



Intercontinental Geoinformation Days

igd.mersin.edu.tr



The current state of use of satellite-based positioning systems in Turkey

Nuri Erdem ^{*1}, Abdulsamet Demirel ¹

¹Osmaniye Korkut Ata University, Faculty of Engineering, Department of Geomatics Engineering, Osmaniye, Turkey

Keywords

Satellite Based Geolocation,
Satellite Signal,
Signal Receiver

ABSTRACT

Nowadays, the cartography sector has also been affected by the rapid developments in the field of technology. Recently, satellite-based positioning systems have been used instead of the classic land measurements made with total station and engineer's level. In this study, the general structure of satellite-based global and regional positioning systems is examined. The general usage densities of the system in the public and private sectors in Turkey and the status of the signals that can be received and the average sales prices of devices on the market have been investigated. The results were presented in the form of tables and graphs, and it was found that the most ideal device for our country is the device called Kolida K58 Pus, which can work with systems such as GPS/GLONASS/SBAS/GALILEO/QZSS/BEIDOU and receive signals from many satellites of these systems.

1. Introduction

Mankind has always wanted to improve itself in the field of communication from the very beginning of its existence. It has used a different communication method in each cycle by producing new communication systems. After a while, satellites were sent to space and satellite-based communications began. Today, satellites are widely used both for communication and for providing location data. In this study, the number of satellites seen by devices using the data of satellite-based positioning systems and the variety of signals it can receive from these satellites are presented as tables and graphs. Then, with the help of the relevant tables and graphs, recommendations were made about which brand and model could be the most suitable GNSS buyer for our country.

2. Structure and components of satellite-based positioning systems

The GPS system, first developed in the early 1940s for military requirements, was developed during World War II. It is based on similar ground-based radio-navigation systems used during World War II, such as LORAN (LORAN - Long Range Navigation) and the Decca Navigator, which later became a solution for that period. The first use of GPS was intended for use in military plans and for the control of guided rockets. The GPS system was opened for civilian use only in the 1980s [1, 2]. GLONASS operated by the Russian Aerospace Defense

Forces, both civilian and military-service space-based satellite navigation system. Although the development of GLONASS is somewhat delayed, it has parallels with GPS [3]. GALILEO's satellite team, a positioning system with global coverage, consists of a total of 30 mid-orbit (MEO) satellites, including 24 main and 6 backup ones. The GALILEO satellite team was originally planned to consist of 27 active and 3 reserve satellites in order to meet the Life Safety (SOL) service requirements [4]. BeiDou means "Big Bear Team Star" in Chinese. The Big Bear is considered to be the most important star team that allows people to find direction in the northern hemisphere. Although this name was naturally chosen when China decided to create its own satellite-based navigation system, the COMPASS name was used as the English name of the system for many years [5]. GPS-intensive, Japan, in dense urban areas and resolve their own problems encountered during the use of GNSS satellite-based positioning capability to create Quasi-Zenith Satellite System (QZSS) is called to establish a regional positioning system continues to work. QZSS satellites can also act as additional GPS satellites and work in an integrated way with GPS. The system, the first satellite of which was launched in 2010, is expected to reach full operational capability in 2018 [6]. The NavIC satellite suite consists of 7 satellites. 3 of the satellites are in an earth-stationary orbit, and 4 are in an oblique earth-synchronous orbit. When designing the satellite set in question, attention was paid to minimizing the sensitivity loss (DOP value), maximizing the number of satellites visible over the targeted area, and using the fewest

* Corresponding Author

^{*}(nurierdem@osmaniye.edu.tr) ORCID ID 0000-0002-1850-4616
(demirel.6699@gmail.com) ORCID ID 0000-0003-0435-3404

Cite this study

Erdem N & Demirel A (2021). The Current State of Use of Satellite-Based Positioning Systems in Turkey. 3rd Intercontinental Geoinformation Days (IGD), 46-49, Mersin, Turkey

possible satellites. All of the satellites in the NavIC satellite suite are constantly visible from the Indian region [7].

3. Experimental method

The current use status of satellite-based position systems in our country, public and private sector users

have been contacted by phone, website and mail to determine which of their respective devices have seen how many satellite systems and which signals they have received. The obtained results are given in Table 1.

