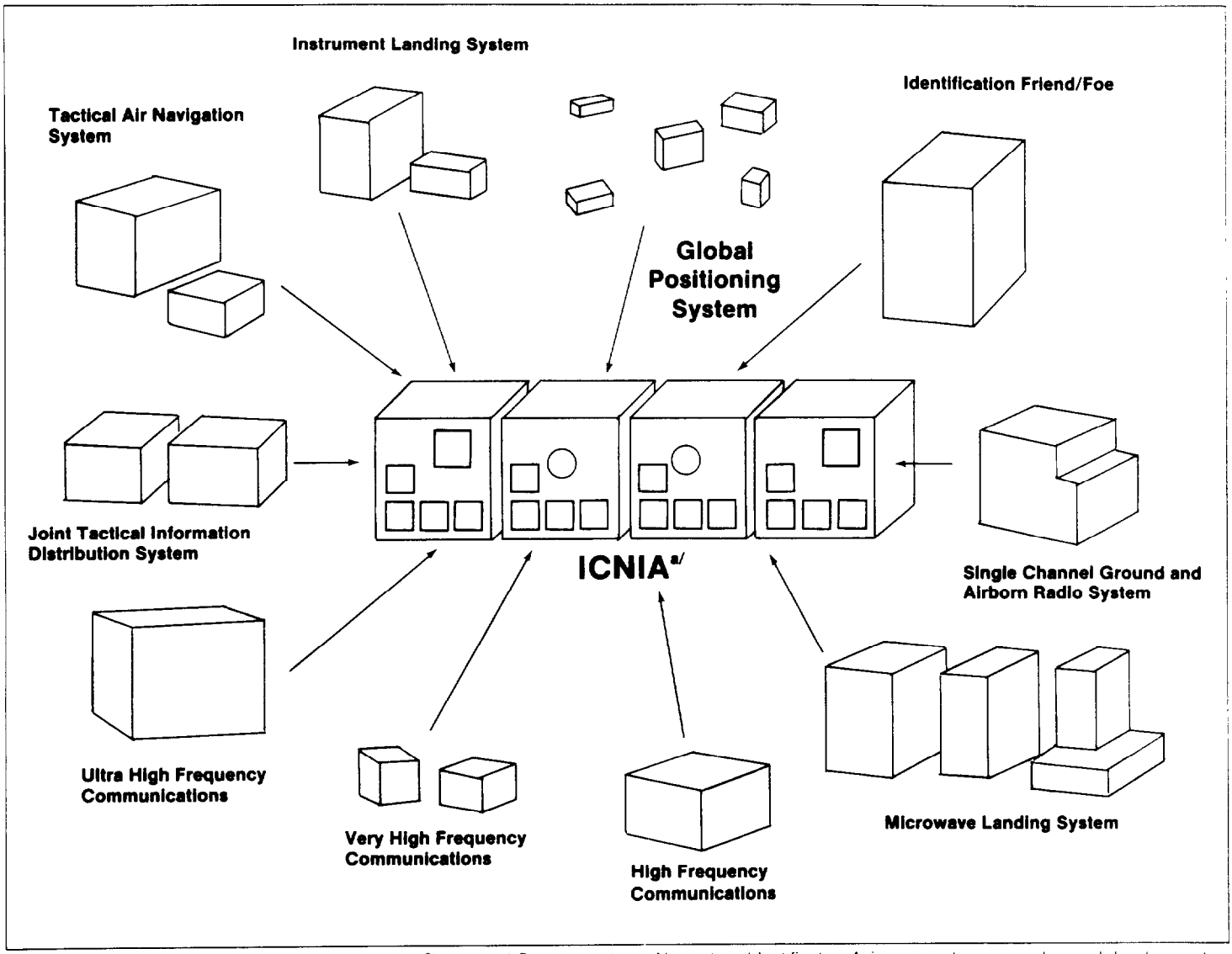
To attain these advances, the proposed ATF avionics system will incorporate recent developments in microelectronic circuitry—very high speed integrated circuits and a modular system architecture. This high speed integrated circuit technology provides a much higher density of circuits and transistors on the basic silicon chip and therefore results in faster processing speeds. Hence, more computing power is packed into less space, requiring fewer chips and circuit boards for a given function. This requires less wiring and connections, the cause of many maintenance problems.

