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How the "Space Fence" Will Help Keep Orbital Junk from Killing Satellites

You have to see it before you can avoid it.



Lockheed Martin

By Eric Tegler Apr 6, 2016

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When the Air Force turns on its new "Space Fence" radar system in 2018, it will be able to detect far more objects in orbit than the 17,000 currently tracked by the 1960s-vintage Space Surveillance System. But just how much junk is up there?

A lot. Several million objects are currently in orbit. In 2015 the International Space Station crew had to make at least 25 avoidance maneuvers to dodge them. Various-sized bits and pieces traveling at speeds of nearly eight miles per second passed the station four times last year. And while the Space Fence won't block orbital collisions or "conjunctions" as the U.S.A.F. likes to call them, it will help prevent them.

"Nobody really knows exactly how many objects we'll see," says Steve Bruce, Lockheed Martin special projects manager for Space Fence, "but there are estimates of somewhere between 100,000-200,000."

Once you can see those objects, you can start working to avoid collisions like the 2009 smashup of communication satellites Iridium and Kosmos. It's a crucially important task because every new collision just makes the job that much harder going forward. The smash in 2009 scattered thousands of pieces of debris into orbit and destroyed a key communications node. Every time another crash happens, it only makes things worse.

AT LOWER ORBITAL ALTITUDES, THE SPACE FENCE WILL BE ABLE TO DETECT OBJECTS AS SMALL AS MARBLES.



On Earth, Space Fence will take the form of radar arrays on Kwajalein Atoll in the Pacific Ocean, about 2,100 nautical miles southwest of Honolulu. Built by Lockheed Martin, the Space Fence will be

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the largest digital array radar in the world when it is finally completed. Its Gallium Nitride-based system will be able to see far into space with unprecedented resolution to help the Air Force detect and track objects—both satellites and vehicles—and maintain a database of their orbits. At lower orbital altitudes it will be able objects as small as marbles.

The radar uses a bi-static design with separate transmit and receive arrays, the transmit array roughly the size of a tennis court and the receive array closer to basketball court-sized. Each one lives in its own building with an extremely heavy concrete foundation to hold it in place in case of an earthquake. The twenty-five foot walls are also multi-ringed with thick concrete to protect against hurricane winds. Sitting atop the receiver antenna is dome of multi-ply kevlar fabric clear enough to be transparent to radar but strong enough not to tear in hurricane winds. It's held up by air pressure, not unlike domed-roof football stadiums.

Other buildings house three diesel generators, chillers and pumps for the liquid cooling system, and calibration towers. All crucial because Space Fence uses an impressive 8.5 megawatts of power to do its thing.

While the real-deal Space Fence is still coming online, a "mini-Space Fence" test site in New Jersey has been in operation since January, tracking objects and giving Lockheed and the Air Force a feel for how the real system will work when it's completed on Kwajalein. The mini version is only about two-percent the size of the full system, but that's enough to give a pretty good impression of system functionality and construction.

"We're using it to do all of our software development prior to installing it on the island," Steve Bruce explains. "We're also using it to make sure all the hardware works properly. There's a precision steel structure which holds the antenna arrays. That structure is exactly the same as one section of what would be on the island." Transmitter and receiver construction on the big boy, meanwhile, is set to be completed this fall with radar electronics and software installed next year.

The mini-Space Fence doesn't have full-size resolution to see space marbles but it *can* see softball-sized objects at lower altitudes. It's already generating system performance projections and turning observations into orbital data sets with predictive tracking. But it's not until the real Space Fence is finished that the Air Force will be able to start sending tracking data and emergency alerts to the Joint Space Operations Center at Vandenburg AFB, which can then share some of that information with commercial satellite operators or other governments.

IT WILL ALSO SEE ANYTHING FLYING THROUGH ITS FIELD, INCLUDING AIRCRAFT AND BALLISTIC MISSILES.

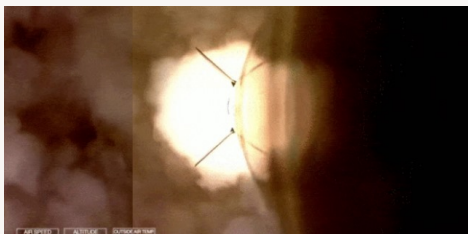


As you can tell by the name, Space Fence is primarily concerned with tracking space junk and satellites, but by no means is it limited to that. The array's mid-Pacific location is strategically important. And though Lockheed won't say what Space Fence's specific field-of-view is, the system will naturally see a large swath of the sky as the planet rotates. Practically, it will also see anything flying through its field, including aircraft and ballistic missiles.

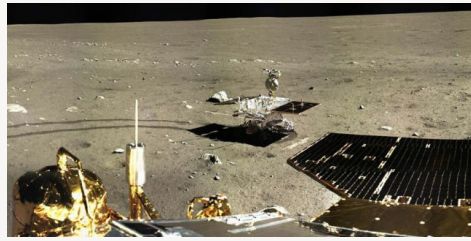
Space Fence's digital array radar is also similar to that found on the F-35. Scanned array radars such as these are good at directing energy for offensive purposes (jamming, sensor destruction) and given the amount of power Space Fence will use, it's reasonable to assume it has some hefty capabilities in this regard. Lockheed won't comment but it seems that, like an electric fence, the Space Fence is a zapper, even if its main objective is to sit and watch from distance.

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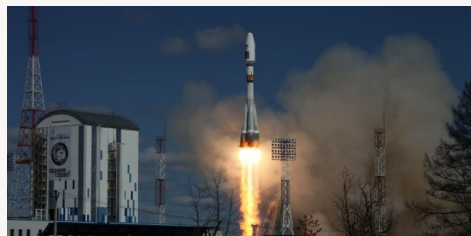
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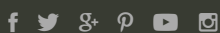
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