

Engineering Options to Intercept “A House of Dynamite” Attack.

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An informal essay proposing engineering designs or options that could help the United States intercept a single missile rogue nuclear attack like that presented in the 2025 Netflix motion picture film *A House of Dynamite*. Theoretical modern technology designs are presented that the United States Department of Defense and advanced military armament and space organizations can consider for possible near-term and future platforms including *Golden Dome* proposals.

“Invincibility lies in the defense”
-- Sun Tzu, *The Art of War*

“Reaction time is a factor.”
-- *Blade Runner*

“Ants, fighting together, will vanquish the lion.”
-- Saadi

In the 2025 Netflix motion picture film *A House of Dynamite*, the public is made aware of the challenges with intercepting even a single ICBM armed with a nuclear warhead¹. The film does a great job in stressing a key challenge and obstacle - the limited amount of time to intercept and react to a high-velocity threat. In a world of random events, and with the daily chaos of human life, the odds of all government systems, communication, monitoring, and processes working instantly, or as expected, in any given approximately 30-minute-long window, is very small. Thus, beyond a vast investment in anti-ballistic missile (ABM) defense systems, we have a real-world problem and dangerous threat². The existence of submarine launched ballistic missiles (SLBMs) guarantees the threat of retaliation by the United States, so even a “failure to intercept,” does not require, per se, an immediate response i.e. a “launch on warning” as somewhat insinuated in the film³. Note that a single United States Navy Ohio class nuclear submarine has enough warheads (up to 240 MIRV nuclear warheads with between 100 and 475 kiloton yield on its twenty Trident II missiles) to destroy any nation^{4, 5, 6}.

But perhaps there are designs and strategies with modern technology that can reduce the massive spending requirement from a standard ABM system, like the initial proposals for an American *Golden Dome* defense system, based on the deployment of massive quantities of ground-based interceptor missiles⁷. The technology of *artificial intelligence* (A.I.) is a critical component of all theoretical designs, but a larger benefit is likely from the miniaturization of satellites and drones, and both technologies, using A.I. for *swarm coordination* that enables an extremely fast response time⁸ (Figure 1). Examples of such small microsattellites, nanosatellites, picosatellites, and femtosatellites (Figure 2) include: Agile MicroSat (AMS)⁹, Millennium Space Systems⁹, CubeSat¹⁰, Demeter¹¹, Essaim¹², Parasol¹³, Picard¹⁴, Microscope¹⁵, Taranis¹⁶, Elisa¹⁷, SSOT¹⁸, SMART-1¹⁹, Spirale-A/-B²⁰, and Starlink^{21, 22} satellites .

This is of particular importance given the additional threats that now exist with even less reaction time from an attack using cruise missiles and hypersonic cruise missiles that never travel above earth’s atmosphere, not to mention new technologies like aeroballistic missiles, hypersonic glide vehicles (HGV) and attack cruise missiles, fractional orbital bombardment system (FOBS), and possible nuclear powered cruise missiles²³. Theoretical designs are presented that may help that United States, or any technologically advanced nation, optimize modern aerospace systems to address the threat of a rogue ICBM attack.

As a black widow spider spins a web to immobilize its victim, we can label a platform a *white widow* that resembles an umbrella style approach to warhead interception i.e., when it begins to rain, we don't attempt to stop each rain drop, we use an umbrella.

With new extremely fast and lightweight microprocessors, SpaceX has advanced maneuvering small rocket thrusters built to the technological level of landing large rocket boosters on floating platforms in the ocean and, as they return to earth after a launch, being caught by the “arms” of its launch site tower^{24, 25}. This level of miniaturization and precision are needed to overcome the challenge, as literally noted in the film’s dialog, of “hitting a bullet with a bullet”²⁶.

Thus, let us imagine a swarm of at least three small satellites, akin to Starlink-sized satellite devices, in a fleet that always has at least three satellites over the United States at any given time ²⁷. This design has fleets of small satellites “stacked,” resembling a “layer cake,” with fleets at various altitudes orbiting the planet, perhaps even dozens of fleets or more at various altitudes akin to a *deep shield* (Figure 3). If an ICBM or MIRV re-entry warhead approaches any United States territory, or even the territory of its allies or forward deployed forces anywhere on the globe, we can imagine high-powered lasers creating a *full mesh* “web” between each satellite - at least three satellites as a minimum but up to a much larger number of satellites given the amount of time another satellite in the swarm has to reach its maximum distance to join the mesh ²⁸. This occurs separately via A.I. swarm coordination at each altitude in this “layer cake” approach (Figure 4).

