

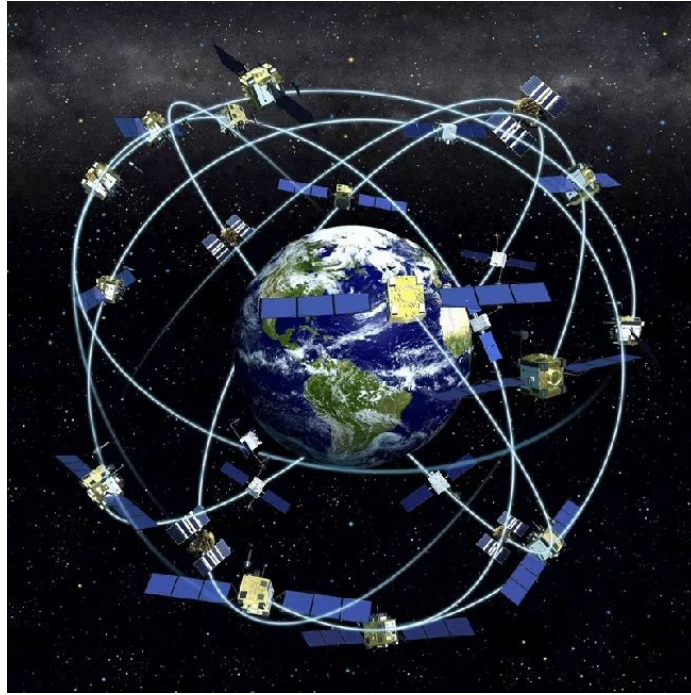
GPS Jamming

Context:

Russia is jamming GPS satellite signals in
Ukraine, US Space Force says

<https://www.space.com/russia-jamming-gps-signals-ukraine>

GPS Jamming



The orbits of GPS satellites are inclined to the Earth's equator by about 55 degrees. The system is designed to ensure that at least four satellites are visible at least 15 degrees above the horizon at any given time anywhere in the world.

GPS Jamming

Image Credit:

http://celebrating200years.noaa.gov/transformations/gps/Figure_1.html

Navstar: GPS Satellite Network

<https://www.space.com/19794-navstar.html>

GPS Jamming



GPS Jamming

GPS services appear to be under threat in Ukraine.
(Image credit: Lockheed Martin and U.S. Space Force)

Russia is jamming GPS satellite signals in Ukraine, US Space Force says

“Ukraine may not be able to use GPS,” a Space Force official told NBC.

GPS Jamming

<https://www.space.com/russia-jamming-gps-signals-ukraine>

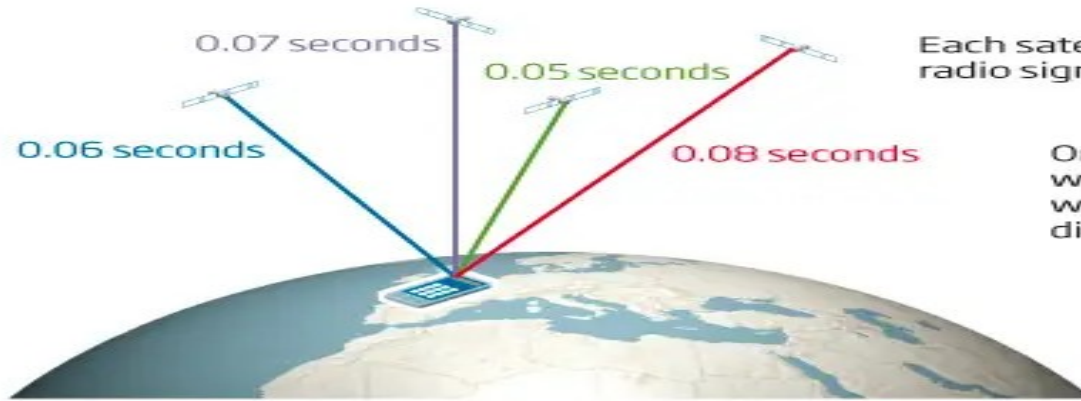
Putin is holding GPS hostage – Here's how to get it back

<https://www.c4isrnet.com/opinion/2022/04/12/putin-is-holding-gps-hostage-heres-how-to-get-it-back/>

