Integrated Air Defense Systems (IADS) and Military Ranges

For as long as aerial warfare has existed, the continual expansion of offensive air and missile weapons capabilities has led militaries to develop commensurate defensive capabilities. These "air defense systems" (also called "air and missile defense" (AMD) systems) provide surveillance, tracking, command and control, and weapons delivery capabilities to battlefield commanders. Historically, AMD systems were independently operated and managed by each military service. Gradually, they became more connected, and today several of these systems can communicate and operate collectively. This is basis for the concept of an *integrated* air defense system, or IADS. According to the Department of Defense (DOD), an "IADS is not a formal system in itself, but the aggregate of Service / functional component and agency AMD systems."

Considered part of what DOD terms "defensive counterair" (DCA), an IADS' purpose is to protect military assets and vital locations from aerial threats. Conversely, countering an enemy's IADS by destroying, suppressing, or otherwise neutralizing their system is part of what DOD defines as "offensive counterair" (OCA). The U.S. military tests and trains to effectively employ an IADS as well as counter an enemy's IADS. Training for and conducting DCA and OCA activities typically requires a significant amount of air and ground space, along with access to, and control of, the associated electromagnetic spectrum (see CRS In Focus IF11155, *Defense Primer: Military Use of the Electromagnetic Spectrum*, by John R. Hoehn).

Military "ranges"—defined under 10 U.S.C. §101(e)—that support IADS generally correspond to large-scale ranges used for aviation training. These ranges have the required land, defined airspace (called a "military operations area" or MOA), and when necessary sea space, available to employ multiple AMD systems.

DOD states that several of these ranges are now regularly operating at full capacity to support numerous types of military units from across the joint force (e.g., aviation units, marine amphibious forces, special operations forces). At some locations, non-DOD federal agencies and coalition partners also make use of these ranges. This has presented a capacity challenge for the Military Services who schedule and manage range use. Further exacerbating the issue, DOD asserts that recent technology increases in IADS capabilities have necessitated an increase in testing and training space (i.e., range size). This has led DOD to request from Congress expansion of, and in some cases additional access to, certain ranges that could support "modern IADS" testing and training—along with several other readiness requirements.

Congress faces the issue of addressing DOD's request for additional range space and access at certain locations, as DOD seeks to fully train for advances in IADS.

What is a Modern IADS?

Potential adversaries like Iran, Russia, and China have identified airpower as a primary U.S. advantage in military operations. As a result, several of these nations have developed sophisticated IADS to counter U.S. military capabilities. This includes networking multiple types of ground–based radars (e.g., long-range surveillance radar, engagement radar) with mobile command posts and air and space-based capabilities to provide a larger, and more comprehensive, picture of the battlespace (**Figure 1**). This creates a challenge for U.S. forces because there is no single sensor or missile to neutralize, but rather a distributed network to contend with.

Figure 1. How a Modern IADS Functions
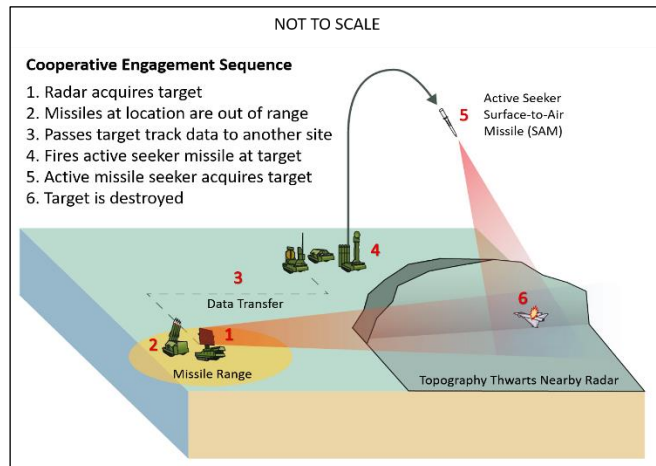
Source: Adapted from *Royal United Services Institute for Defence and Security Studies* report titled "Modern Russian and Chinese Integrated Air Defence Systems," January 2020.

Additionally, advances in U.S. and foreign technologies—particularly in microelectronics and processing power—have significantly increased the ranges IADS are able to surveil, track, and engage targets. These are the "modern IADS" capabilities U.S. forces employ; they are also the modern IADS threats U.S. forces face.

Selected Foreign IADS Capabilities

For over 10 years, Russia and China have developed sophisticated anti-access/area denial (A2/AD) systems in an attempt to prevent U.S. forces from accessing certain areas and regions. Capabilities of A2/AD systems—which include IADS—continue to increase, consequently increasing the distance from which U.S. forces must operate to avoid detection and potential harm.

One of the most challenging foreign IADS capabilities that U.S. forces may encounter is the Russian developed S-400 missile system (SA-21 Growler). This weapons system uses radars with ranges of up to 400 kilometers (~250 miles), paired with missiles that can reach similar distances. An

adversary would not necessarily launch a missile to its maximum range to engage a target, but this capacity allows for additional maneuverability within 250 miles to more effectively engage targets.