The lasers in this vision need to be powerful, but not beyond current technology as the satellites can maneuver using the aforementioned modern rocket thrusters to “catch” the warhead in their mesh “web,” akin to a baseball outfielder catching a pop fly baseball in their glove ^{29, 30}. The warhead is destroyed as the laser overheats or cuts the projectile as it passes through the laser beam mesh. If the first attempt fails, another micro-swarm is already beneath it at a lower altitude creating a “stack” of more and more “webs” in a vertical cylindrical shaped “tunnel” along the re-entry path of the warhead.

For suborbital attacks, we can imagine a new Strategic Air Command style *Operation Looking Glass* fleet of aircraft in flight 24x7x365, naval ships, or even an assortment of tall towers, containing swarms of drones ready to deploy in a similar manner, but within our atmosphere ³¹ (Figure 5). As seen in the ongoing war between Ukraine and Russia, these drones can be armed with small explosives and, even with a reasonably sized swarm, can create a very high percentage kill success rate ³². Early detection, as always, is essential in any of these scenarios ³³.

Another design option is a single satellite or drone that deploys lasers akin to a spinning fan or dandelion for a similar destructive effect. Also, a satellite, with a nuclear device in it, may be able to spread a flat stream of high-powered X-rays in a horizontal blanket or pancake shape to destroy, damage, or divert any incoming projectile ³⁴.

Note how all of these designs do not require the creation of new ultra-high powered lasers like a *Star Wars* “Death Star” aiming at the single incoming warhead ³⁵. Also note that the total cost of these platforms would likely be much less than a vast fleet of ground based interceptor (GBI) missiles and much faster and also with a higher success rate of interception ².

A theoretical design for a *Golden Dome* anti-ballistic missile system, proposed by the Trump Administration and Lockheed Martin, is the aforementioned “umbrella” analogy ⁷. We can also consider the analogy of a baseball outfielder with a baseball glove (mitt) to catch a baseball akin to “catching” a MIRV warhead in a mesh or spider web of laser beams or being intercepted by the microsattellites themselves crashing into the warhead. These designs resemble the classic calculus optimization problem of a drowning swimmer and a lifeguard (or dog) attempting to travel down the beach and then swim in the ocean, in as short an amount of time as possible, to save the drowning swimmer ³⁶.

An assortment of factors come into play in terms of engineering the ability to quickly intercept a high-velocity threat and to ensure the success of the effort. Obviously at a certain point, the number or quantity of ground based interceptors (GBI) or even orbiting satellites (regardless of size) becomes cost prohibitive - to build, launch, track, and maintain them. The total spherical surface area of any given earth orbit is a vast amount of space to cover, thus even the use of nanosatellites or femosatellites would still be an enormous challenge to engineer and operate at scale, even with A.I. coordination and miniaturized satellites with powerful and maneuverable thrusters ⁹. But, like our calculus analogy, where the optimal solution becomes a “dual path solution” (using X amount of time running down the beach and Y amount of time swimming in the ocean to save the drowning swimmer for a total minimum amount of time of $Z = X + Y$), we can envision a fleet of small satellites in orbit (with a certain minimum fleet count), with a certain standard distance between each of them, and with an optimal number of orbital levels (each orbital altitude with its own satellite swarm fleet). Factors like: time to identify, the speed of a given satellite or swarm to coalesce (get to the warhead or to the point at their orbital level where the warhead will cross), the maximum distance of laser efficacy, the maximum distance of swarm communication and coordination by our A.I. system, and the expected lifespan, replenishment rate, and cost of each satellite model, are all engineering constraints that play into any final design.

The swarm formation can have a variety of architectures including: a high-powered laser creating a meshed web by reflecting off of a swarm of mirrored nanosatellites (Figure 6), a swarm of small satellites

each with various lasers being transmitted around it like a fan or dandelion shape (Figure 7), a swarm of these satellites arranged in a patchwork or quilt formation (Figure 7), or the noted swarm of A.I. coordinated satellites each emitting a small number of laser beams with all of the beams overlapping into an optimal mesh with the power of A.I. adjusting the swarm's laser-based web shape at extremely high-speed and adjusting to all relevant variables of each satellite - and the warhead telemetry - to ensure interception (Figure 3).

During any interception event, satellites using thrusters, continue to coalesce into a larger and larger swarm formation that the high-speed calculating A.I. engine is able to process and coordinate, including the coordination of fleets at each orbital level, so if the high-altitude initial intercept swarm misses, the next lower altitude levels (with more and more coalescing satellites) has a higher and higher percentage of kill success. Classic *kill success* calculating approaches like *single shot kill probability* (SSKP) and *circular error of probability* (CEP) would be rapidly adjusted and updated in these designs via A.I. processing ^{37, 38}.