GPS Jamming

How GPS works

©NewScientist

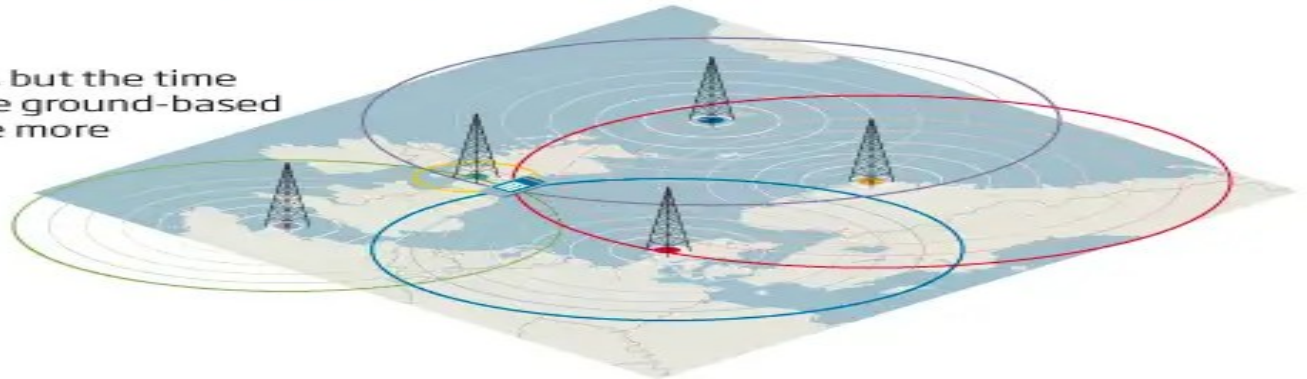


Each satellite is continually sending out weak radio signals with its position and the exact time

On Earth, a receiver will compare the time when the signal was sent with the time it was received. This is used to calculate distance from the satellite

After correcting for errors, the receiver uses the signals from four or more satellites to calculate its position in 3D. This is called trilateration

eLORAN uses a similar principle, but the time signal is broadcast from multiple ground-based stations. These radio signals are more powerful and harder to jam



GPS Jamming

GPS chaos: How a \$30 box can jam your life

<https://www.newscientist.com/article/dn20202-gps-chaos-how-a-30-box-can-jam-your-life/>

It was just after midday in San Diego, California, when the disruption started. In the tower at the airport, air-traffic controllers peered at their monitors only to find that their system for tracking incoming planes was malfunctioning. At the Naval Medical Center, emergency pagers used for summoning doctors stopped working. Chaos threatened in the busy harbour, too, after the traffic-management system used for guiding boats failed. On the streets, people reaching for their cellphones found they had no signal and bank customers trying to withdraw cash from local ATMs were refused. Problems persisted for another 2 hours.

GPS Jamming

It took three days to find an explanation for this mysterious event in January 2007. Two navy ships in the San Diego harbor had been conducting a training exercise. To test procedures when communications were lost, technicians jammed radio signals. Unwittingly, they also blocked radio signals from GPS satellites across a swathe of the city.

GPS Jamming

“The problem is that the GPS signal is very weak. It’s like a car headlight 20,000 kilometers away,” says consultant David Last, former president of the UK’s Royal Institute of Navigation. You can’t boost the signal any further because of the limited power supply on a satellite.

GPS Jamming

In November 2010, a NASA-appointed executive committee for “space-based positioning, navigation and timing” warned that jamming devices could cause disaster if activated in cities. It is not known how many are out there, but the panel is concerned that the risk of interference is growing fast. And in future, devices called “spoofers” – which subtly trick GPS receivers into giving false readings – may make the problem even worse (see “Faking it”).

