

The military is looking at ways to intercept nukes from space – but experts say it's not feasible

On Thursday, the Pentagon released a massive report detailing the new capabilities it wants to pursue to beef up US missile defense – and part of that list involves updating our assets in space. But while some of the suggested upgrades to our space-based technology could prove useful, experts say other ideas, like stopping nukes from orbit, are a bit more farfetched.

The document, known as the Missile Defense Review, calls for a new constellation of satellites, equipped with infrared sensors that can better track warheads on Earth. It's a technology that's intended to help the US follow the paths of new hypersonic vehicles that are being developed to transport nukes from one place to another. But the review also encourages the Pentagon to study the possibility of creating satellites that can *intercept* nuclear missiles from space. And for this research, the Pentagon may perform experiments and technology demonstrations in orbit around Earth.

"Much has changed since the United States last considered space-based interceptors in a potential architecture, including major improvements in technologies applicable to spacebasing and directed energy," the report says.

"The real problem is the sheer size of what would be necessary."

Satellites designed to knock out a missile just as it launches have been proposed and studied many times in the past. The idea can be traced back to the Reagan administration's Strategic Defense Initiative – nicknamed "Star Wars" by its

critics – which called for creating a large swath of space-based technologies to prevent nukes from reaching US soil. But the general consensus on these assets has long been the same: such interceptors would be too costly and too complex to be feasible. For one, we'd need a lot of them – many hundreds or thousands, to provide global coverage. And they would have to perform a very advanced set of technical tasks in a very short amount of time to be effective.

“Physically, it's certainly possible to get a satellite in space at the right time to intercept an ICBM,” Laura Grego, a senior scientist with the Union of Concerned Scientists who focuses on missile defense and space security, tells *The Verge*. “That's an engineering problem. The real problem is the sheer size of what would be necessary.”

A rocket arcs into space during launch

Image: SpaceX

Though space-based interceptors are not actively being pursued by the Pentagon at the moment, President Trump insinuated that he wants the kind of coverage these satellites might provide. “Our goal is simple – to ensure that we can detect and destroy any missile launched against the United States anywhere, any time, any place,” Trump said during a speech on Thursday announcing the details of the Missile Defense Review, or MDR. “That's the kind of coverage you could only get from a multi-thousand space based system,” Ian Williams, deputy director of the Missile Defense Project at the Center for Strategic and International Studies, tells *The Verge*.

For now, our missile defense is mostly tethered to the Earth. The largest intercepting system at our disposal is the Ground-Based Midcourse Defense system, or GMD, which relies on a network of sensors, personnel, and missiles. If a nuke were launched from North Korea, for instance, infrared satellites

along with ground and sea-based radars would detect it and quickly calculate the missile's final destination. Then personnel with GMD would order the firing of missiles located in either Alaska or California. Those interceptors would then attempt to meet the incoming nuke as it soared through the vacuum of space – the longest phase of the ICBM's flight. They would then ram into it and destroy it before it reached the ground.

when it comes to destroying any missile "anywhere, any time, any place," we just can't do that

But when it comes to destroying any missile "anywhere, any time, any place," the GMD just can't do that, because there are only so many interceptors in existence. The GMD has 44 interceptors, though the new MDR calls for the creation of 20 more. Still, such an arsenal would not be enough if Russia or China decided to launch their entire nuclear fleet at once. The system is more focused on addressing threats from smaller players, like North Korea or Iran. Another problem is that these interceptors aren't always effective. Of the 19 intercept tests done by the GMD, only 10 have been considered successful.

Part of the issue is that hitting an ICBM going many thousands of miles per hour is incredibly difficult. But another complication is that it's actually pretty hard for an interceptor to determine what object it needs to hit. During flight, ICBMs shed parts and hardware that can confuse an interceptor. Plus, nations are also developing their missiles in ways that make them harder to discern. More sophisticated ICBMs are capable of deploying decoys during flight, making it difficult to discriminate which piece is the actual warhead. The interception happens in the vacuum of space where a heavy warhead travels the same speed as a lighter decoy. "It's trying to cat and mouse where the actual warhead is, and that's actually a really difficult problem," says Grego.