It is very likely that the ability of satellite or a swarm of satellites to all coalesce using their mass as an *exoatmospheric kill vehicle* (EKV) itself is possible, but the main kill advantage in this approach is in the quantity of attempts to intercept the path of the warhead akin to a game of darts with dozens of throws to hit the bullseye center target of the board ³⁹. This is a possible strategy, but it depends on the quantity of satellites and their ability to maneuver fast enough to directly reach the warhead or warhead path (Figure 8). In this approach the satellites are also not reusable as some or many will have been lost with the kinetic collision with the incoming warhead.

Thus, it is likely the case that a swarm's web or mesh of lasers will have an ability to cross the path of the warhead faster than any single satellite or small swarm group of satellites. A laser is faster than any rocket powered device but, given current technology, it will need to already be in orbit. Thus the need for an A.I. coordinated swarm of satellite-based lasers. Akin to the lifeguard optimization problem, the proposal uses both 1) the *quantity* of a swarm of satellites, and 2) the faster *speed, flexibility, and destructive power* of laser beam weapons, for an optimal design.

We can compare this approach to the evolutionary optimization seen in the ant kingdom. A *sweet spot* is found between the strategies of using a large quantity of soldier ants and of using groups of ants with *specialization* or specific focused abilities, to overcome a threat, regardless of its speed or size ⁴⁰. Many of these design concepts are likely already being considered, but all possible methodologies should be considered when working to solve a problem of such national and existential importance.

Figures

Figure 1.

The miniaturization and mass production of small and highly maneuverable satellites and airborne drones, with both technologies using A.I. for "swarm coordination," enables an extremely fast response time to small and high-velocity targets .