GPS Jamming

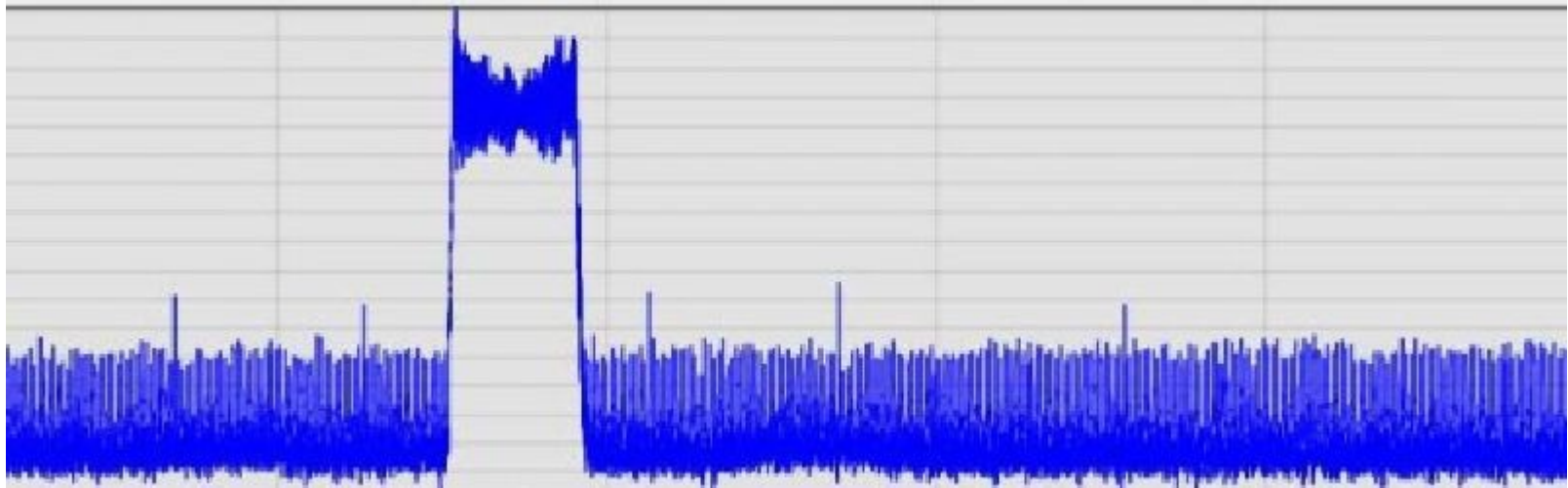
TEARDOWN: MINI GPS JAMMER



GPS Jamming

<https://hackaday.com/2020/09/08/teardown-mini-gps-jammer/>

A TEARDOWN OF SOMETHING YOU SHOULD NOT OWN



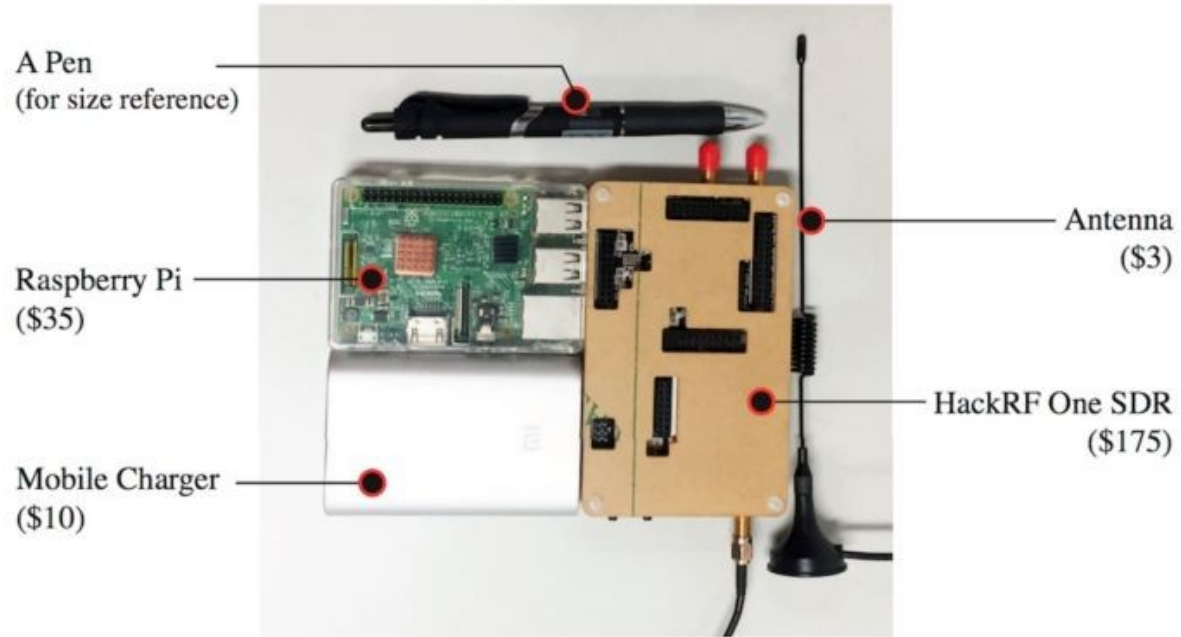
GPS Jamming

A \$225 GPS spoofer can send sat-nav-guided vehicles into oncoming traffic *

* Some restrictions apply.

