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RAPID DEPLOYMENT OF AIRBORNE DIRECTED ENERGY WEAPONS: A STRATEGIC SOLUTION TO EVOLVING AERIAL THREATS



Ariel Dvorjetski, Ray Jones, Bonnie Johnson

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Innovation Summit

Unclassified



IRAN

MISSILE ATTACK



The New Threat Doctrine: Fighting a Dollar War with Million-Dollar Weapons



Air-to-air interceptor of

\$2.5M INTERCEPTOR

Commercially-derived kamikaze UAV

\$10,000 THREAT

Modern aerial threats, particularly low-cost UAVs and cruise missiles, are evolving faster than our kinetic defense systems. The current model of using expensive, limited-capacity interceptors against cheap, disposable adversaries creates an unsustainable defense strategy that erodes strategic advantage.



Kinetic interceptors are expensive, limited in magazine depth, and unsuitable for persistent defense against massed attacks.



This economic imbalance forces a disproportionate consumption of high-value resources against low-value targets.



Recent operations in the Red Sea and Ukraine have validated this challenge, demonstrating the high operational tempo and cost of kinetic defense.

A Paradigm Shift in Defensive Warfare: Directed Energy

Directed Energy Weapons, particularly Solid-State Lasers (SSLs), offer a disruptive solution. They fundamentally change the cost-exchange ratio and provide capabilities that kinetic systems cannot match.



Deep Magazine

Engagements are limited only by available power, not by a finite number of physical interceptors. Enables defense against swarm attacks.



Low Cost-Per-Shot

The cost of firing a high-energy laser is measured in dollars per shot (for fuel and power), versus millions for a missile.



Speed-of-Light Engagement

Near-instantaneous engagement is critical against fast, maneuvering threats, eliminating time-of-flight calculations. Precision targeting minimizes collateral damage.

The objective is not to replace kinetic systems, but to create an integrated, layered defense architecture where DEWs handle high-volume, low-cost threats, preserving high-value interceptors for strategic targets.

Defining the Path to Rapid Deployment: Selecting the Right Technology

Given a three-year window to Initial Operational Capability (IOC), which DEW technology offers the best balance of performance, maturity, and integration feasibility for an airborne platform?

Technology	TRL (Airborne)	SWaP-C Feasibility	Logistics Footprint	3-Year IOC Viable?
Solid-State Laser (SSL)	TRL 6-8	High	Low	
Chemical Laser	TRL < 5	Low	High (Hazardous materials)	
Free Electron Laser (FEL)	TRL < 4	Very Low	Very High	

High-TRL Solid-State Lasers are the only mature, practical option for rapid airborne integration. Their demonstrated capability in testbeds, manageable SWaP-C, and simpler logistics make them the definitive choice for this initiative.

The Engineering Challenge: Defining the Constraints for an Airborne Laser Pod

Integrating a DEW onto a fighter platform is not just about the laser; it's a complex systems engineering problem governed by strict constraints. The optimal solution must exist at the intersection of these competing demands.



SWaP-C (Size, Weight, Power, Cooling)

The pod must fit within the aerodynamic and weight limits of a standard external store (e.g., a 600-gallon tank envelope, <4000 lbs). Power draw and thermal dissipation cannot compromise the aircraft's core mission systems.



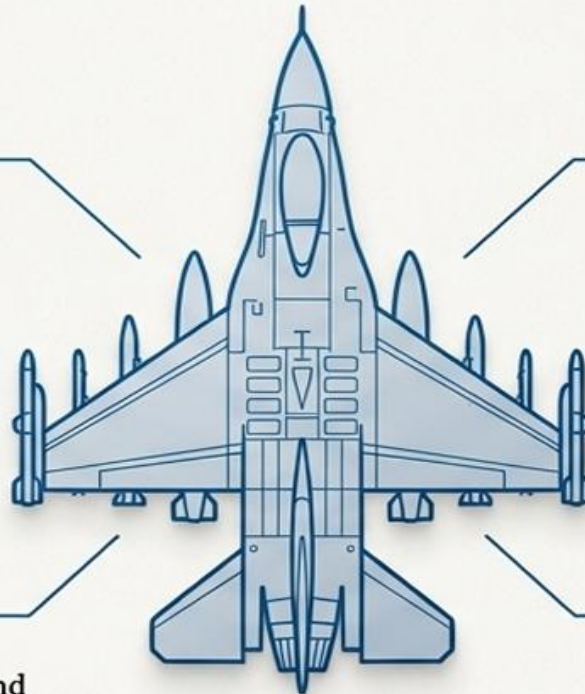
Platform Integration

Must interface seamlessly with existing hardpoints, power busses, and avionics without extensive, costly airframe modifications. Requires compatibility with fire control and mission computers.



