Although its definition is not yet final, it is clear that the Expeditionary Aerospace Force (EAF) concept will play a central role in future United States Air Force (USAF) operations. The EAF relies on rapidly deployable, immediately employable, and highly flexible forces to serve effectively the strategic role of deterring and responding to aggressive acts. The EAF allows the Air Force to use sustainable force tailored to individual contingencies.

Earlier RAND reports (see the Preface) have discussed the importance of Agile Combat Support (ACS) in meeting EAF system requirements. Our analyses have relied on an employment-driven analytical framework—a framework identifying mission resource needs and adjusting mission goals to available resources—to guide the design and evaluation of ACS systems.¹

This report is one in a series using this analytical framework. It focuses on the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) maintenance system, and how the system can be improved for the EAF ACS.² Our preliminary work looked at LANTIRN support requirements in the most stressing scenario; here we include other scenarios as well as analyses based on data

²The LANTIRN system includes pods mounted on aircraft and their associated second-level repair resources.
collected in the Air War Over Serbia (AWOS). The new data enable a more realistic assessment of wartime support requirements.

Following our initial analysis, Major General Dennis Haines (ACC/XR) and Mr. George Spencer (Program Manager of the Precision Attack Air Logistics Center at Warner Robins) asked us to consider other variables affecting LANTIRN maintenance issues for EAF operations: the effects of performance improvements through investment, different logistics structures, multiple wartime scenarios, and the sensitivity of our analyses to assumptions on removal rates, personnel, productivity, transportation times, and equipment availability.

As the Air Force adopts EAF concepts, it faces multiple alternatives for addressing LANTIRN system degradation and obsolescence of spare parts. Alternatives include maintaining the current support system and its support equipment, modernizing LANTIRN support equipment, and developing new navigation and precision attack systems to replace LANTIRN. We examine intermediate-level pod repair and assess opportunities for consolidating some of these repair operations in regional support centers. This analysis addresses three support equipment investment options and six logistics structures in light of possible equipment performance levels and four illustrative operational scenarios that represent a broad range of possibilities that may need to be supported in the future.

**EAF GOALS AND REQUIREMENTS**

Several trends have led the USAF to reconsider its operational concepts. In contrast to the Cold War years in which the USAF sought to contain one major adversary at a relatively fixed number of identifiable locations, the USAF now faces much more uncertainty in its operations. A growing number of frequent, small-scale, and rapid U.S. deployments have exacerbated this uncertainty and have made clear that future operational requirements will be very different from those that led to the planning and development of the existing support system.

The current system was designed with an extensive overseas infrastructure to support one large conflict in Central Europe or Korea.
Political pressure to reduce U.S. forces permanently stationed overseas, however, coupled with economic pressure to reduce defense outlays, has resulted in basing a larger percentage of a smaller force structure in the continental United States (CONUS). This shift occurred without corresponding changes in organization or equipment. As a result, the Air Force is now straining to sustain readiness while meeting a more demanding peacetime environment of frequent deployments. This strain and continuing struggles to meet tight deployment timelines led Air Force leaders to examine alternative operational organizations and support concepts.

The growing reliance on CONUS-heavy basing coupled with the need to project force rapidly overseas present significant support challenges. The Air Force must be able to deploy aerospace capability quickly and employ that capability immediately; to meet tight deployment and employment timelines, units must be able to deploy rapidly to the reception sites and set up logistics production processes quickly. The need for rapid deployment of massive forces leads the Air Force to minimize associated support resources, particularly so that more combat forces can deploy in a given period. Demanding employment scenarios further lead the USAF to ensure that support resources are in place to sustain heavy combat operations almost immediately. At the same time, uncertainties about access to foreign bases, the resource requirements of future operations, and the difficulties in protecting forward locations favor minimizing the amount of materiel prepositioned at reception bases.

These contradictory pressures require a transportation pipeline both to reduce the support footprint (the amount of initial airlift space needed to transport operating materiel and combat equipment) and to ensure responsive resupply to support operations. This alternative would trade substantial early airlift capacity devoted to moving support equipment for constant and much smaller airlift capacity dedicated to quickly moving spare parts for the duration of the conflict.

The variety of operations that the USAF must meet presents additional support challenges. The USAF must maintain readiness for potential Major Theater Wars (MTWs) while having forces available
for “boiling peacetime commitments.” The support system must be able to accommodate EAF operations in a variety of locations with varying infrastructure capabilities in any area of responsibility. It must be able to respond to changing events and to shift rapidly between different kinds of operations.

All these challenges have led the Air Force to reexamine its combat support system and to determine how these new support challenges can best be met.

**LANTIRN SUPPORT ISSUES FOR THE EAF**

Our research focuses on LANTIRN intermediate-level support systems and structures, for several reasons. LANTIRN support easily lends itself to new support structures such as consolidation that may improve the effectiveness and efficiency of the overall ACS, and thereby of the EAF. Beyond its lessons on overall support structure, this research may offer more specific insights on dealing with support issues relating to aging equipment and technology obsolescence—although they remain an essential part of combat operations, LANTIRN pods are becoming obsolete and eventually will be replaced by newer technology.