<https://arstechnica.com/information-technology/2018/07/a-225-gps-spoofers-can-send-autonomous-vehicles-into-oncoming-traffic/>

GPS Jamming



GPS Jamming

<https://greatscottgadgets.com/hackrf/one/>

SDR = Software Defined Radio

Faking it

<https://www.newscientist.com/article/dn20202-gps-chaos-how-a-30-box-can-jam-your-life/#:~:text=manager%20Stephanie%20Tomkins.-,Faking%20it,-Todd%20Humphreys%20can>

GPS Jamming

Todd Humphreys can trick you into thinking you are somewhere else. He uses a “spoofers” device that causes a GPS receiver to give an inaccurate reading.

Humphrey’s GPS spoofers looks like a wireless internet router. It picks up genuine GPS signals and synchronizes its output to resemble them. Any nearby receiver will treat this output as a genuine signal from a GPS satellite. The spoofers then gradually alters its time output, changing from the true value by, say, 3 nanoseconds per second. Since GPS receivers use the time signature in a signal to find location or as an easily accessible clock, the error builds up.

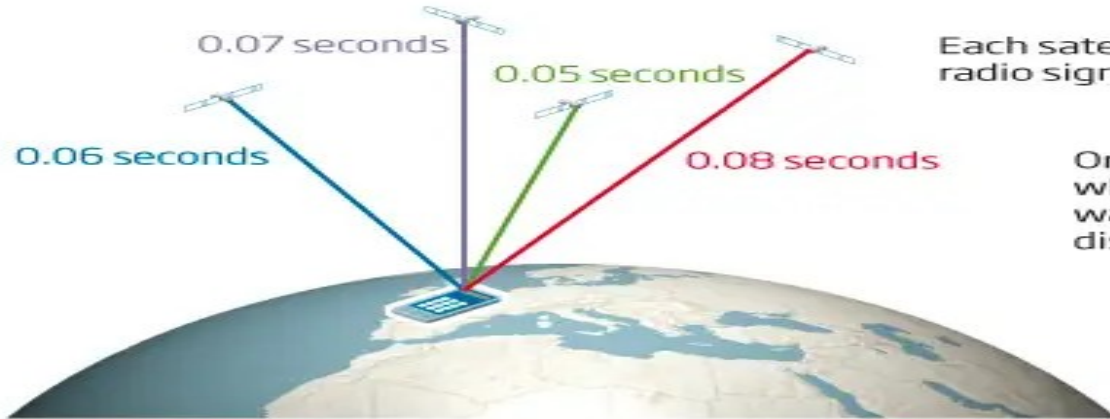
GPS Jamming

A GPS signal already has to be corrected for Relativistic Effects, and spoofing simply inserts an additional “correction” to mislead the detector. This could then make a missile for example, turn back toward a city on your own side of the front lines in a war.