Table 1. Current status of satellite-based position sites in Turkey

Companies	Devices	Used Satellite Systems	Monitored Signals
Kaya Harita	E-Survey E600	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1 ,L1P,L1C,L2P,L2C,L5 / G1,G2,P1,P2 / B1,B2,B3 / E1BC , E5A,E5B /L1,L2C,L5,L1C / L1 ,L5 /WAAS, EGNOS,MSAS,GAGAN
Paksoy Teknik M	Topcon Hiper Hr	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6 / L5 /WAAS, EGNOS, MSAS, GAGAN
Sistem A.Ş.	Leica Viva Gs16	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6/L5 / WAAS, EGNOS, MSAS, GAGAN
Sistem A.Ş.	Leica GS18 T	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6 / L5 /WAAS,EGNOS, MSAS,GAGAN
Baytekin Müh.	Sanding Aquila T66 Pro	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6 / L5 /WAAS,EGNOS, MSAS, GAGAN
Geomatik Hizmetler	Geomax Zenith 40	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1,L2,L2C,L5 /L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,altboc,E6/L1,L2C,L5,L6/L5/EGNOS,WAAS,MSAS,GAGAN
Sistem A.Ş.	Leica GS07	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1,L2,L2C,L5/L1,L2,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2,L5,LEX / L5 /WAAS,EGNOS, MSAS, GAGAN
Geomatics Group	Spectra Geospatial S	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC /SBAS	L1 C/A, L1P,L2C,L2P,L5 / L1 C/A,L1P,L2 C/A,L2P,L3 /B1,B2 /E1,E5a,E5b/ L1 C/A,L1C,L2C,L5 / L5 / L1 C/A,L5
Geoteknik Müh.	Kolida K58 Pus	GPS /GLONASS /SBAS /GALİLEO /QZSS /BEİDOU	L1C/A, L1C, L2C, L2E, L2P, L5 /L1C/A, L1P, L2C/A, L2P, L3 / L1 C/A, L5 /GIOVE-A ve GIOVE-B, E1 , E5A, E5B, E5AltBOC, E6 /L1C/A. SAIF, L1C, L2C, L5, LEX /B1,B2,B3
Kaya Harita Müh.	E-Survey E300 PRO	GPS/GLONASS/BeiDou/Galileo/SBAS/QZSS	L1 C/A, L1P, L1C, L2P, L2C, L5 /G1, G2,G3 / B1L,B2L,B3L,B1C,B2A,B2B,ACEBOC /E5A, E5B, E5AltBOC, E6 /L1,L5 /L1 C/A,L1C,L2C,L5,LEX
Sistem A.Ş.	Leica GS18 I	GPS/GLONASS/BeiDou/Galileo/QZSS/SBAS	L1,L2,L2C,L5/L1,L2,L2C,L3/E1,E5a,E5b,AltBOC,E6/B11,B1C,B21,B2a,B31/L1,L2C,L5,L6/WAAS,EGNOS,MSAS,GAGAN L-bant
Geoteknik Müh.	Kolida K1 PRO	GPS /GLONASS /QZSS /GALİLEO /SBAS /BEİDOU	L1C/A, L1C, L2C, L2E, L5 / L1C/A, L1P, L2C/A, L2P, L3 /L1 C/A, L5 /GIOVE-A ve GIOVE-B, E1, E5A, E5B, E5AltBOC, E6 /WAAS, MSAS, EGNOS, GAGAN /B1, B2,B3
Paksoy Teknik	Topcon MR-2	GPS /GLONASS /BeiDou /Galileo /SBAS /QZSS	L1 C/A, L1C,L1P,L2P,L2C,L5 / L1 C/A, L1P,L2 C/A,L2P,L3C / E1,E5a,E5b,AltBOC /B1,B2 /WAAS, MSAS, EGNOS/L1 C/A,L1C,L2C,L5C
Eksen Teknik	Foif A90	GPS / GLONASS/ BEİDOU / GALİLEO /SBAS/QZSS	L1 C/A, L1P , L1C ,L2P , L2C ,L5 / G1,G2,P1,P2 / B1,B2,B3 / E1BC, E5a,E5b,E5AltBOC ,E6 /L1,L5 / L1 C/A, L2C, L5,L1C
Geoteknik Müh.	South Galaxy G1	GPS /GLONASS /SBAS /GALİLEO /QZSS /BEİDOU	L1C/A, L1C, L2C, L2E, L5 /L1C/A, L1P, L2C/A, L2P, L3 / L1 C/A, L5 /GIOVE-A ve GIOVE-B, E1 , E5A, E5B, E6altBOC /L1C/A, L1C, L2C, L5 /B1,B2,B3
Satlab Geosolut	Satlab SLC	GPS /GLONASS /SBAS / BeiDou /GALİLEO /QZSS	L1 C/A, L1C,L2P,L5 /L1,L2 / WAAS,EGNOS,MSAS,GAGAN/B1,B2/E1,E5a,E5b,AltBOC/L1,L2C,L5,L6
Geomatics Group	Spectra SP60	GPS /GLONASS /BeiDou /GALİLEO /QZSS /SBAS	L1 C/A, L1P,L2C,L2P,L5 / L1 C/A,L1P,L2 C/A,L2P,L3 /B1,B2 /E1,E5a,E5b/ L1 C/A,L1C,L2C,L5 / L1 C/A,L5
Baytekin Müh.	Sanding T28	GPS /GLONASS /Galileo / BeiDou /SBAS /QZSS	L1 C/A, L1C,L2C,L2E,L5 / L1 C/A, L1P , L2 C/A, L2P,L3 / GIOVE-A , GIOVE-B,E1, E5A ,E5B / L1 C/A, L5 / WAAS,EGNOS,MSAS,GAGAN/L1,L2C,L5,L6
Doğa Elektro.	Stonex S700A	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC	L1,L2,L2C,L5/L1,L2,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2,L5,LEX / L5
Doğa Elektro.	Stonex S850a	GPS /GLONASS /BeiDou /Galileo /QZSS /NAVIC	L1,L2,L2C,L5/L1,L2,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2,L5,LEX / L5
Ifa Grup Müh.	Sokkia GCX3	GPS/GLONASS /BeiDou /Galileo /SBAS /QZSS	L1 C/A , L1C,L2P,L2C / L1 C/A , L1P , L2 , L2P / B1,B2 /E1 / L1 ,WAAS,MSAS,EGNOS,GAGAN / L1 C/A ,L1C,L2C
Gnss Teknik	Chcnav İ73 İmu Mini	GPS /GLONASS /SBAS / BeiDou /GALİLEO /QZSS	L1,L2,L5/ L1,L2 /L1 / B1,B2,B3 / E1, E5a,E5b / L1,L2,L5
Baytekin Müh.	Sanding T66	GPS/GLONASS/BEİDOU/Galileo/SBAS	L1 C/A ,L1 , L1C ,L2,L2C,L2E,L5 / L1, L1 C/A ,L1P ,L2, L2 C/A ,L2P ,L3 / B1,B2,B3 / GIOVE-A,GIOVE-B,E1,E2-L1, E5A,E5B,E6-ALTBOC/WAAS,MSAS
Geoteknik Müh.	South Galaxy G1 P	GPS/GLONASS/SBAS/GALİLEO/SBAS	L1C/A, L1C, L2C, L2E, L5 / L1C/A, L1P, L2C/A, L2P, L3 / L1 , L5 / GIOVE-A ve GIOVE-B, E1, E5A, E5B, E5AltBOC, E6 / WAAS, MSAS, EGNOS, GAGAN
Baytekin Müh.	Gintec G9	GPS/GLONASS/BeiDou/GALİLEO /SBAS	L1 ,L2E,L2C,L5/ L1 C/A,L1P,L2 ,L2P / B1,B2/ L1 BOC,E5A,E5B,E5 ALTBOC1 /L2 CBOC,E5A,E5B,E5 ALTBOC1 / WAAS,EGNOS,MSAS,GAGAN
Baytekin Müh.	Pentax G6Tİ	GPS/GLONASS/BeiDou/Galileo/SBAS	L1 ,L2E,L2C,L5 / L1 C/A,L2 , L3 CDMA / B1,B2 / E1,E5A,E5B,E5 ALTBOC / L1 C/A, L1 SAIF,L2C,L5 / L1 C/A, L5