The LANTIRN system is composed of two independently operated pods mounted under the fuselage of an aircraft (Figure 1.1). The navigation pod (NAV) enables pilots to fly at low altitudes, even in limited visibility, and thus avoid detection by unfriendly forces. The targeting pod (TRG) illuminates targets for precision-guided munitions (PGMs). The TRG is key to precision attack capabilities of combat aircraft and offers distinct advantages over munitions guided by Global Positioning Systems. Laser-guided bombs using LANTIRN targeting, for example, are more effective than satellite-guided munitions against moving targets.

The USAF currently has three aircraft types configured for LANTIRN: the F-15E, F-16C, and F-16D blocks 40 and 42. Although there are several initiatives to modify additional F-16 models for LANTIRN

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3"Boiling peacetime" is a term coined by General John Jumper to describe the requirements to deploy substantial aerospace forces during peacetime to ensure global stability.
There are several issues affecting the future availability of this system and its support resources. LANTIRN pods and their support equipment are based on 15-year-old technology. The support technology is increasingly unreliable, and growing obsolescence of spare parts makes it increasingly difficult to repair both pods and test sets. Given the current attrition rate of five targeting pods per year, by 2002 there may be fewer pods than LANTIRN-capable aircraft in the Air Force inventory. Pods are typically lost when an aircraft crashes. Although the Air Force continues to buy F-16s and F-15Es, it is not continuing to purchase LANTIRN pods. The USAF must maintain a support system for the remaining pods to realize their maximum use.

Requirements to maintain a support system for increasingly obsolete technology are complicated by differences in availability, performance, and use of navigation and targeting pods. There are many more NAV than TRG pods. TRG pods, however, have a failure rate
about twice that for NAV pods and their repair times are about four times longer.

Furthermore, our analysis of the AWOS data shows that NAV pods may not be used at all for certain operations, whereas TRG pods consistently support mission requirements. Most TRG pod usage occurred at about 10,000 feet, well above the useful range of NAV pods. NAV pods on F-15E AWOS missions flown from Aviano were used so little that by the second week of the campaign the pods were removed to reduce aircraft weight. Certain terrain and mission requirements may still dictate use of NAV pods, but it appears that there is a USAF mission trend toward reduced use of these pods. Nonetheless, our results reflect the resource requirements associated with supporting both navigation and targeting pods.

In addition to issues of LANTIRN technology obsolescence, the USAF faces increased attrition of the skilled personnel needed to support this equipment. The unique support needs of LANTIRN and the increased attrition of LANTIRN support personnel suggest that the USAF should examine all opportunities to mitigate the effects of these problems on the future readiness of the force.

**DIMENSIONS OF LANTIRN SUPPORT DECISIONS**

Beyond the general issues framing our research, we consider several specific variables affecting LANTIRN support decisions, as shown in Figure 1.2. First, we analyze variables affecting LANTIRN support system performance. These include likely EAF scenarios, trends in LANTIRN support personnel and equipment, and the sensitivity of LANTIRN performance to assumptions about pod employment and support processes.

The EAF scenarios we consider are

- “Boiling peacetime”—deployment of squadrons for Expeditionary Aerospace Force (EAF) peacetime commitments (such as an Air Expeditionary Force [AEF])
- “Stressing”—the resources needed for immediate employment
- “Halt phase”—the resources needed for compressed deployment to bring enemy aggression to a halt
An extended MTW deployment.

The trends in LANTIRN support that we focus on concern personnel, support equipment, and total number of pods. Removal rate, deployment time, and repair turnaround time (including pipeline transportation time) sensitivities are those most crucial to our analysis.

We consider both decentralized and centralized support structures, with four investment options. For each option, we analyze seven measurements for achieving EAF objectives, including metrics on

- pod availability
- deployment footprint
- test set requirements
- personnel needs
**8 Expanded Analysis of LANTIRN Options**

- recurring program costs
- investment costs
- risks.

These variables and operation metrics were analyzed in light of EAF goals: reducing deployment footprint, cutting operational risks to equipment and personnel, lowering peacetime operating costs and investments, and, most important for this analysis, achieving LANTIRN availability across various operational scenarios. The combination of variables on system performance, support structure, and operation metrics yield, in the end, 48 options for LANTIRN support from which we discuss the four most viable solutions.

**Support Structure Goals**

We evaluated resource allocation options in light of four operational scenarios, six logistics structures (five centralized options) and three investment options (LITENING II\(^4\) investment does not affect LANTIRN resource requirements). Specifically, we analyzed the distribution of intermediate test stands, the associated personnel, and spares in terms of pods and line replaceable units (LRUs). We also assessed the peacetime transportation system costs needed to support various logistics support structures. These parameters were analyzed in connection with EAF objectives, particularly achieving LANTIRN availability across various operational scenarios. Other objectives include a reduced footprint, reduced operational risk to both the support equipment and personnel, and lower peacetime operating costs and investments.