An interceptor launched from Vandenberg Air Force Base in California in 2017, which successfully collided with a launched target

Image: Missile Defense Agency

It's this decoy problem that pushes some to call for space-based defense, according to Grego. The idea is that satellites equipped with interceptors could target ICBMs during their initial launch, or boost phase, rather than during the long trip through space. During boost phase, the missile is at its most vulnerable state, as it's doing a controlled burn of its rocket engine and it hasn't deployed any decoys yet. But the boost phase has a very limited window. It lasts just a few minutes, so any interceptor needs to be relatively close by and act super quickly to hit the missile at that time. "They've explored in the past doing this with ground-based or sea-based interceptors and have found they simply cannot get them there fast enough," says Williams.

a massive amount of satellites would be needed to catch any launch at any time

But satellites *might* work, if they're in a low enough orbit and flying overhead just as a missile is launching. But when you zoom out and consider just how many missiles there are all over the globe, a massive amount of satellites would be needed to catch any launch at any time. Satellites in low Earth orbit don't hover over the same patch of Earth. They zoom through high altitudes at upwards of 17,000 miles per hour, completing one orbit around the planet every hour and a half. "As soon as you've got something in the right place, it's gone again," says Grego. That's why a mega-constellation of satellites working in tandem would need to zig zag all over Earth to cover the necessary ground.

It's a similar issue that companies like SpaceX and OneWeb face as they try to develop satellites to beam internet

coverage to Earth. SpaceX, for instance, is proposing a constellation of thousands of probes to get the complete coverage it desires. But an internet-beaming satellite is only transmitting light signals. A space-based interceptor would be propelling what is essentially a tiny missile, with engines and a fuel tank, from orbit.

Some experts have proposed using lasers, or directed-energy, instead of physical interceptors on satellites. With lasers, travel time to reach an incoming missile isn't as much of an issue. However, it's possible there are limits on how much energy a satellite can direct through Earth's atmosphere – satellite-mounted lasers might simply not be powerful enough to take down an ICBM.

An artistic rendering of how OneWeb's proposed satellite constellation would cover the globe

Image: Airbus

And a constellation of laser-equipped satellites would still be *huge*. The National Academy of Sciences released a detailed report on missile defense in 2012 that found that the US would need many hundreds, or even thousands, of these vehicles to truly cover all the areas where a missile might launch on the globe. And the cost of launching such a constellation would be astronomical. The NAS estimated that the total life cycle cost of just 650 satellites would hover around \$300 billion.

Whether laser or missile-based, a space-based interceptor would also need to accomplish a gargantuan number of detailed tasks within a three-minute window. It would need to detect a launch, determine that it's a threat to the US, decide to intercept the missile, figure out the trajectory of the target, and then launch the interceptor. Some experts think that since this is all happening so fast, the satellite would need to work autonomously, which is a scary prospect

considering how many would be in the sky at one time. “That means you’re talking about several thousand killer satellites that are autonomously trying to detect a launch that is a threat or not,” Brian Weeden, director of program planning at the Secure World Foundation focusing on space operations and policy, tells *The Verge*.

A space-based interceptor would need to accomplish a gargantuan number of detailed tasks within a three-minute window

Finally, politics should be considered. Launching hundreds to thousands of what are essentially weapons in space probably wouldn’t go over well with China and Russia. The two states might retaliate by refining their launch systems to make nukes more resilient during the boost phase or they might ramp up their abilities to destroy satellites in orbit.

For many, the entire concept of missile defense just isn’t as effective as that of mutually assured destruction – the idea that if one nation decides to strike another, then it will be destroyed in the process. And Congress has expressed worry before about missile defense leading to an arms race. But for others, mutually assured destruction is a moral dilemma. Is it necessary to threaten the deaths of millions to maintain peace? That’s the driving factor behind missile defense, argues Weeden. “The notion that you can come up with a technological solution that prevents things to do that and you can basically make it so they can’t hurt you – that’s a very appealing idea from a moral and emotional sense,” he says.

Of course, none of this is set in stone, or written into policy yet. The MDR only calls for a study, which is supposed to be completed six months from now. In the meantime, the Pentagon plans to move ahead with a far less controversial space-based defense layer: satellites equipped with infrared sensors that can at least track the full trajectory of a launched missile. Most ICBMs follow a ballistic trajectory – a path that a vehicle can’t really alter. But some engineers are

trying to develop new hypersonic vehicles that can glide a nuke to its location. These are particularly difficult to trace, but an upgraded constellation of satellites could track them down.

While those more immediate space-based defenses may help with national security, it's not quite a global shield from any nuclear attack. For now, defending against threats from above will still have to start from the ground up.

<https://www.theverge.com/2019/1/20/18188332/space-based-interceptors-icbms-missile-defense-review>