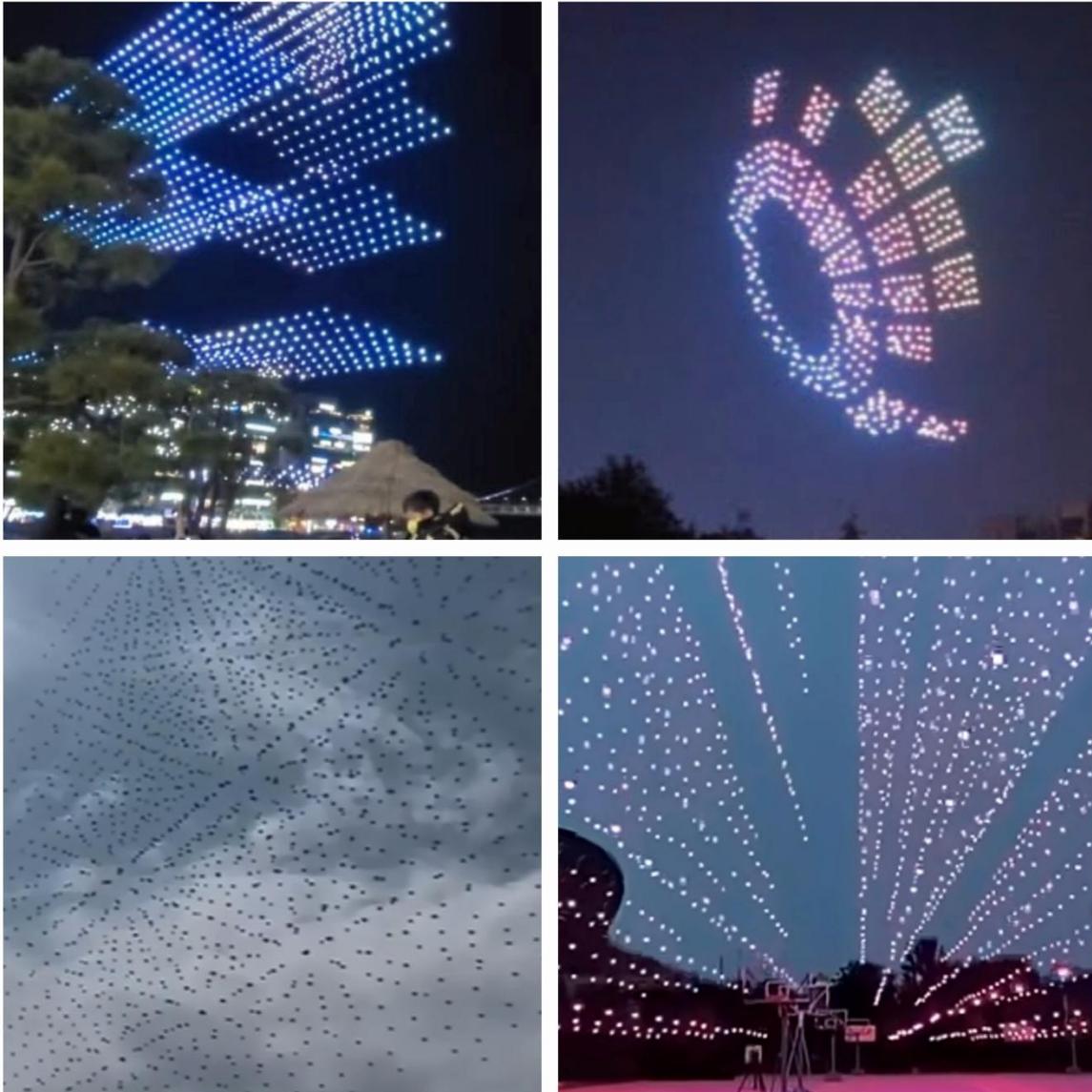


Figure 2.

In an evolutionary pattern, similar to Moore's Law with computer microprocessors, the increasing production of miniaturized satellites has led to the creation of new "categories" including mini-, micro-, nano-, pico-, and femto- scale satellites 9.

	Mass Class Name	Kilograms (kg)
Smallsats	Femto	0.01 – 0.09
	Pico	0.1 – 1
	Nano	1.1 – 10
	Micro	11 – 200
	Mini	201 – 600
	Small	601 – 1,200
	Medium	1,201 – 2,500
	Intermediate	2,501 – 4,200
	Large	4,201 – 5,400
	Heavy	5,401 – 7,000
	Extra Heavy	> 7,001

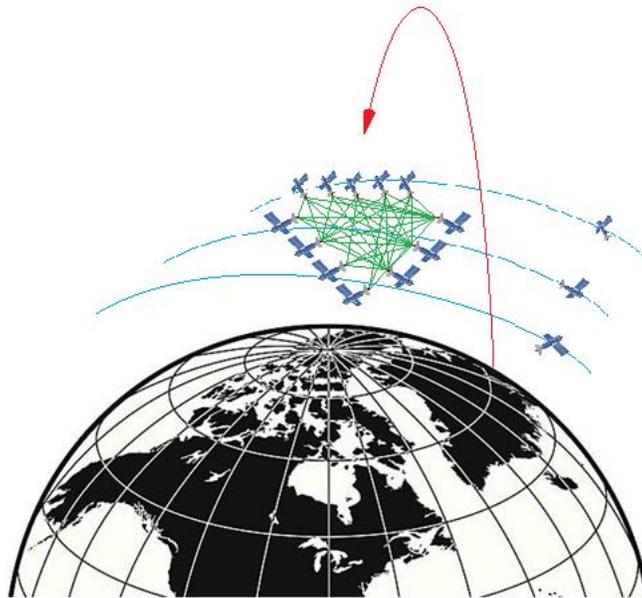
From FAA The Annual Compendium of Commercial Space Transportation: 2018

Figure 3.

A "before and after" style diagram is presented below of a fleet of small satellites at a single orbital level. Each small satellite in this design is equipped with powerful laser beams and each maintains an equidistant position from its peer satellites at this orbit around the globe in its "normal operational state." Upon identification of an ICMB attack, the artificial intelligence coordinated fleet swarms into action using laser beams to create a mesh at a location in the warheads path that will destroy the warhead re-entry vehicle upon contact.



SINGLE ORBITAL LEVEL EXAMPLE
NORMAL OPERATIONAL STATE



SINGLE ORBITAL LEVEL EXAMPLE
"A.I. COORDINATED SWARM"
MIRV INTERCEPTION

Figure 4.

A proposed “white widow” platform using a full-mesh of lasers based on A.I. coordinated swarms of small satellites at various orbital altitudes, akin to a layer cake or “deep shield” to ensure successful interception and destruction of any rogue missile ICBM attack. The “web” of high powered laser beams (green), between highly maneuverable satellites, ensures a successful warhead target interception via the ability to respond exponentially faster than ground based interceptor rockets - that must reach orbit before attempting a single attempt kill – and via layers of redundancy with small satellite fleets at various orbital levels.