The Chinese HQ-9 surface-to-air missile system, and its naval variant the HHQ-9 series, pose similar challenges. It's reported that these systems were developed in China and have radar ranges of up to 200 kilometers (~125 miles) with missile ranges of around 125 kilometers (~78 miles). China also has been improving versions of the HQ-9, such as the HQ-19 ballistic missile interceptor, intended to reach targets up to 3000 kilometers (~1865 miles).

Selected DOD Programs Linked to IADS

DOD has developed a number of capabilities that support and counter IADS. These include "stealth" (i.e., low observable) technology, long-range missiles, and radar jamming equipment. Examples of air-based platforms and weapons systems that include IADS technologies are:

- F-35 Lightning II
- EA-18 Growler (incl. "Next Generation Jammer")
- B-2 Spirit
- AGM-158 Joint Air-to-Surface Standoff Missile
- AGM-88E Advanced Anti-Radiation Guided Missile

The Army and Marine Corps also maintain a number of ground-based platforms and systems used in U.S. IADS, such as the Avenger Air Defense System. They also have begun developing long-range precision fires to support the Joint force in countering adversary IADS. These include the strategic long-range cannon and the precision strike missile.

IADS Range Requirements

The Air Force states that modern combat operations are

> characterized by a wide battlespace that includes a simulated IADS, incorporating early warning radars, strategic and tactical surface-to-air missile systems, fixed military-type targets, and friendly ground forces postured against organized enemy military ground forces.

Replicating this setting at military ranges for the testing and training of IADS requires a certain amount of assets and infrastructure (e.g., buildings, vehicles, aircraft, sensors), as well as the space to position and maneuver those assets to match modern capabilities. An example of the extent of a "peer IADS" with a size and configuration that reflects "an actual relevant geopolitical area that the U.S. warfighter might engage" is provided in **Figure 2.** The sheer size of this theoretical example—paired with existing range configurations and land use restrictions—suggests that DOD may be limited in its ability to test and train today's IADS at military ranges.

Figure 2. Example Range Overlay of a Peer IADS
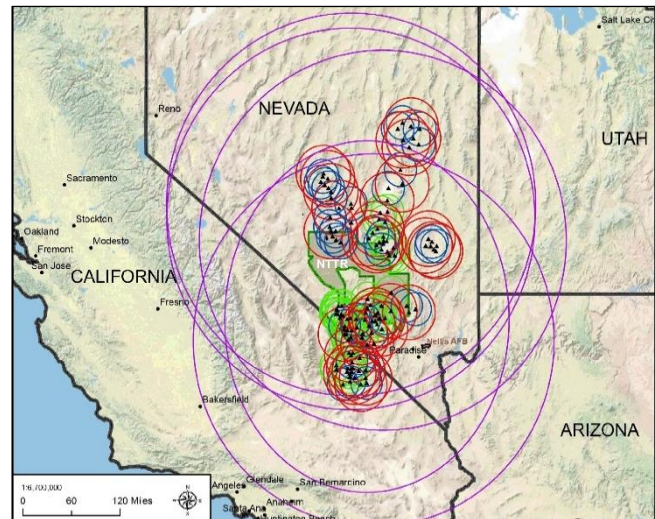
Source: U.S. Air Force, Final Legislative Environmental Impact Statement (FLEIS), Nevada Test and Training Range (NTTR) Land Withdrawal, October 2018.

Note: Figure is theoretical and not representative of any Air Force land withdrawal request included as part of the 2018 NTTR FLEIS.

Considerations for Congress

Annual defense authorization and appropriations acts, including the *Military Construction, Veterans Affairs, and Related Agencies Appropriations Act*, provide opportunities for Congress to fund and shape defense programs for both IADS and military ranges. Enacting federal real property transactions (e.g., land conveyances, exchanges, transfers) and setting the terms for federal land withdrawals are also actions Congress could take to address those IADS-related range challenges DOD has reported.

- **Land Withdrawals.** A periodically recurring role of Congress is to assess the need for, and set the terms of, federal land withdrawals (see CRS Report R46657, *Withdrawal of Federal Lands: Analysis of a Common Legislated Withdrawal Provision*, by Carol Hardy Vincent and Erin H. Ward). This includes renewing expiring land withdrawals—a process which can involve redefining the spatial boundaries of withdrawn lands.

- **Technological Advancement and Virtual Training.** Advancements in IADS' capabilities increase the physical space required to fully conduct live training. At the same time, technological advancements in virtual/mixed training environments (e.g., Live, Virtual, Constructive (LVC) technology) allow, to a certain degree, virtual training space to substitute for physical space. Congress may request DOD examine the extent to which virtual training environments could potentially reduce physical space requirements for IADS training.

CRS Products

CRS Report R46463, *U.S. Army Short-Range Air Defense Force Structure and Selected Programs: Background and Issues for Congress*, by Andrew Feickert

CRS Report R44572, *U.S. Airborne Electronic Attack Programs: Background and Issues for Congress*, by John R. Hoehn

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Other Resources

Joint Publication 3-01, *Countering Air and Missile Threats*

Department of Defense *2019 Missile Defense Review*

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