Operational Environment

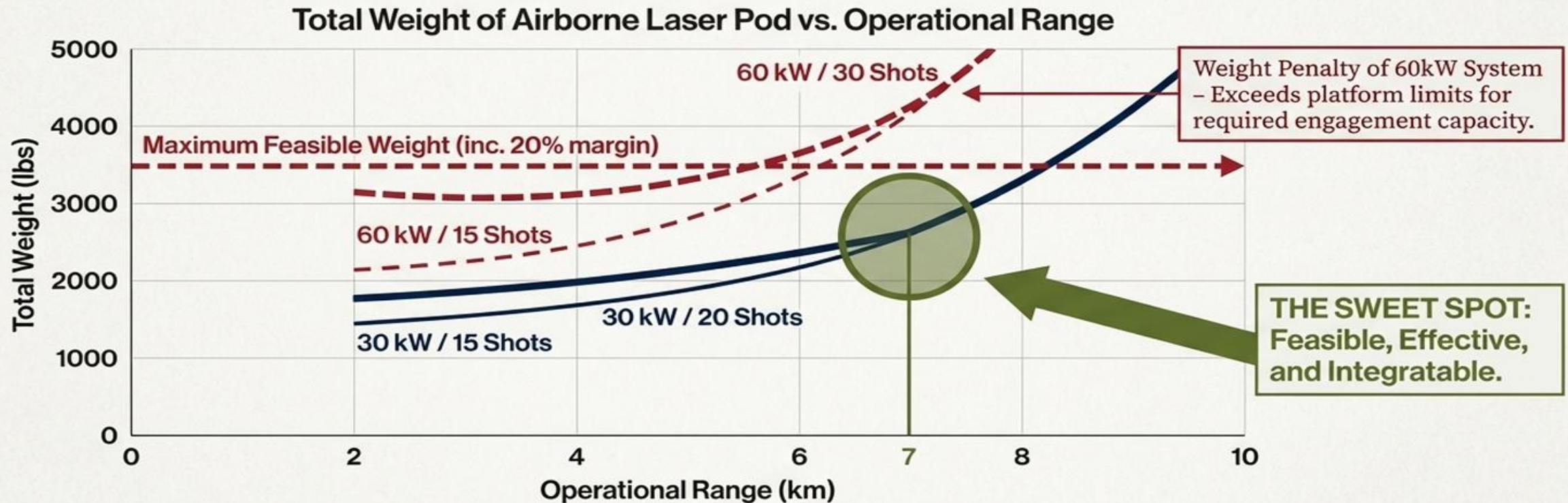
Must perform reliably in high-g maneuvers, variable atmospheric conditions (turbulence, moisture), and at tactical airspeeds (300-400 KCAS). Beam quality must be maintained.



Mission Effectiveness

Must neutralize a sufficient number of threats per sortie to be tactically relevant and justify the mission payload. This dictates the required power, range, and "magazine depth."

Identifying the Operational Sweet Spot: The Data-Driven Working Point



Modeling reveals a clear optimal design baseline. A 30 kW system provides the necessary **operational range and engagement capacity (~20 shots)** while remaining within the critical **weight and integration** constraints of a fighter platform.

The Operational Blueprint: Key Performance Parameters for Rapid Fielding



30 kW

Laser Power Output

Sufficient to neutralize Class II-III UAVs and cruise missile threats with effective dwell times (~11 seconds).



7 km

Effective Engagement Range

Provides a safe standoff distance for the aircraft, enabling threat neutralization before they pose a direct risk to assets or populations.



~20 shots

Engagements Per Sortie

Delivers the tactical capacity to counter swarm threats and persist in a high-intensity environment.



