

Galileo joins fast-growing satnav market

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Initially designed for the US military, satellite geolocation systems today power countless civilian applications, from car satnavs to browsing for shopping on mobile phones.

The European system Galileo, [which became operational on Thursday](#), is the latest entrant in a sector where activities worth hundreds of billions of dollars are the prize:

GLOBAL POSITIONING SYSTEM (GPS)

The United States' historic lead in [satellite](#) navigation traces its origins to 1978, with the launch of a test satellite by the US Air Force called Navstar. A constellation of 24 satellites became fully operational for military use in 1993, and was opened for civilian use in 1998.

Continually upgraded, GPS has 31 operational satellites plus three or five decommissioned satellites that can be reactivated if needed. GPS [accuracy](#) ranges from 30 metres (yards) to under eight metres.

GLONASS

Also available for military and civilian use, GLONASS is a Russian system whose name is an acronym for Global Navigation Satellite System. The first satellite was first launched in 1982 and the system was declared operational in 1996. It deteriorated in the late 1990s, prompting President Vladimir Putin to make its restoration a priority, and was declared fully operational once more in 2011. It comprises 27 satellites, of which 23 are currently operational, providing global coverage with an

accuracy of three to five metres. GLONASS is compatible with GPS.

GALILEO

The European Union's rival to GPS survived a 17-year saga of political attacks, budget squabbles and technical setbacks to become operational on Thursday. Eighteen satellites are in place so far, so coverage will be patchy until the system becomes fully operational in 2020. The programme will eventually have 30 satellites, offering a claimed accuracy of a metre (3.25 feet)—for paying subscribers accuracy will be measured in centimetres (inches)—and accessibility inside traffic tunnels and on roads where high buildings block GPS signals. Galileo is compatible with both GLONASS and GPS, but unlike these systems is civilian-run and not at risk of being turned off by military operators, the EU says.

BEIDOU

Chinese system meaning Ursa Major, the star constellation also known as the Plough or the Big Dipper. The first satellite was launched in 2007; there are currently 20 today, providing coverage for the Asia-Pacific region, where it is notably used in China, Laos, Pakistan and Thailand. Thirty satellites are due to be deployed in all, with global coverage scheduled to begin in 2020. Beidou offers accuracy of 10 metres, for military and civilian use.

IRNSS

The Indian Regional Navigation Satellite System (IRNSS) is a planned constellation of seven satellites, offering 20 metre accuracy for India and 1,500 kilometres around the Indian mainland. Service will be civilian-run, free to all, and compatible with other systems, according to the

Indian Space Research Organisation (ISRO), which says the system will become fully operational shortly, but declines to set a date.

MICHIBIKI

Satnav system covering Japan being deployed by the Japan Aerospace Exploration Agency (JAXA). The first satellite was launched in September 2010, three more will be launched in the fiscal year 2017 (from April 2017 to April 2018), enabling services to start in the 2018 fiscal year. Three satellites may be added in 2023. Michibiki is intended for civilian use free of charge, with a claimed positioning accuracy of just one metre—or even centimetres—which is important in a country where mountainous terrain and high buildings may interfere with GPS signals. It is GPS-compatible. The name means "guide" or "guidance" in Japanese.

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