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# Why GPS-dependent apps deplete your smartphone battery /

Hint: it's not all GPS's fault

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Photo by Amelia Holowaty Krales / The Verge

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## The past, present, and future of the lithium-ion battery

Have you ever turned on location services and noticed your smartphone battery drain in a matter of minutes? People have come up with theories of why that's happening: maybe you forgot to quit an app that keeps tracking your location, or your phone's too busy searching for connections to cell towers and satellites. But which is it? Why *do* smartphone batteries drain so much faster when it's using GPS?

Here's what's really happening when you turn on location services. First, your GPS receiver — a small chip and antennae located inside your smartphone — is always listening to cell towers, which give it a rough estimate of where you are at all times. Without cellular data or Wi-Fi, the GPS receiver guesses your location. “Without Wi-Fi... you just would not be able to download maps to view your position, so you would see a blue dot in the middle of nowhere,” Columbia Engineering associate professor of electrical engineering Harish Krishnaswamy says in an email interview. Think of it as turning on your map when you're in airplane mode. Maybe your phone can guess what state or city you're in, but not the exact neighborhood.

Once you activate location services, that's when your phone starts to listen for satellites — yep, the ones placed into orbit on what's called a GPS constellation. While the GPS chip in your phone isn't able to send signals out, it is constantly receiving signals in order to triangulate your exact positioning.

## Walmart has a dreaded metal roof

With GPS turned on, your phone can't enter sleep mode. The GPS chip is constantly listening for satellites, and if you head underground or are in a place that blocks the signal, like under a metal roof or a Costco, the phone will go into random search mode.

“If you go inside a Walmart [which has] metal roofs, the phone will go into high consumption if location services are turned on,” says Robert W. McGwier, research professor of electrical and computer engineering at Virginia Tech. “It dials through all the different satellites looking for a signal.”

If you're in a poor signal area and your location services are on, that can drain your smartphone battery far more than if you're in an area with strong signal. Similarly, you can imagine that if you're traveling fast through a bullet train or in a car, your signal weakens and battery gets drained faster, partly due to the metal roof and partly due to how many nearby satellites your GPS receiver searches through.

## **If you have GPS on and a strong signal, you lose 13 percent of battery compared to 38 percent if the signal is weak**

A 2016 study by computer engineering professors in the UK and Saudi Arabia found that under a good signal strength, a battery depletes 13 percent while a weak signal could cause the battery to drop up to 38 percent. (The professors used older devices like the Samsung Galaxy Note 3 and the Sony Xperia Z2 for their experiments, but it's safe to say the concept still holds true.)

Is there a way smartphones could protect their GPS chips from overusing the battery? A lot of this has to do with GPS technology being old. The Global Positioning System was fully launched in 1995 by the US military and, despite advancements to technology, it still moves pretty slowly. It takes about 12 to 30 seconds for your phone's GPS to receive a transmission from a satellite, but if it needs to receive signals from all nearby satellites, it could take up to 12 minutes, according to numbers stated by Google software engineer Robert Love that were independently verified by *The Verge*.

"The issue is that the rate of data transmission to and from the satellite is very slow compared to fiber optics," Virginia Tech associate professor of chemistry Louis Madsen says in a phone interview, "They're as fast as they can be, but still not as fast as anything cable-based."

## **A combination of factors lead to a missing chunk of**

## battery

While GPS may be to blame for fast battery depletion, it's more likely that when you're using a GPS-dependent app, a combination of high-power activities is happening. Typically when you're getting directions from a map app, your screen is on. That's why apps like Google Maps or Apple Maps are capable of significantly depleting your battery, since they require the GPS chip, phone display, and cellular data to be on for downloading maps and traffic information. Similarly, if you're constantly looking at your Uber or Lyft app and watching your driver move along a map to your pickup location, your phone is doing multiple things at once to drain power.

Still, there are plenty of ways to manage your battery and optimize your settings, including killing off background apps and adjusting your screen's brightness when appropriate. "Both Apple and Android are massively incentivized to get this right," says McGwier, "Every month, both of them update their software and every single time, a major portion is dedicated to improving the battery management." At its latest developer conference, for example, Google announced an "Adaptive Battery" mode for Android 9 Pie that automatically shuts down background apps you're not using to reduce overall CPU usage.

So contrary to common perception, GPS itself is not entirely to blame for battery drainage. And if you're someone who uses these apps often and likes to have your phone screen brightness turned up high, there are several quick fixes to help your phone last through the day.



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