Furthermore, with the use of common hardware modules, the system's software could move functions from one module to another. For example, if a problem occurred within a module during flight operations, a function could be continued by transferring the responsibility for that function from the faulty module to an operative module.

This hardware sharing feature also would allow maintenance to be deferred. As long as all necessary functions are performed, maintenance to correct problems can be deferred to a more opportune date.

Both contracting teams with their avionics subcontractors are working toward developing and demonstrating their avionics systems. The basic integration, modular packaging, cooling and built-in testing/diagnostics of each contractor's avionics system will be demonstrated on the avionics ground prototype. Flying test bed aircraft will be used to basically demonstrate the avionics sensors, apertures, and the communication, navigation, and identification functions.

Figure 3.1: Example of Discrete Functions Consolidated Into an Integrated System



[a]Integrated Communications, Navigation, Identification Avionics is a triservice advanced development program in the Air Force Avionics Laboratory, which seeks to consolidate and automate the various communications, navigation, and identification radio functions now performed by a multitude of separate transmitters and receivers on tactical aircraft.

While the Air Force is pursuing new developments in microelectronic circuitry, common modules, and modular architecture for the ATF, the Army and Navy also are developing new combat aircraft, the Light Helicopter Family and ATA, respectively, which could benefit from these

same advancements. Accordingly, the Congress directed the three services to prepare a joint plan for developing a common set of avionics for all three aircraft. Further, the Congress expressed concern that the schedules for two key supporting avionics development programs, the Integrated Communications, Navigation, Identification Avionics (ICNIA) and the Integrated Electronic Warfare System (INEWS),[5] did not support any of the aircraft production schedules.

In response to this congressional direction and concern, Assistant Secretaries of the three services agreed to the Joint Integrated Avionics plan, dated March 13, 1987. The plan addresses the three aircraft and supporting technology development schedules and the Joint Integrated Avionics Working Group, the triservice organization created to coordinate the efforts, regarding commonality, funding, and competition. The group has restructured the ICNIA and INEWS schedules to provide advanced development model demonstration to meet the aircraft development schedules. It believes the avionics schedules have been structured to be mutually supporting and to allow the orderly introduction of common avionics.

[5]INEWS is a joint Air Force and Navy program that seeks to integrate the multiple defensive electronic warfare functions of combat aircraft.

Prospects of the ATF Meeting Its Cost Goal

Achieving the desired ATF performance capabilities while remaining within the Air Force's $35 million (in fiscal year 1985 dollars) unit flyaway cost goal will pose a challenge to both the Air Force and its contractors. As the ATF design matures, the Air Force could be forced to make difficult trade-off decisions among cost, schedule, and performance. To control acquisition and future operations and support costs, the Air Force is seeking major technological advancements in reliability, maintainability, and producibility.

Estimated Cost of the ATF Program

Because of initiatives to balance the budget and reduce the deficit, the total ATF program cost, which is estimated to be $64 billion (then-year dollars), is of critical concern to the Air Force and the Congress. Recognition of projected fiscal constraints compelled the Air Force to set stringent design-to-cost goals for the ATF. In an effort to hold down cost and to keep the program affordable, the Air Force reduced the ATF's original unit flyaway cost goal from $40 million to $35 million (fiscal year 1985 dollars). It also decreased the estimated total program cost from about $69.7 billion to about $44.3 billion (fiscal year 1985 dollars), which is $64 billion in then-year dollars. These estimated program costs, however, are expected to be refined as prototype cost data become available at the end of demonstration and validation. In addition, if the Navy acquires the ATF as a replacement for its F-14, the Air Force's acquisition cost could be reduced by $2 billion or more due to the higher economic order quantity. Table 4.1 shows the program office's January 1987 estimated total ATF cost for fiscal years 1983 through 2004.