GPS Jamming

How GPS works

©NewScientist

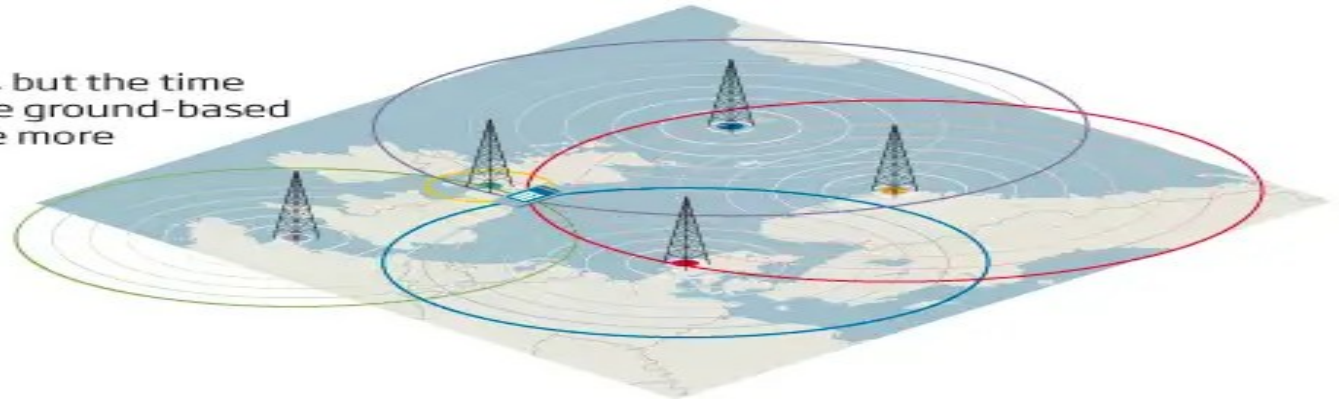


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GPS Jamming

Innovation: Enhanced Loran

<https://www.gpsworld.com/innovation-enhanced-loran/>

A ground-based backup solution for GPS jamming. Amazingly, the US until recently, saw this as redundancy and would not fund it. No ground-based backup system for NAVSTAR exists today

GPS Jamming

Now the US Defense Advanced Research Projects Agency (DARPA) is testing the idea of using radio pulses from lightning instead. These natural atmospheric radio sources – or “sferics” – have a very low frequency, so can penetrate deep underground and even underwater. The military is interested because it would improve navigation in caves and tunnels or for submarines.

(S-BUG.)

GPS Jamming

5 Common GPS Jammer / GPS Blocker Myths

<https://blog.route4me.com/5-common-gps-jammer-blocker-myths/>

Why GPS jamming is not harmless. Drivers who do this are endangering everyone on and off the highway.

GPS Jamming

GPS Jamming is also used by truck and other drivers, to prevent tracking of their activities while on the job. This is illegal and dangerous. See above reference for reasons this is a really bad idea.

GPS Jamming

WARNING: The use of any jammer is illegal in the United States and most other countries. It is a felony to manufacture, possess or use these devices.

Which is why most of these units are manufactured in China. (Remember, China has a ground-based backup for their GPS system.)

GPS Jamming

Russia excels at cyber and electronic warfare. Its experts have boasted their abilities could “make aircraft carriers useless.” Russian forces regularly jam GPS and other satellite signals in various parts of the world. They also have perfected “spoofing,” a technique which sends false signals to make GPS users think they are someplace they are not.

GPS Jamming

Unlike Russia, China, and some other countries, the U.S. does not have a terrestrial system to fall back on when essential timing and navigation signals from space are not available.

We had such a system, but instead of security and resiliency, bureaucrats saw unneeded duplication with GPS and it was shutdown. And notwithstanding promises in 2008 and 2015 to establish a land-based backup for GPS, and a 2018 law requiring one to be in operation by the end of 2020, nothing has been done.

GPS Jamming

The law seeking a GPS backup

A few years back, the National Timing Resilience and Security Act directed the transportation secretary to establish a land-based timing system that could serve as a backup for GPS within two years. That deadline came and went in late 2020, but in January of this year [2021] the Transportation Department reported to Congress on the "roadmap to implementation" it's been following toward that goal.

GPS Jamming

<https://www.cnet.com/science/gps-at-risk-those-signals-are-more-vulnerable-than-you-realize/>

This CNet Report goes into significant details about ground-based alternatives and backups for GPS, including at least one which could be on every cell phone in just a few years. Ukraine was already mentioned as a place where GPS from satellites had been jammed. This was 2019-2021.

