Our Invisible Data Highway Is a Congested Mess

The U.S. government is opening up prime spectrum for commercial use, but where does that leave the government?

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By Eric Tegler Jan 30, 2017

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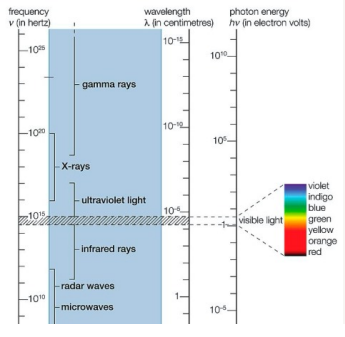
America's infrastructure—its highways, bridges, airports—has been in some state of degradation for decades. But there is another "highway" few people talk about that's vital to our way of life. You likely use it every single day, but you've never even seen it.

We're talking about spectrum, the information superhighway that carries voice, video, and data to our smartphones and televisions. It's a part of the electromagnetic spectrum (hence the name) once dominated by radio communication and broadcast users. Now certain spectrum bands have been overwhelmed by billions of new wireless devices over the past decade, and they need more room to breathe.

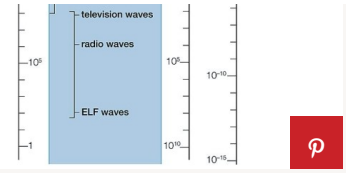
This increased demand, spurred on by the rise of the smartphone, is why President Obama issued an executive order in 2013 directing federal agencies to make 500 MHz of spectrum available for both mobile and fixed wireless commercial broadband within a decade. But as the federal government makes moves to create the bedrock of our high-speed 5G future, it comes with one serious side effect: It's intruding on the military's wavelengths. The result is a spectrum migration that could take upwards of a decade to complete.

WHY HERTZ MATTER

A big portion of this newly freed-up spectrum will come from UHF bands. UHF is the sweet spot where the short, high frequency waves that offer bandwidth wireless devices need are combined with the ability to travel relatively long distances and penetrate walls and buildings. It's the spectrum coveted by mobile carriers, often referred to as "beachfront spectrum," that could one day become the cornerstone for the nation's future high-speed 5G network, according to former FCC chairman Tom Wheeler.



That's great news for companies like AT&T and Verizon that have ponied up tens of billions of dollars for spectrum. But the U.S. military also uses that same range for radars, unmanned aircraft systems, telemetry, meteorological satellites, computed tomography, and classified systems.



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The continued sale of spectrum is forcing the military to move to different frequencies—or else share existing bands with commercial users. This electronic mass migration will begin this February and go on for as long as a decade. The cost of this whole operation will be more than $3 billion. The Feds have also set aside $500 million for research and development to ease the transition.

In most cases, government and military users will have to move to higher frequencies. While these frequencies theoretically provide plenty of bandwidth, their shorter radio waves don't travel as far and often get blocked by buildings or other structures. To make up the difference, higher frequencies require using different waveforms and more power.

CHANGING TIMES, CHANGING FREQUENCIES

Moving military equipment up a few gigahertz isn't nearly as simple as it sounds. Take flight testing, for example, which uses extensive telemetry to test airplanes, UAVs, and even artillery rounds. Erik Perrins, professor of electrical engineering and computer science at the University of Kansas, leads a research team cooperating with the Air Force Research Laboratory to move the flight test community up the spectrum to 5 GHz.

Perrins says we could imagine using a wireless transmitter from which you need to send 40 megabytes of data every single second—about 10 YouTube videos streaming simultaneously—over a distance of 100 miles. The transmitter can't be bigger than a pack of chewing gum. All the while, it's traveling Mach 2 at 30,000 feet.

IMAGINE USING A WIRELESS TRANSMITTER FROM WHICH YOU NEED TO SEND 40 MEGABYTES OF DATA EVERY SINGLE SECOND—ABOUT 10 YOUTUBE VIDEOS STREAMING SIMULTANEOUSLY—OVER A DISTANCE OF 100 MILES.

"These guys need high power signals in miniaturized transmitters," Perrins says. "The inefficiency (waste heat) makes it difficult to miniaturize things without them being melted. This is a major disruption to the way they've historically been doing things."

The team thinks they can get around the power/range problem using a different signal amplification technique called Amplitude Phase-Shift Keying. But there is a risk of interference with other bands Perrins admits, potentially disrupting communications or data on nearby frequencies.

A SPECTRUM OF POSSIBILITIES

Flight testing is only a small portion of the people who will be affected by this spectrum shuffle. Satellite operators and UAV managers will be affected as will the data they provide along with secure mobile communications. But the Department of Defense's chief information officer, Terry Halvorsen, told *Popular Mechanics* that there is a silver lining.

"There are new risks we'll work through, but the move also makes it harder for [adversaries] trying to gather intel," he says. "They have to take all the investment they made [in intelligence collection] in the current spectrum and move it up to the new spectrum." So as the government invests in this gigahertz move, so too must its opponents.

The FCC expects that most of the military and other government services will make the

transition within five years. However, some groups will need 10 years, and others like air combat training telemetry and high-powered satellite uplink users, will just share spectrum rather than move to a new spectrum band. So far, the FCC has turned over 245 MHz of spectrum to commercial users. Future auctions will turn over the remaining spectrum in years to come, essentially adding new lanes to the information super highway—a few megahertz at a time.

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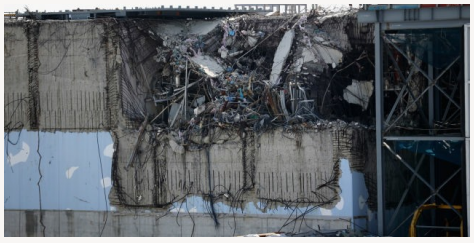

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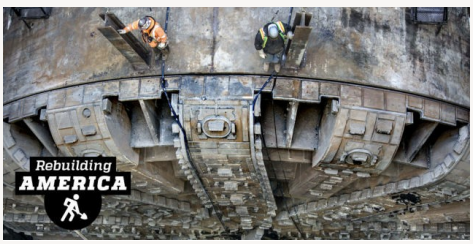

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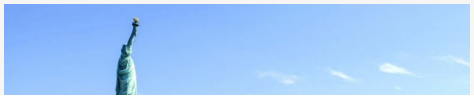

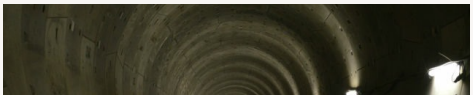

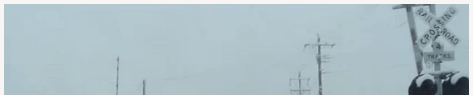

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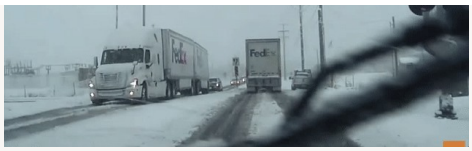

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