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IMPROVING YOUR GPS

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Have you ever wondered why your GPS works great when it is out in the open but isn't as accurate when it is near trees, buildings, or bridges? While the answer can be quite complex, one simple solution is to ensure you are tracking as many satellites as possible.

Satellite navigation systems need to track a minimum number of satellites, (typically 4 to 6), to work properly, and generally, their accuracy continues to improve as more satellites are added. For precision performance, they also need a clear line of sight between the antenna and the satellites, meaning objects like trees, buildings, and bridges can all block the incoming satellite signals. While there is a limited number of GPS satellites to track, there are many other navigation satellites you can likely use as well.

Let us look at what GPS is: it is a satellite navigation system operated by the United States Space Force, comprised of approximately 30 satellites orbiting the Earth, providing global positioning coverage.

So, what else is there besides GPS? There are three other global systems currently in operation.

GLONASS. Launched at a similar time as GPS, the Russian-operated GLONASS constellation includes 24 satellites which provide a slightly higher number of satellites visible at mid and high latitudes, compared to places near the equator.

Galileo. The European Union operates the Galileo constellation. Once fully deployed it will include 30 satellites and, like GPS, it will provide relatively even coverage globally.

BeiDou. The Chinese-operated BeiDou system has been launched in phases. While a few of the phase 2 satellites continue to be operational, the phase 3 system is based on 2 main types of satellites. BeiDou phase 3 uses 27 satellites that provide well-balanced global coverage, and another 8 satellites which remain over the Eastern hemisphere, or more specifically at the

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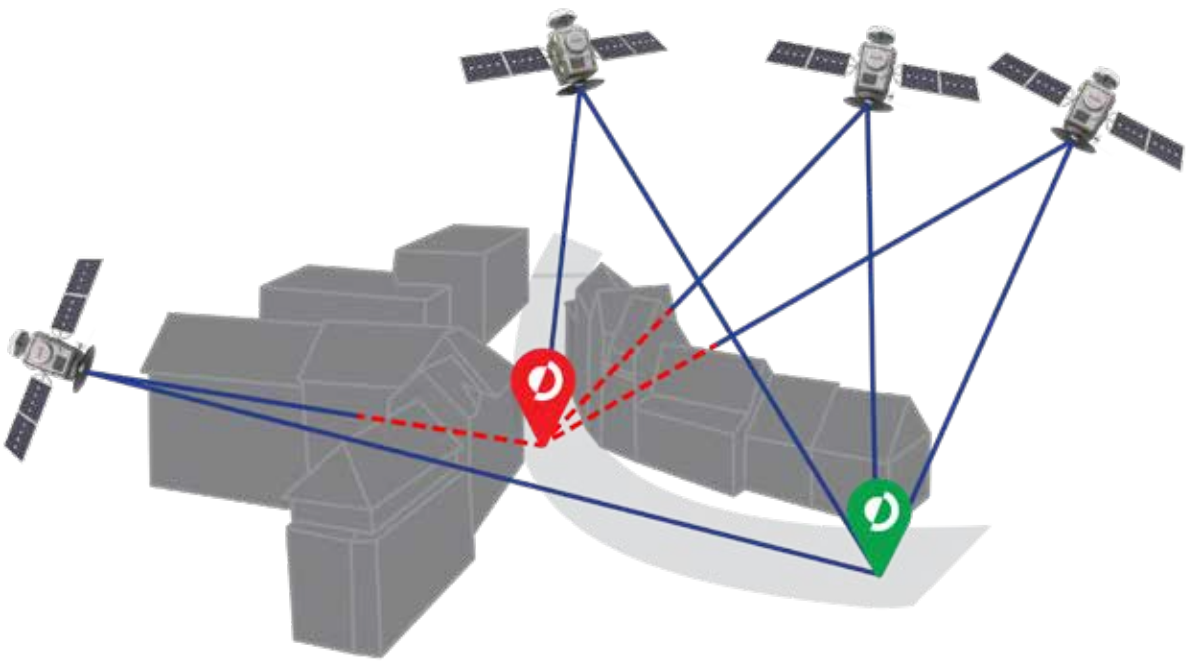
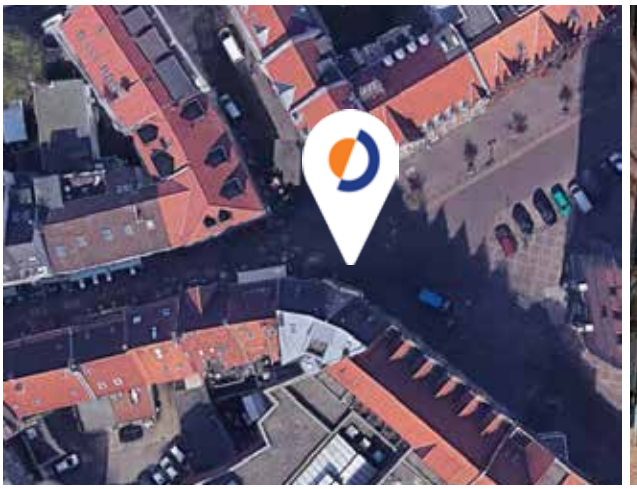
longitudes which provide coverage over China. In this way, BeiDou has both a global and a regional component.