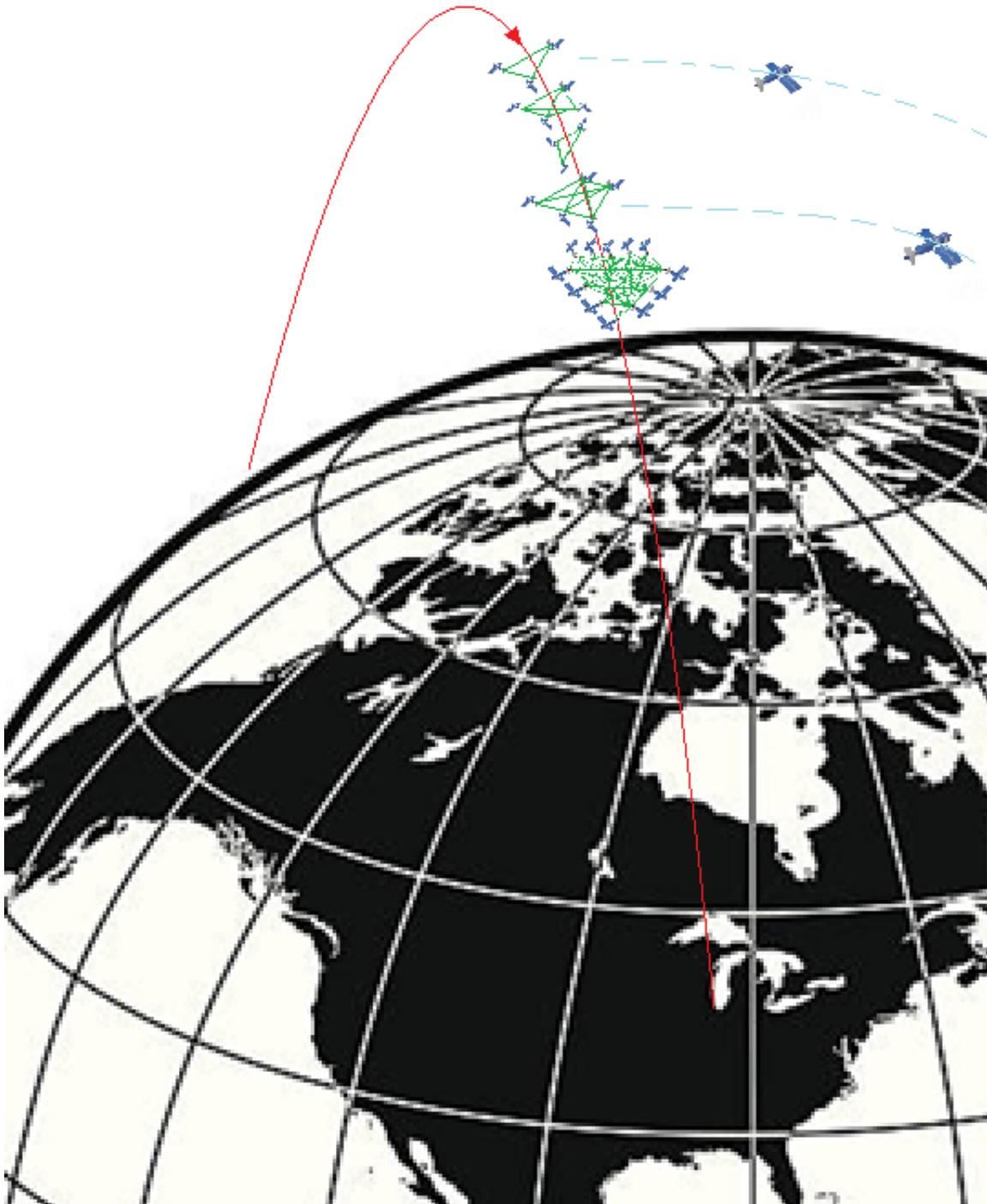


Figure 5.

For suborbital attacks, we can imagine a new Strategic Air Command style “Operation Looking Glass” fleet of 24x7 aircraft in flight and naval destroyer ships containing swarms of drones ready to deploy in a similar manner, but within our atmosphere ³¹. This is of particular importance given the additional threats that now exist, with even less reaction time, from an attack using cruise missiles and hypersonic cruise missiles that never travel above earth’s atmosphere ²³.