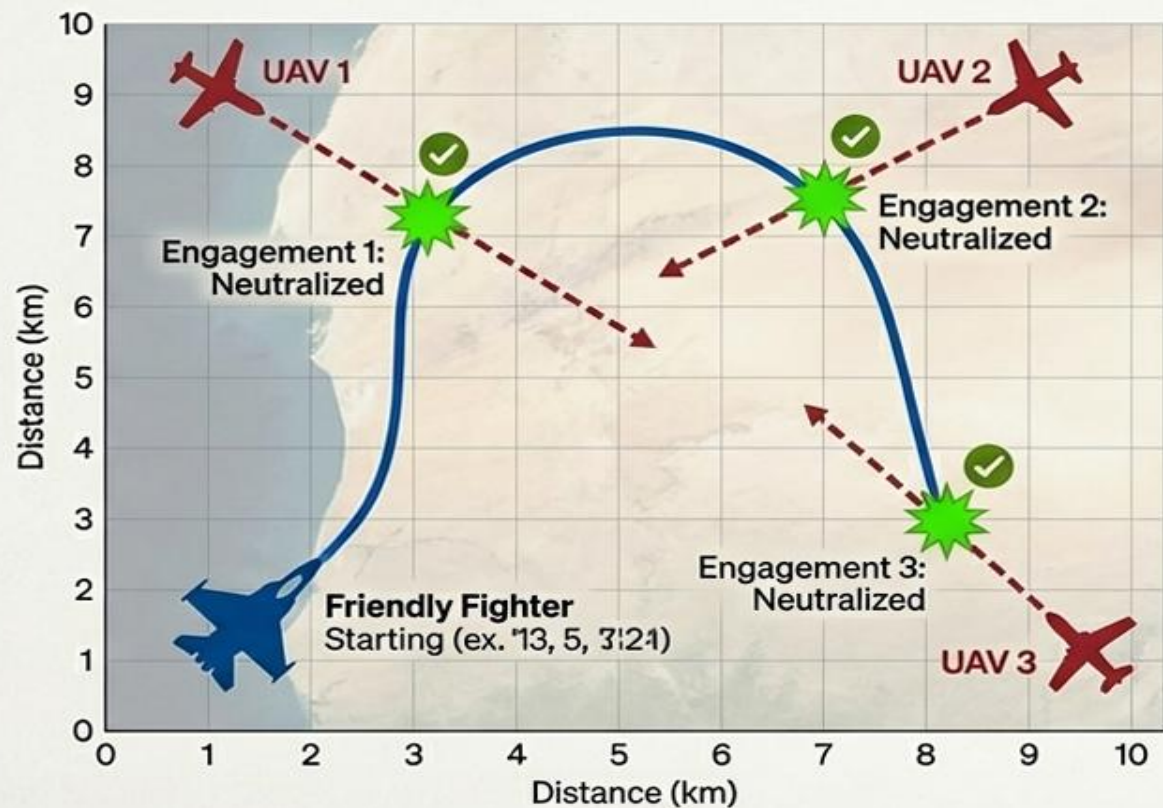
<3,000 lbs

All-Up Pod Weight

Calculated at ~2,150 lbs, ensuring it remains well within the structural and aerodynamic limits of legacy fighter platforms.

Validating the Blueprint: Dynamic Simulation of Mission Effectiveness

A dynamic simulation was run to validate the KPPs in a realistic engagement scenario, modeling a single fighter jet intercepting three hostile UAVs in a contested area.



Key Simulation Results:

Operational Area: 10 km²

Threats: 3 UAVs (30-50 m/s)

Total Time to Neutralize All Threats:
258 Seconds

Average Dwell Time Per Target:
11-17 Seconds

Conclusion: The simulation confirms the 30 kW / 7 km system is highly effective, enabling rapid, sequential neutralization of multiple threats within a single sortie.

A Pragmatic Approach to De-Risking Complex Integration

We have identified the primary integration risks and have established a clear, phased strategy to mitigate them, ensuring the three-year timeline is achievable.



SWaP-C Constraints

Fighter platforms have strict size, weight, power, and cooling limits.



Mitigation: A self-contained pod design minimizes aircraft modification. Leveraging advances in high-efficiency solid-state lasers and modular battery systems keeps weight under 3,000 lbs.



Structural & Aerodynamic Effects (Flutter)

External stores can impact flight stability and structural loads.



