

# New Scientist

WEEKLY February 15–21, 2020

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Satellite navigation

# Global positioning

A geopolitical battle is being played out in orbit as countries vie for the best navigation satellites. **David Hambling** reports

SATELLITE navigation systems are integral to everyday life, an invisible utility that underpins not just how we get around, but also our power supplies and communications. While the world once shared the US Global Positioning System (GPS), rival satellites are now becoming fully operational, and a political battle is under way in orbit.

“Reliable position and timing are strategically important resources,” says John Pottle, director of the Royal Institute of Navigation in London. “Having control over them is important in the same way as having secure energy supplies or access to medicines.”

The first GPS satellite was launched in 1978, but the full array of 24 required for continuous global coverage didn't go live until 1993. It was originally intended as a military system, and still broadcasts encrypted signals exclusively for military users as well as the signals civilians use.

Now it is getting an upgrade. Last month, the US Air Force declared that the first of its Block III satellites is operational. Ten of these, costing a total of \$4 billion, will replace satellites reaching the end of their service life and add new capabilities.

## Pinpoint accuracy

The new satellites are claimed to give three times the accuracy of the previous version, providing a position to within roughly 1 metre. It will also broadcast its encrypted signal through a directional antenna that can focus on a spot a few hundred kilometres across to aid military operations and resist enemy attempts to jam the signal in the immediate area.

The upgrade isn't just about staying ahead of the competition.



## Next-generation GPS satellites have an antenna for military use

“It's both a space race and a cooperative enterprise,” says Dana Goward at the Resilient Navigation and Timing Foundation in the US.

Block III are the first GPS satellites to broadcast a signal known as L1C, an international frequency already in use by the European Galileo and China's BeiDou satellite systems. Using this signal creates a super-constellation with more satellites than any of the individual systems.

This should improve satellite navigation for urban users, who often have signals blocked by tall buildings. While in theory you only need the signal from four satellites to pinpoint your location, more is better.

It makes sense to cooperate. In recent years, China has overtaken the US and Europe in navigation satellite launches (see graph, right), and its BeiDou system is scheduled to become fully operational this June.

“It's a prestige project, like going to the moon,” says Goward. “As a country, China feels it can and should have its own capability. But it's also one of these engineering projects where you get lots of spin-off benefits in terms of education and learning.”

Like GPS, BeiDou broadcasts encrypted military-only signals alongside its openly accessible

**£3-5bn**

**Estimated cost for the UK to build a post-Brexit satellite navigation system**

signals. A report in the *South China Morning Post* last year claimed that it can be used by submerged submarines, which isn't possible with GPS. To do this, China could be using a longer-wavelength signal to penetrate water.

It is also a major consumer tool. The Chinese government encourages manufacturers to incorporate BeiDou, rather than GPS, into all Chinese-made equipment. Some 5 million vehicles have BeiDou navigation, and 70 per cent of new phones in China are fitted with BeiDou. Hundreds of thousands of rental bikes in Beijing have BeiDou “to compel users to park bicycles in designated areas”, according to Chinese newspaper *Global Times*.

There are concerns that BeiDou equipment might present a security risk to other countries.

A 2017 report by the US-China Economic and Security Review Commission, a US government body, raises the possibility of BeiDou satellites transmitting malware, although it goes on to say it isn't clear how this would happen. “Critical infrastructure in a non-Chinese territory would not want to rely on Chinese technology, as the debate about Huawei shows,” says Charles Curry at UK navigation consultancy Chronos.

The desire for a system free from potential outside influences also explains the European Union's decision to build the Galileo constellation, which will become fully operational in 2020. It is the only navigation system under civilian control, but has a military encrypted signal accessible only to member governments.

“This signal is harder to jam and, because it's encrypted, much more difficult to spoof,” says Pottle. “It gives a more

assured positioning capability for government agencies and emergency services.”