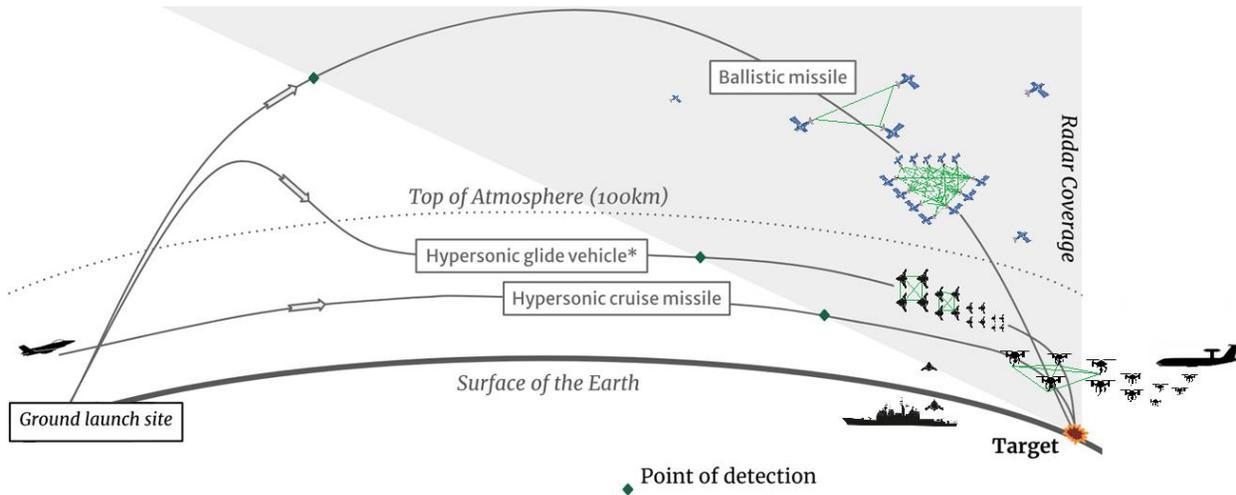


Figure 6.

A theoretical “Golden Dome”⁷ architecture where a satellite with a high-powered laser creates a mesh or web of laser beams by reflecting it off of a swarm of mirrored nanosatellites.

