

A Hundred-plus Signals

By 2020, four GNSS constellations will be fully operational: in addition to the US GPS, complete and fully operational since July 1995, these are the Russian Glonass, European Galileo and Chinese Beidou (Compass). Glonass was completed in 1997, but lacking economic impetus jeopardised continuation and by April 2002 only eight satellites were active. Twenty-four satellites, required for world coverage, would be orbiting today had the launch of three completing Glonass-M satellites succeeded on 5th December 2010. However, the launch rocket splashed down in the Pacific and rehabilitation is due in July 2011. By the end of 2011 Glonass will be augmented with another four satellites, so by the end of this year two GNSS systems will in all probability be fully operational.

Galileo became tangible reality on 28th December 2005 with the launch of Giove A, put into orbit primarily to secure future access to provisionally allocated radio frequencies. On 27th April 2008 Giove B joined Giove A, securing access to additional radio frequencies and checking the in-orbit working of the passive hydrogen maser and rubidium clock. Operational Galileo satellites will carry two atomic clocks, to maximise reliability. By 2015 eighteen Galileo satellites will be in orbit, and the fully operational constellation will consist of thirty satellites, three of which are spares.

Chinese Beidou 2 (Compass) builds on Beidou 1, completed December 2000 and consisting of two satellites. Positioning by two satellites is possible as Beidou 1 derives an estimate of the height coordinate from a digital elevation model and eliminates time bias by dual-way broadcast. Since 2001 China's army and others have thus had access to an operational domestic satellite positioning system. Since April 2007 China has been working on phased extension of Beidou into a full GNSS system called Compass. As of April 2011 eight satellites are in orbit, and by 2012 the constellation will include fourteen, fully serving the Asia-Pacific region. By 2020 Compass will be filled up with a total of 35 satellites covering the entire globe: 27 satellites in medium orbit, three in inclined geo-synchronous orbit, and five orbiting in geostationary mode for backward compatibility with Beidou 1. Compass will serve both civilian and Chinese government/military. The free service for civilians will be lower (10-m) accuracy than that available for licensed users.

By 2020, at least a hundred GNSS signals will thus be receivable at any position on earth. The four systems are sometimes seen as competitors. However, manufacturers are keen to develop GNSS receivers capable of utilising all four types of signal, enabling reliable and accurate positioning anywhere, including urban canyons, under canopy and even indoors.