With the UK having now left the EU, the country no longer has access to this encrypted signal, despite having contributed £1.2 billion to the development

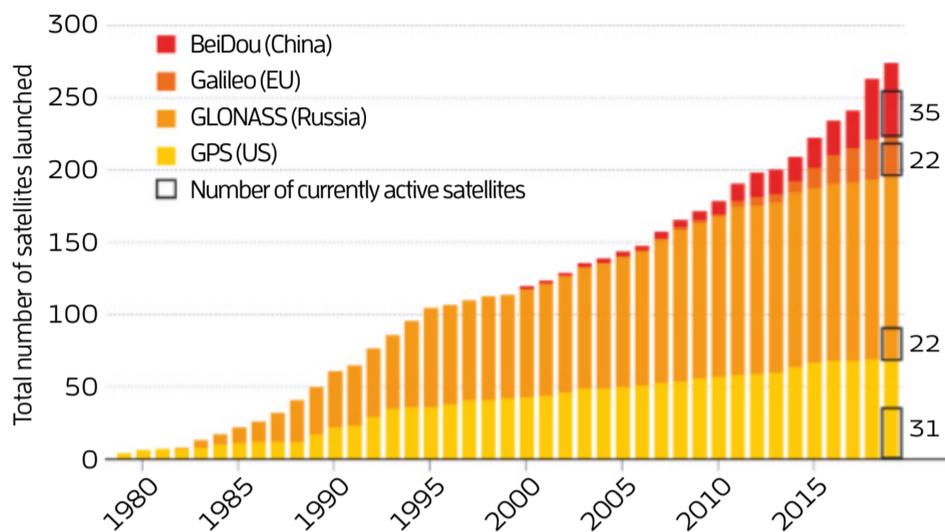
**“Reliable position is a strategically important resource, the same as energy or medicine”**

of Galileo. Curry says this makes sense from an EU national security perspective, but the decision angered the UK government.

In May 2018, it announced plans to look at the options for a UK satellite navigation system. A £92 million feasibility study has been carried out, while one estimate suggests that a system would cost £3 to 5 billion.

“Assessing what a UK system could look like, and how it would

China and the EU have joined other heavyweights in launching competing satellite navigation systems



SOURCE: WIKIPEDIA.ORG

meet the country’s needs, is the purpose of the current phase of work. The potential specifications, cost and schedule will depend on the outcome of this work,” says a UK Space Agency spokesperson.

Curry is in no doubt that the project will go ahead in some form, citing the vastly more

expensive HS2 rail project as a sign that the UK government is willing to spend on infrastructure when there are perceived benefits.

Meanwhile, Russia is beefing up its GLONASS system. Like GPS, it was started in the cold war period with military backing, but it was only completed in 2011. GLONASS satellites have a shorter design lifetime than the other systems (between seven and 10 years rather than 15), so despite the large number of launches there tend to be fewer available for use. At least 24 need to be operational to provide global coverage, but Russia currently has only 22 active.

Recently, Russia has shown a new determination to keep GLONASS competitive. In January, ISS-Reshetnev Company, the chief contractor for GLONASS, announced it had received orders for 27 more satellites up to 2025, and that the rate of launches was set to double in the coming year.

“There are some signs they are upgrading the technology in their new satellites, and planning to join in on L1C,” says Pottle. This would see all four satnav providers forming one super-system for civilian users – a happy ending for everyone. ■

## Help from the skies

Navigation satellites do much more than just tell you where you are. For example, in order for power stations to feed electricity into the national grid without interference, their output must be synchronised to a particular frequency – most countries use either 50 or 60 Hz. Time signals from GPS provide a universal clock, allowing the stations to sync up.

Some satellites have other uses as well. China’s BeiDou system provides an integrated text messaging service, which is currently used by 70,000 fishing boats, both for practical purposes and so fishers can send texts to families and friends.

The system could be used

worldwide to provide messaging in areas outside the range of cellphone reception, because it has a massive capacity, although smartphones would need specialised receivers to be able to use it.

The European Union’s Galileo satellite system also provides an emergency search-and-rescue service to boats equipped with the right hardware, which is claimed to save 2000 lives a year. In January, a new return-link system became operational. This sends a confirmation to the person making a distress call that the alert has been received. The calls are routed to local authorities for action within half an hour.

## Working hypothesis

Sorting the week’s supernovae from the absolute zeros



### ▲ Christina Koch

The astronaut has returned from 328 days on the International Space Station – the longest time spent in space by a woman.

### ▲ Fastest flight

A flight from New York to London lasted just 4 hours and 56 minutes thanks to tailwinds linked to Storm Ciara. It was the fastest subsonic flight ever between the cities.

### ▲ Viking games

A piece of blue and white glass found on the island of Lindisfarne, UK, is thought to be a piece from a Viking board game.

### ▼ Face recognition

As millions of people in China wear face masks to stave off coronavirus, people are finding that the masks disrupt face recognition technology.

### ▼ Heat records

Antarctica’s hottest ever temperature, 18.3°C, has been logged on the Antarctic Peninsula, one of the fastest-warming regions on Earth.



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