Pentagon leaks suggest China developing ways to attack satellites—here's how they might work

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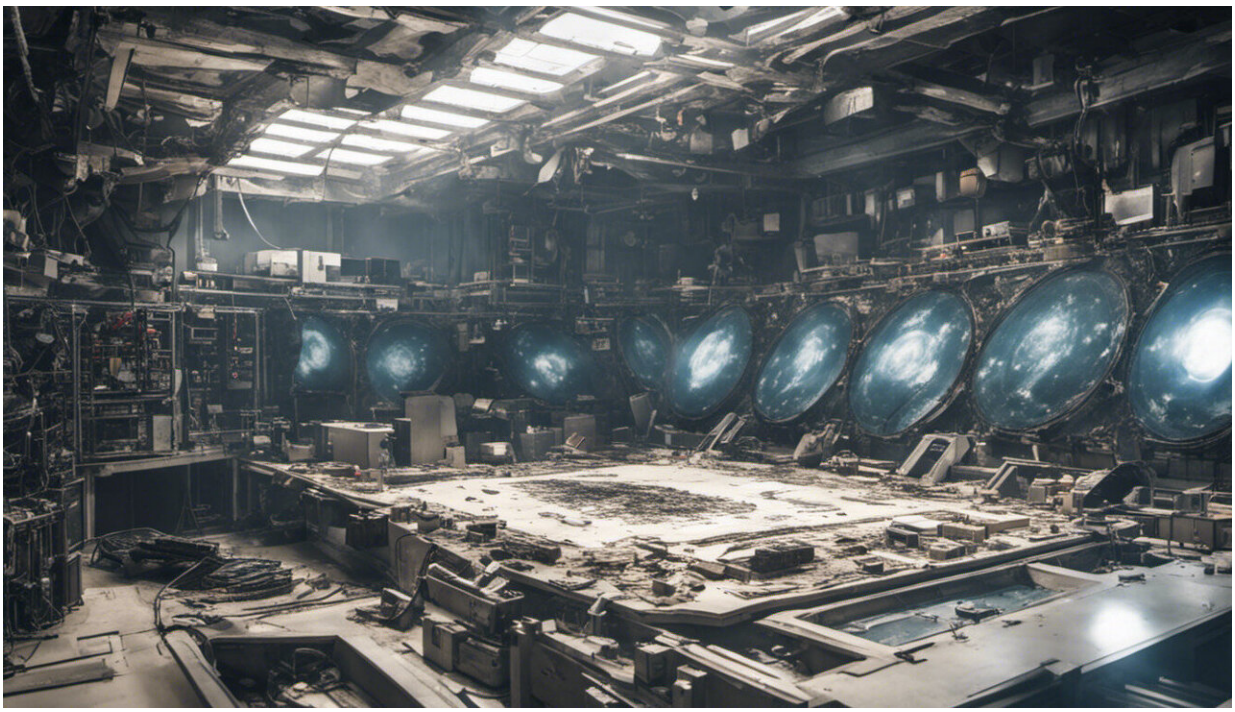

Credit: AI-generated image (disclaimer)

The recent leak of Pentagon documents included the suggestion that China is developing sophisticated cyber attacks for the purpose of disrupting military communication satellites. While this is unconfirmed, it is certainly possible, as many sovereign nations and private companies

have considered how to protect from signal interference.

Nearly every aspect of our lives is enabled by satellite communication, from financial transactions, navigation, weather prediction, and internet services to more remote locations. Yet given how many satellites are in orbit, while the effect might be felt on some of the population, if a satellite or two were lost there would not be any major problems.

But when we consider the military benefits of satellites, immediate communication is vital for early warning systems and tracking. So how easy would it be to disrupt these services?

The Chinese space program has been advancing at a faster rate than that of any other country. China's first successful launch was in 1970, but in 1999 its space program leapt forward with the Shenzhou-1 launch which was the first in a series of unmanned, then manned, space missions of increasing sophistication.

China conducted just over 200 launches between 2010 and 2019. In 2022, it set a record with 53 rocket launches in a year—with an incredible 100% success rate.

As such, the Chinese National Space Administration (CNSA) has become a major player in global space activity and has a lot of experience with satellite communications. The leaked document suggests that the Chinese are looking for the capability to "seize control of a satellite, rendering it ineffective to support communications, weapons, or intelligence, surveillance, and reconnaissance systems."

It's also quite possible that the US and other nations might also be developing such capabilities.

Satellites orbit our planet at a range of altitudes. The lowest stable orbits

are around 300km, the International Space Station and the Hubble Space Telescope sit at 500km altitude, and geostationary satellites are around 36,000km up (about six times the radius of the Earth).

The idea of physically capturing or taking over a satellite has been considered a largely impossible task, although it has featured, famously, in the film such as "You Only Live Twice" where a large orbiting cylinder swallowed manned spacecraft.

Smaller craft designed to remove space debris from orbit have been launched in the past few years. But the practical challenges of capturing a fully working and operating satellite are far greater (particularly due to the recoil of firing harpoons).

However, there are methods of disrupting and even taking over satellite communication?

Three ways to disrupt satellite communications

1. Saturation

This is the easiest method. Satellites communicate by broadcasting on a specific set of radio or microwave frequencies. By bombarding the receiving station or the satellite itself you can effectively drown out the signal. It is particularly effective with positioning information.

2. Jamming

This is a method of diverting the communication signal from reaching the satellite or the ground control station. This requires high-power signals to fool one or the other that the jamming signal is the main transmitting station as a communication will lock onto the strongest

source.

This method of interference works best when the jamming signal contains no information, so the receiver assumes there is no data transmission (a human would hear silence or just a tone).

3. Command sending

This is an infinitely more tricky procedure. The original signal needs to be silenced or overpowered and the replacement signal must be able to accurately communicate and fool a satellite.

This usually requires knowing an encryption key that would be used as well as the correct commands and syntax. This sort of information cannot be easily guessed, meaning knowledge of the launch systems and companies is required.

To make these three techniques easier to understand, imagine you are at a restaurant and your partner is sitting opposite you. You are talking to them normally and then the background music gets turned up really loud. You may be able to make out some words but not everything—this would be saturation.

Now the waiter comes past and starts talking loudly at you taking your attention away—this would be jamming.

Now your partner goes to the toilet and you receive a call that appears to be from them but is actually from somebody who has taken their phone and is impersonating them—this would be command sending.

This final example is infinitely more difficult to achieve but has the most potential for disruption. If you can trick a satellite into thinking you are the true command source, then not only are communications blocked

but false information and images can be sent to the ground stations.

Zombie satellites

When a satellite does go out of communication, we refer to it as a zombie satellite. Essentially it cannot do any of its intended tasks and just orbits with little chance of recovery.

This can happen naturally during coronal mass ejections, when the Sun releases large amounts of energetic charged particles that can interact with satellites causing electrical surges. In some cases this results in untrustworthy data, but can also result in communication loss.

The most famous of these cases was the Galaxy 15 telecommunications satellite, which lost ground station communication in 2010 but continued to broadcast communications to customers.

While the military cannot replicate coronal mass ejections, the hijacking of signals is possible. The leaked document does not provide any proof of China's capabilities, or indeed the United States' current advancement in this field.

All we can say is that our understanding of atmospheric physics and wave propagation in the upper atmosphere is likely to increase rapidly as this becomes more and more important.

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