Five Satellites in Geostationary Orbit

China's Beidou Navigation Project

Beidou is the Chinese name of the constellation known in English as the Big Dipper or the Great Bear. It is also the name of an independent satellite navigation system, a project of the People's Republic of China. China has announced that the system will be fully operational by 2008 and will offer open service with an accuracy of 10 meters. Three satellites have already been launched.

By Job van Haaften

The launching of a CZ-3A that is used for getting the Beidou satellites in orbit.

Geostationary Orbit

Unlike the GPS, Glonass, and Galileo systems which use satellites that orbit the earth, Beidou uses satellites in geostationary orbit. This means the system does not require a large constellation of satellites. It also limits the coverage to areas on earth where the satellites are visible. The system now covers the region bounded by longitude 70 to 140 degrees and latitude 5 to 55 degrees.

The Beidou 1A satellite was launched on October 30, 2000, Beidou 1B followed on December 20, 2000 and Beidou 2A was put into orbit on May 24, 2003. These three were designed as experimental satellites. China has yet to build the remaining satellites that will make Beidou an operational global-positioning utility. The complete system will contain 35 satellites, including 5 geostationary orbit satellites and 30 medium earth orbit satellites. The first two satellites in the next phase will be launched in early 2007. In the next few years China plans to continue experimentation and system setup operations.

This system will ultimately offer complete coverage of the globe. There will be two levels of service: free service for those in China and licensed service for the military. The free service will have a 10 meter location-tracking accuracy, will synchronize clocks with an accuracy of 50 nanoseconds, and will measure velocity within 0.2 meter per second. This service, however, will be of little interest to consumers who can already achieve better accuracy with unaided GPS receivers. The licensed service, more accurate than the free service, can be used for communication and will supply information about system status to the users.

Important Economic Role

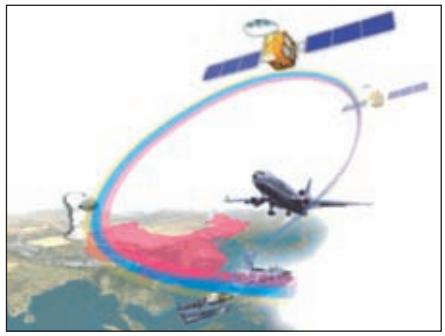
The China-made system provides positional information for highway, railway and marine transportation. The three satellites have formed a complete satellite navigation and positioning system which will help to ensure all-weather navigation and positioning information. The Beidou system will play an important role in economic matters, not only for regional transportation, but also for meteorology, geology, forest fire prevention, disaster forecasting, telecommunications and public security. With accurate longitude, latitude and altitude data, it will help subscribers know their location any place, any time. It also serves as a radio beacon in outer space.

Many details of the Beidou system remain unknown, but it appears to have some analogy to WAAS (Wide Area Augmentation System). WAAS, implemented in the United States to supplement GPS, is a network of precisely surveyed ground reference stations that receive GPS signals, determine if errors exist and compute corrections. These corrections are then transmitted from a geostationary communication satellite on the same frequency as GPS.

The Beidou Program

Beidou is being developed by the Chinese Academy of Space Technology. The Academy has 12 research institutes and one manufacturing facility, and has developed and launched satellites since 1970. Beidou's primary mission is a military one. There has been little information so far on possible civilian use.

Beidou began in 1983 with a proposal by Chen Fangyun to develop a Twinsat regional navigation system using two geostationary satellites. The concept was proven in a test using two in-orbit DFH-2/2A communication satellites. The test showed that the precision of the Twinsat system would be comparable to the American GPS. In 1993, the Beidou program started officially. The program used the DFH-3 bus and displayed a similar basic performance. The final Beidou constellation will consist of five geosynchronous satellites: three operational and two backups.



The China-made system provides positional information for highway, railway and marine transportation. Source: www.globalsecurity.org

The central control system sends inquiry signals to the users via two satellites. Source: www.globalsecurity.org

One of the satellites in the Beidou system. Source: www.geocities.com

Dual-way Transmissions

The ground systems include the central control station, ground correction stations and user terminals (receivers and transmitters). The central control system sends inquiry signals to the users via two satellites. When the user terminal receives the signal from one satellite, it sends responding signals back to both satellites. The central station receives the responding signals sent by the user from two satellites, and calculates the user's 2D position based on the time difference between the two signals. This position is then compared with the digital territorial map stored in the database to get the 3D position data, which is sent back to the user via satellites using encrypted communications. The user can also transmit encrypted text messages, up to 120 Chinese characters, to the central station via the satellites. Because the Beidou system requires dual-way transmissions between the user and the central control station, its user segment needs extra space for the transmitter and its battery. Therefore the Beidou system's user segments are much bigger, heavier and more expensive than GPS user receivers. Additionally, the number of users that can be served by the system is limited by the communication capacity of the network.

Rivals

It is not clear how the Chinese system will rival the American global positioning satellite system or the EU's Galileo satellite navigational system which is built with Chinese participation. The Beidou system is expected to cover China and parts of neighboring countries by 2008, before being expanded into a global network of satellites. This expansion is called Beidou-2 or Compass by some sources. Expansion of Beidou functionality could undermine the Galileo business case. The expansion of Beidou underlines the difficulties in building international consensus on global navigation systems. European, Japanese, Russian and U.S. administrations have gone to considerable lengths to make their systems compatible. China and India seem to be going down quite separate paths. India announced plans to build an independent system that will use S-band. This will make it incompatible with the GNSS. They have also threatened to withdraw from Galileo. It is reported that China proposes to overlay the M-code, which would effectively prevent the US military from jamming Beidou transmissions without jamming its forces' own signals.

The last published information on the Beidou system is in the Aerospace White Paper for the year 2006, a publication in Chinese from October 12.

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