Table 4.1: Total ATF Program Cost Estimate for Fiscal Years 1983 Through 2004

Dollars in millions

	Fiscal year 1985 dollars	Then-year dollars
Demonstration and validation	$2,705 3	$3.112.9
Full-scale development	7,167 9	9,246.7
Total research and development	$9,873 2	$12.359.6
Total production	34,452.1	51,959.5
Total program	**$44,325.3**	**$64,319.1**
Average unit flyaway cost[a]	$35 0	$52 8
Average unit production cost[b]	$45.9	$69.3
Average unit total cost[c]	$59 1	$85.8

[a]Unit flyaway consists of the following cost accounts: engineering, tooling, labor, material, quality control, propulsion, avionics, armament and engineering change orders

[b]Unit production consists of the flyaway cost accounts plus training, data, support, other government work, and initial spares. No development costs are included.

[c]Average unit total cost is determined by dividing the total program cost estimate by the number of units to be produced.

ATF Navy Variant and Potential Cost Avoidance

The Air Force and Navy have signed a memorandum of understanding on the potential cross-service use of the ATF and the Navy's ATA. While these two aircraft do not have the same missions, the Navy is examining the ATF as a replacement for its F-14 aircraft, which has a comparable mission to the ATF. Both services have assigned officers to each other's program office and are studying how the ATF and ATA can satisfy the other service's mission requirements, what alterations may be needed, and what costs and cost avoidance could be expected. According to preliminary contractor estimates, if the Navy acquires the ATF, the Air Force's procurement cost could be reduced in excess of $2 billion (fiscal year 1985 dollars). Moreover, the Navy could avoid an estimated $6 to 7 billion (fiscal year 1985 dollars) in research and development costs.

Cost Estimating Methodology

The three principal methods used to estimate program cost are analogous, parametric, and grass roots. The analogous methodology relates to predicting the cost of a new item or weapons system based on the known costs of similar items or systems. The parametric methodology involves predicting the cost of a new item or weapon system based on a mathematical analysis of cost-estimating relationships developed from prior acquisition programs, for example, historical cost per pound or per square foot. The grass roots methodology, which normally is used in the production phase when program configuration is stable, predicts the

cost of a new item or weapon system based on the detailed data and costs available from producing a system's components during full-scale development and/or production. The analogous method is the least accurate and grass roots is the most accurate.

Because detailed cost data and a physical or technical definition were not available in the early stage of the acquisition cycle, the ATF's program cost estimate was constructed using a combination of parametric and analogous methodologies. The ATF program office, however, anticipates an estimate with a higher confidence level by the end of the demonstration and validation phase as the configuration stabilizes and grass roots data become available from producing the prototype article.

Definitions of Supportability Terms and Requirements

Integrated combat turnaround time. The time it takes to prepare an aircraft for relaunch once it has returned from a sortie. This includes the time to inspect, clean, rearm/load, and service the aircraft's fuel, oil, hydraulics, and avionics.

Break rate. The percentage of time an aircraft aborts or returns from a sortie with one or more mission essential subsystem(s) inoperable, which precludes the aircraft from flying its designated mission.

Fix rate. The percentage of mission incapable aircraft that are returned to a capable status within a specified period of time, such as 2, 4, and 8 hours.

Average number of maintenance personnel per aircraft. The number of personnel per aircraft required for equipment maintenance.

Airlift support. The number of equivalent C-141B aircraft required to deploy a squadron of 24 aircraft with the capability to sustain wartime sortie rate operations for 30 days without additional support.

Total non-mission capable for supply. The cumulative percentage of aircraft within a 24-hour period that are non-mission capable because they need parts.

Total non-mission capable for maintenance. The cumulative percentage of aircraft within a 24-hour period that are non-mission capable because of maintenance.

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