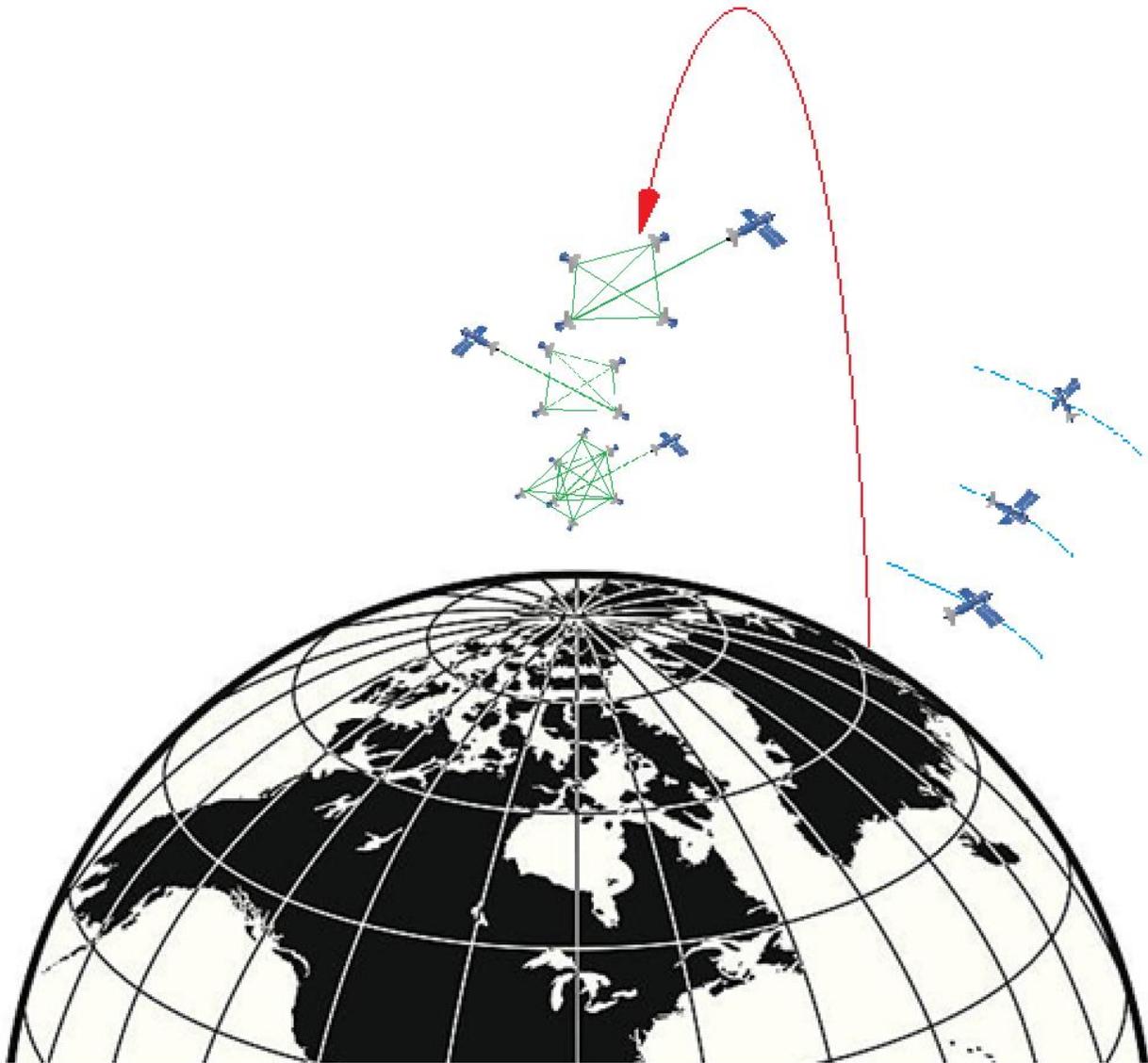


Figure 7.

Another theoretical “Golden Dome”₇ architecture where a small satellite has various laser beams transmitted around it resembling a dandelion shape (top) and then a swarm of these satellites arranged in a patchwork or quilt formation to intercept and destroy a ballistic missile re-entry vehicle (bottom).