Are there other regional systems? Referred to as RNSS, for Regional Navigation Satellite Systems, there are two other systems in operation today. Japan's QZSS consists of 4 satellites orbiting over Japan and Australia, which may expand to include 3 more satellites in similar orbits. As well, India's NavIC (IRNSS) constellation includes 8 satellites providing coverage over India.

Clearly, there are many compatible satellites in orbit and many GNSS receivers are ready to take advantage of them. According to the European Global Navigation Satellite Systems Agency (GSA), between 2016 and 2020 there was a significant shift from single and dual-constellation receivers to true multi-GNSS receivers tracking all four GNSS constellations. In 2016, true multi-GNSS precision receivers accounted for only 30% of the products offered. By 2020 the number had grown to over 70%. Hemisphere's Phantom and Vega series receivers fall into this category, tracking all four GNSS in their default configuration.

If you are flying in a plane or out in a wide-open field, a place where you have nothing obstructing the sky overhead – you can see from horizon to horizon, you are in an ideal place for using satellite navigation. Because there is nothing in the way to disrupt satellite signals you will be able to see the maximum number possible. In places like this, you will see between 9 and 15 GPS satellites.





As you move into more congested areas and start to be surrounded by buildings, trees, tall vehicles, and rising landscapes, an increasing amount of the sky will be blocked, and your receiver will see a decreasing number of GPS satellites.

When objects in our environment block satellite signals, we call them "obstructions." In some applications, there are often very few obstructions, and users can track many satellites all the time. For other applications, obstructions are always part of the environment.

Let's look at an example.

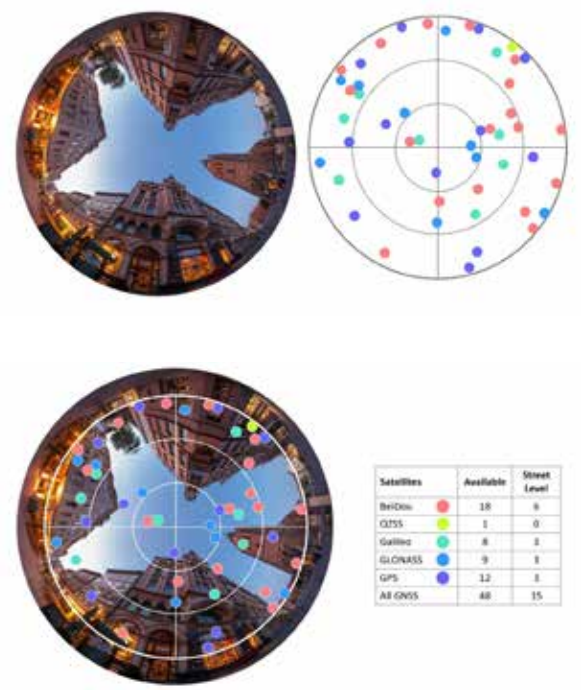
The two images above show an intersection in Hannover, Germany, from above, and from street level.

To visualize which satellites are available, we use GNSS mission planning software on the internet.

One useful item from the software is a sky-plot. It is like using a fish-eye lens on a camera and looking straight up. Around the edge, we can see the horizon, and in the middle is directly above where we are standing.

If you can imagine overlaying the sky-plot onto the fish-eye photo, you understand how the sky-plot works.

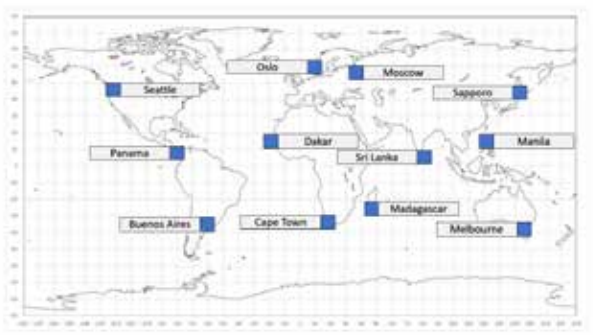
The table shows two sets of numbers. The first set is the number of satellites available. You could track all of these if there were no obstructions – perhaps for an airplane or drone flying over the intersection. The second set shows the number visible down at street level.



Satellites	Available	Street Level
BeiDou	18	9
QZSS	1	0
Galileo	8	1
GLONASS	9	1
GPS	12	1
All GNSS	48	15

Another way to use GNSS mission planning software is to look at the total number of satellites available over a given time. The plot below shows what it would look like over the entire day for Hannover with no obstructions

The following plots show the average number of satellites visible for several different cities around the world. Notice the increased number of satellites available in Eastern hemisphere cities.



The evidence is clear. Using GPS alone there are enough satellites to work when there are few obstructions. However, as buildings, trees, bridges, vehicles, and landscape begin limiting how much sky is visible, using all the available GNSS constellations extends your productivity. To prepare your mission for success, ensure the receivers you are using are multi-GNSS capable.

The good news is it may be quite easy to track more than GPS. Just check the receiver you have now and see if it is multi-GNSS capable. Hemisphere's precision GNSS receivers have been multi-GNSS capable for many years.

Are you using Hemisphere receivers in your products? Contact Hemisphere today to find out how easy it can be to switch to multi-GNSS technology.

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