Mitigation: Design the pod within the proven aerodynamic envelope of a standard 600-gallon external fuel tank. Flight certification will focus on the subsonic envelope where DEW engagement occurs, reducing test complexity.



Avionics & Software Integration

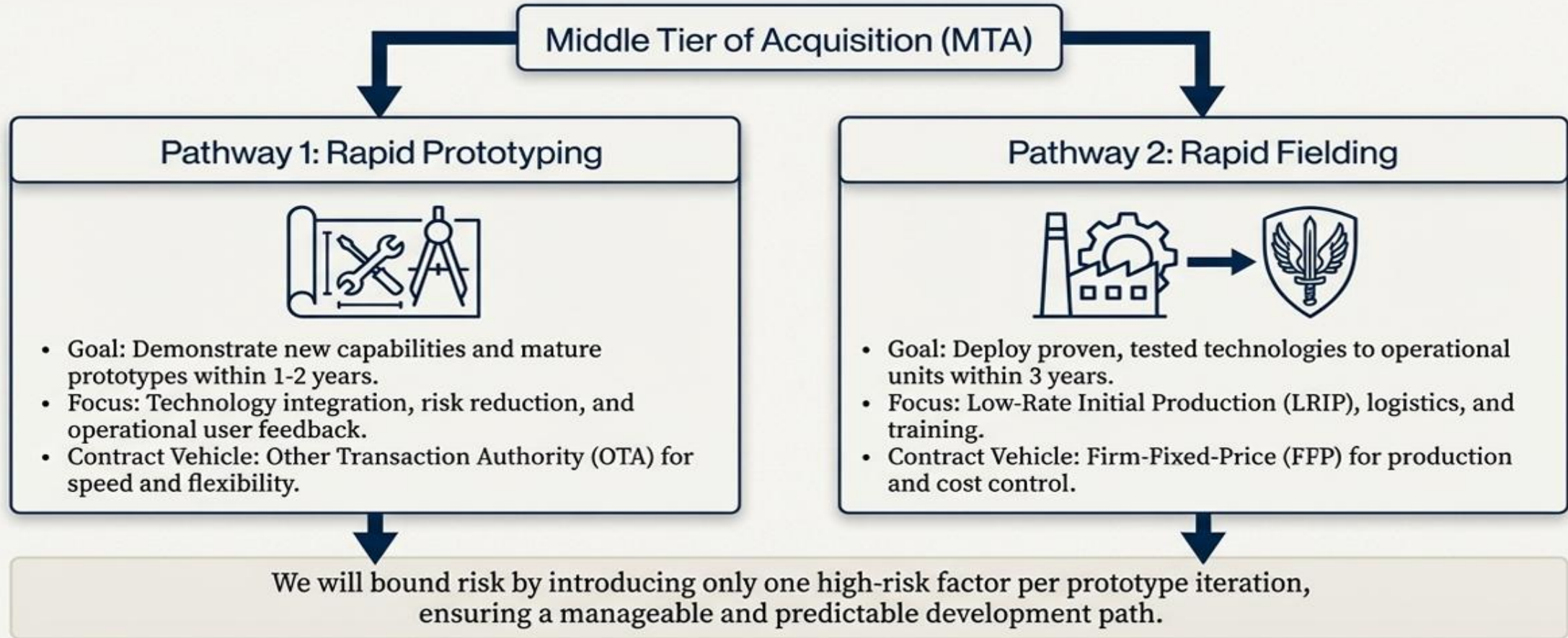
Integrating a new weapon can require costly and time-consuming changes to the aircraft's Operational Flight Program (OFP).



Mitigation: Mandate the use of the **Universal Armament Interface (UAI)**. This standard enables 'plug-and-play' compatibility, drastically reducing software integration timelines.