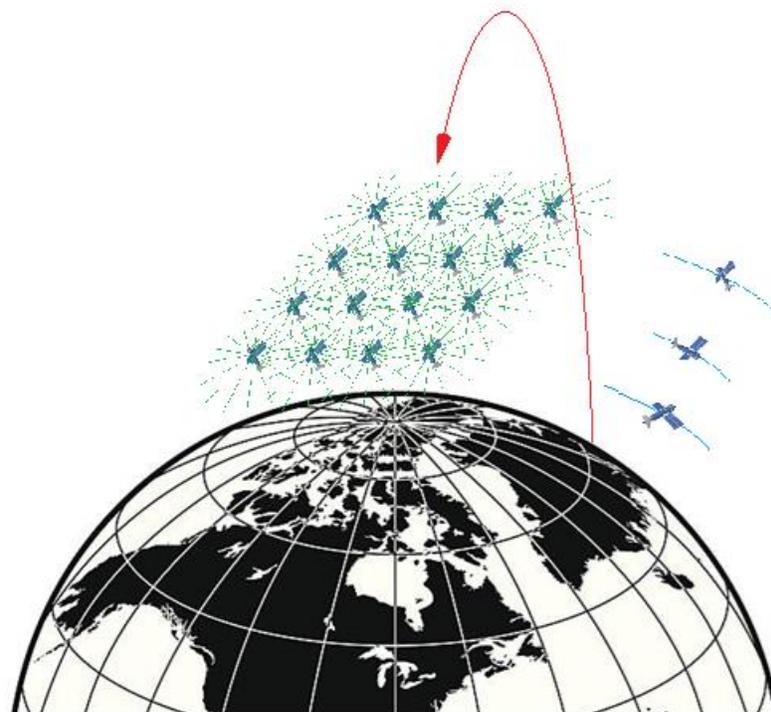
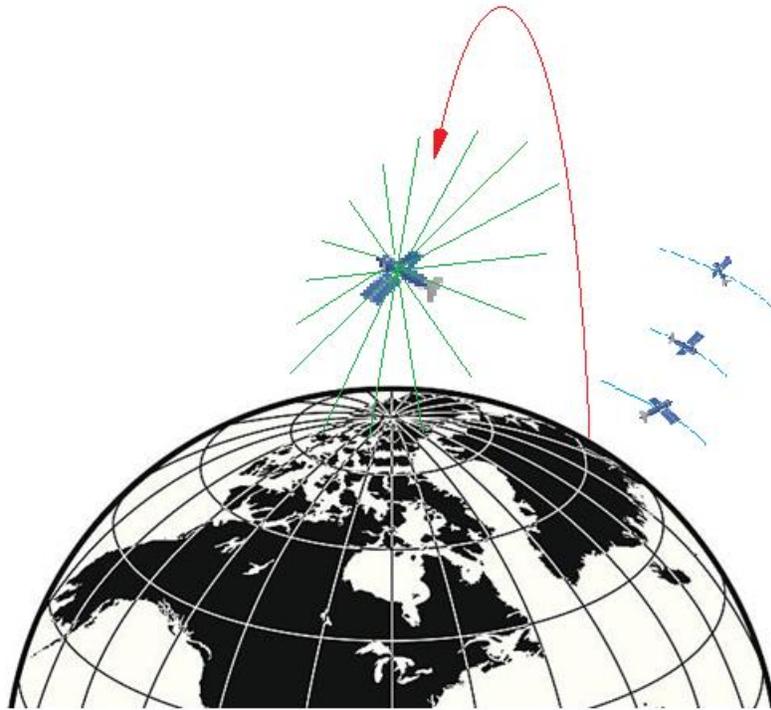
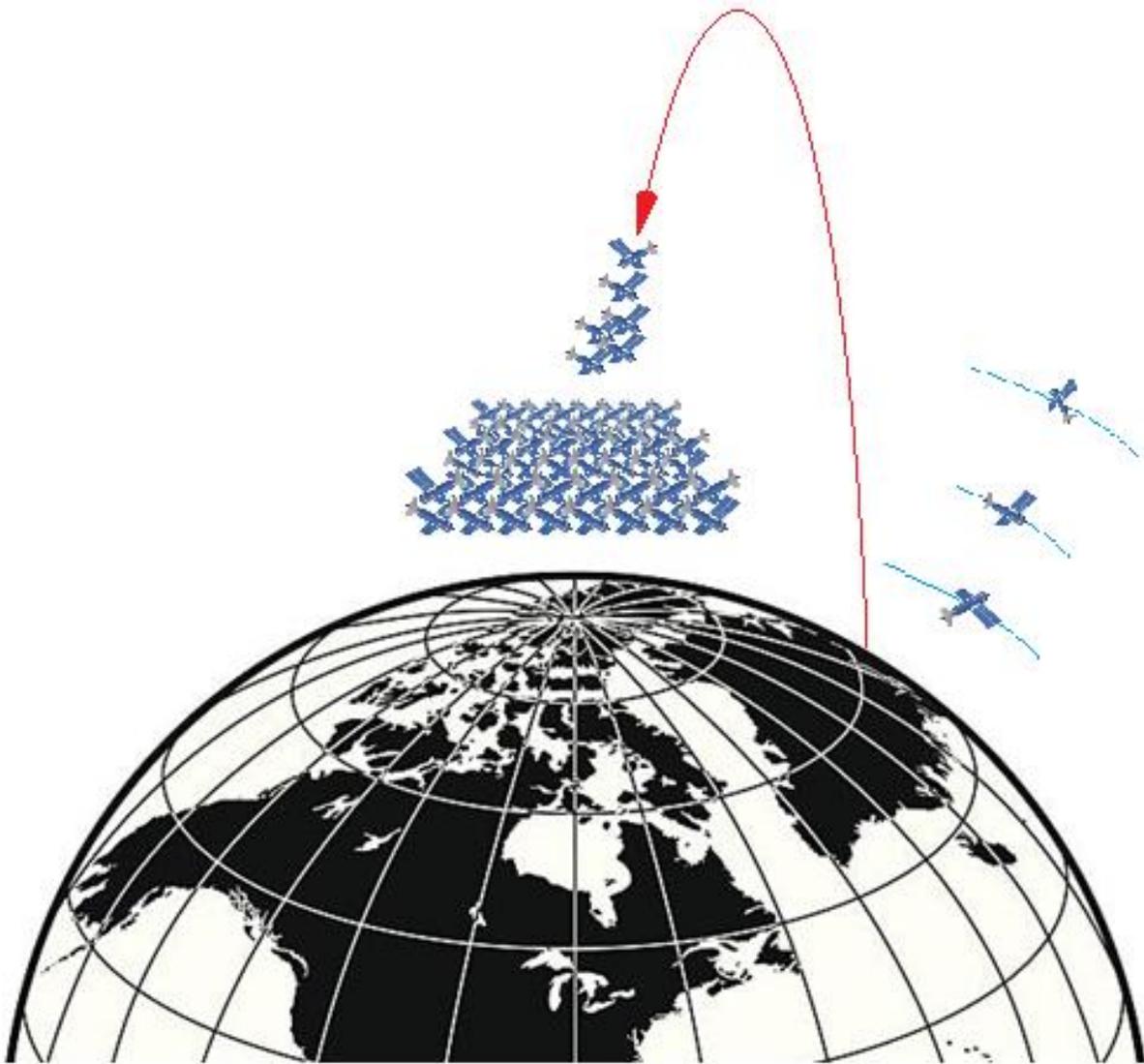


Figure 8.

The ability of a satellite, or a swarm of coalescing satellites, to use their own mass to directly collide with and destroy an incoming warhead i.e., as an *exoatmospheric kill vehicle* (EKV), is possible. But this strategy depends on the quantity of satellites in orbit and their ability to maneuver fast enough to directly reach the warhead or the warhead's path and some or many will be destroyed in the kinetic collision with the incoming warhead.



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