Examining the spectrum of operational requirements produces a set of goals for designing the support structure. We start with the two-MTW mission from the DPG. Current Air Force thought is concentrating on meeting a potential MTW with massive, immediate force in order to bring about the “halt phase.” Such force is typically considered to require a suite of high-precision weapons now avail-

\(^4\)A targeting pod similar to LANTIRN but supported with a two-level maintenance system.
able in only limited quantities or still in development. As one might expect, such weapons are extremely expensive. Budget cuts over the last few years coupled with an environment that makes budget increases politically difficult force the Air Force to make tough budget choices. The Air Force and the other services are looking for ways to reduce costs in order to finance important programs ranging from acquisition to personnel retention. Hence, cost minimization becomes a goal in redesigning the support structure.

However, cost minimization must be secondary to maintaining or increasing operational effectiveness. Our employment-driven models address the first part of this task—determining the minimum resource levels to meet operational demands. However, the manner in which the resources are composed can have an effect on operational effectiveness.

As previously discussed, the fewer support resources deployed in the early stages of a halt-phase operation or an AEF, the more capacity is available for moving valuable combat forces to the theater. Minimizing the support structure's deployment footprint thus becomes another goal. Because of the new operational concepts, all missions have the potential to require tight timelines. A third goal, then, is to meet the required response time. The Chief of Staff of the Air Force (CSAF) has set this goal at 48 hours.

Each alternative support structure is designed to support anticipated operating demands, but the levels and types of operational risks vary across the alternatives. For each structure, we must identify the major risks and evaluate their probabilities and effects.

Finally, the rigorous cycle of deployments for boiling-peacetime commitments (such as the Air War Over Serbia and Operation Northern Watch Over Iraq) has increased personnel turbulence, making it difficult to retain skilled aircraft technicians. Reducing personnel turbulence by regular scheduling of deployments or balancing deployment requirements among units is a central goal of the

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EAF. We adopt further reductions of personnel turbulence as a goal of LANTIRN support structure design.

**Support Structure Locations**

We compared the operational performance and resource requirements of the current LANTIRN support structure with those that could be attained by five different regional structures composed of forward support locations (FSLs). In the current structure, repair capability deploys with the units. In the regional options, FSLs and one or more CONUS locations (CSLs) provide repair. During deployments, the CONUS facility would support only nondeployed aircraft flying at peacetime sortie rates.

The spare parts requirement for the current structure depends on how quickly repair operations can be established in the theater once the support equipment is deployed. For the regional options, this requirement depends on the transportation time between FSLs and forward operating locations (FOLs). The longer it takes to ship and return items for repair between FOLs and FSLs, the greater the spare parts requirement for centralized structures.

Our calculations assume that the Air Force does not procure additional pods. As stated earlier, there will be fewer targeting pods to support the future scenarios we analyzed. We assessed potential policy options to alleviate this apparent shortfall. One approach is to reduce the number of pods available per Primary Aircraft Assigned (PAA) while maintaining the same LANTIRN flying program. For every 100 aircraft, for example, there might be only 80 combat-capable pods available at the end of a flying period. Some LANTIRN pods may need to be moved from one aircraft to another to achieve the desired LANTIRN missions with fewer pods. Conversely, we argue that at any given point some aircraft will not be mission capable because of other factors, thus reducing the actual pod requirement for the unit. We employed this availability methodology in our computations.

Consolidated and decentralized structures pose different types of risks. Under the current, decentralized concept, most FOLs likely will have single test stations. If a single test set goes down and cannot be repaired quickly, then the planned maintenance resupply will
be delayed. Decentralized structures also face risks posed by delays in deployment and in-theater setup time. Under consolidated structures, the collocation of several test stations nearly eliminates the risk of having no maintenance resupply. Consolidated repair also, however, relies on resupply through inventory and transportation rather than local maintenance. Consolidation requires close management of the distribution system and shared assets such as pods or LRU’s.

Consolidating maintenance would create a more functionally oriented organization, in which units would have to rely on others for their resources and not maintain themselves all the resources they need for operations. Although functionally oriented organizations offer many advantages, such organizations can change subunit objectives and introduce cross-functional communication problems that impede planning. Some of these issues became readily apparent during the AWOS, and so we recommend that the Air Force closely examine the logistics and organizational issues associated with centralized support.

**OUTLINE**

In Chapter Two, we discuss the application of our employment-driven modeling approach to LANTIRN support issues and the options for meeting them. We give an overview of the scenarios that the USAF may face, as well as the investment options it is considering to ensure sufficient LANTIRN resources. In Chapter Three, we analyze several metrics for measuring LANTIRN support system requirements, and what they indicate about the available options for future support. In Chapter Four, we review the financial implications of each of the possible LANTIRN support systems by level of consolidation and new equipment investment. In Chapter Five, we evaluate the risks and advantages of each support option and compare them across the decision trade space.