GPS Jamming

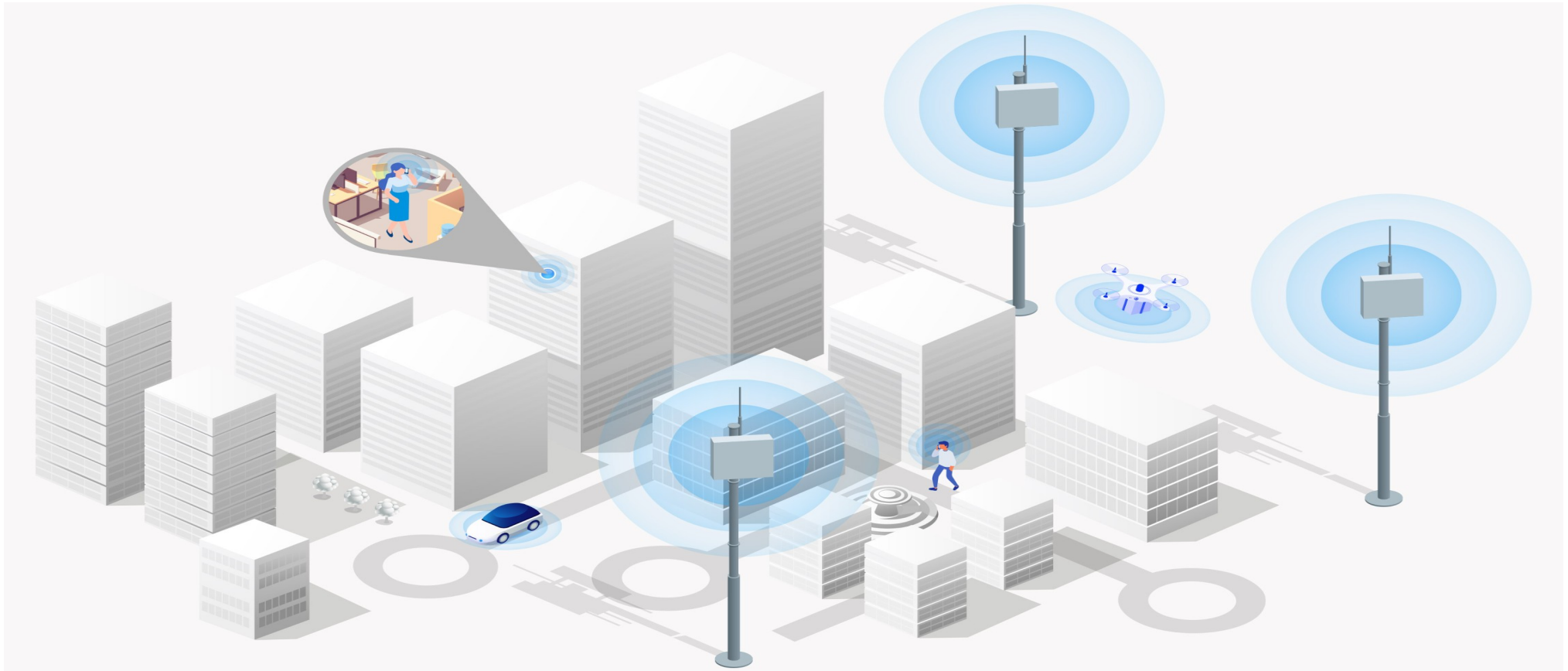
One urban focused backup:

NextNav TerraPoint

<https://nextnav.com/terrapoint/>

5G cell service makes this type of option more attractive. 5G coverage isn't complete right now, but when it gets farther along, the 5G towers and antennas will make a pretty good mesh from which ground-based location calculations can be made. Shorter 5G wavelengths may make such a network more precise than was possible with 4G and 3G cell technologies.

GPS Jamming



GPS Jamming

By the way, cell phones can be used phone to phone (as can routers) to create ad-hoc mesh networks in emergencies or war zones. Also very resilient to jamming.

6 Apps To Chat And Text With No Internet Connection Via Mesh Network

<https://www.geckoandfly.com/22562/chat-without-internet-connection-mesh-network/>

goTenna

<https://gotenna.com/>

GPS Jamming



<https://techcrunch.com/2019/06/18/gotenna-is-ramping-up-public-sector-mesh-networking-with-a-24m-c-round/>

GPS Jamming

Starlink: Elon Musk

Elon Musk's Starlink is keeping Ukrainians online when traditional Internet fails

Musk sent terminals for the satellite Internet service after a Ukrainian official tweeted at him

<https://www.washingtonpost.com/technology/2022/03/19/elon-musk-ukraine-starlink/>

GPS Jamming

So there are alternatives. And on the military side, I'm sure there's a lot more we aren't being told about.

Discussion

GPS Jamming

Slide Show Compiled by Bob Primak

For Lexington Computers and Technology
Group (LCTG)

Wed., April 20, 2022

(I apologize for any missing references.)