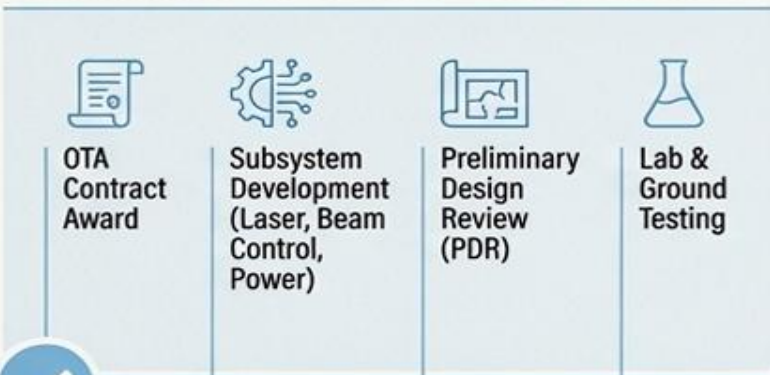
From Blueprint to Reality: An Accelerated Acquisition Strategy

To achieve IOC within three years, we will bypass traditional, lengthy acquisition cycles by leveraging the Middle Tier of Acquisition (MTA) framework. This approach prioritizes rapid prototyping and rapid fielding of mature technologies to meet urgent operational needs.



The 3-Year Path to Capability

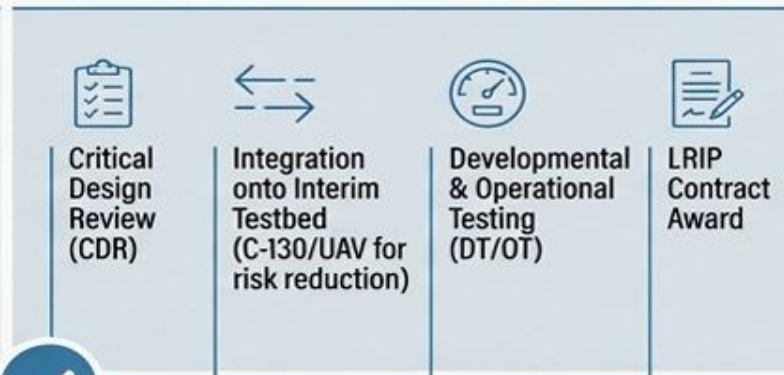
YEAR 1: RAPID PROTOTYPING & INTEGRATION



Successful ground test of integrated prototype pod.



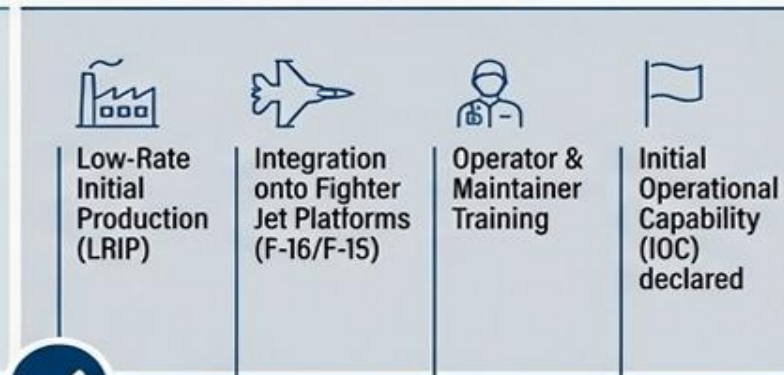
YEAR 2: SYSTEM INTEGRATION & VALIDATION



Successful live-fire demonstration from airborne testbed.



YEAR 3: RAPID FIELDING & IOC



First operational squadron equipped and trained.



This aggressive schedule is enabled by the MTA framework, parallel development efforts, and a focus on high-TRL technologies from the outset.

Redefining the Economics of Air Defense

The rapid fielding of an airborne solid-state laser is not merely an incremental improvement; it is a strategic necessity. It restores a favorable cost-exchange ratio, enhances force resilience, and provides a scalable defense against the threats of today and tomorrow.



A Validated, Achievable Design

We have identified a specific, data-driven "working point" (**30 kW, 7 km, 20 shots, <3,000 lbs**) that is both operationally effective and technically feasible.



A Credible, Accelerated Path

We have a clear, three-year roadmap to IOC, grounded in the proven **MTA framework** and enabled by key technologies like the **Universal Armament Interface**.



A Transformative Strategic Impact

This capability allows us to move beyond an unsustainable defense posture, creating a multi-layered architecture that imposes costs on our adversaries and ensures enduring air superiority.

This is the opportunity to bridge the gap between innovation and national defense—to turn potential into a decisive capability.





NAVAL POSTGRADUATE SCHOOL

1 University Circle • Monterey, CA 93943

(831) 656-1068 • www.nps.edu