Sistem A.Ş.	Leica Viva GS18T	GPS/GLONASS/BeiDou/Galileo/QZSS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6
Doğa Elektronik.	Stonex S900	GPS/GLONASS/BeiDou/Galileo/QZSS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6
Doğa Elektronik.	Stonex S980	GPS/GLONASS/BeiDou/Galileo/QZSS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6
Doğa Elektronik.	Stonex S990	GPS/GLONASS/BeiDou/Galileo/QZSS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6
Kordil Müh.	Hemispre S321	GPS/GLONASS/GALILEO/BeiDou/QZSS	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6/L1,L2C,L5,L6
Baytekin Müh.	Gintec G10	GPS/GLONASS/BeiDou/Galileo/SBAS	L1 C/A, L1C,L2C,L2E,L5/ L1 C/A, L1P,L2 C/A,L2P,L3 / B1 ,B2, optimal B3/ E1,E5a,E5b/WAAS,EGNOS,MSAS,GAGAN
Baytekin Müh.	Pen tax G6Nİ	GPS/GLONASS/BeiDou/Galileo/SBAS	L1 C/A,L1C,L2C,L2P,L5/ L1 C/A,L2C,L2P,L3,L5/B1,B2,B3/ E1,E5 ALTBOC,E5a,E5b,E6/L1 C/A,L1C,L2C,L5,L6/L1,L5
Sistem A.Ş.	Leica Viva Gs14	GPS/GLONASS/BeiDou/Galileo/SBAS	L1,L2,L2C/L1,L2/B1,B2/E1,E5b/WAAS,EGNOS,MSAS,GAGAN
Sistem A.Ş.	Leica Viva Gs14	GPS/GLONASS/BeiDou/Galileo/SBAS	L1,L2,L2C/L1,L2/B1,B2/E1,E5b/WAAS,EGNOS,MSAS,GAGAN
Graftek Müh.	Trimble SPS855	GPS/GLONASS/SBAS/GALILEO/BeiDou	L1 ,L2,L2C,L5 /L1, L2 /L1 C/A, L5 / E1,E5a,E5B /B1,B2
Graftek Müh.	Trimble TDC150	GPS/GLONASS/SBAS/GALILEO/BeiDou	L1 C/A,L1P,L2P,L2C /L1 C/A,L2 C/A, / L1 C/A /E1,E5B /B1,B2
Graftek Müh.	Trimble R1	GPS/GLONASS/SBAS/GALILEO/BeiDou	L1 / G1 / 4 Kanal/E1/ L1
Doğa Elektronik.	Stonex S500	GPS/GLONASS/BeiDou/Galileo	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6
Doğa Elektr.	Stonex S70G	GPS/GLONASS/BeiDou/Galileo	L1,L2,L2C,L5/L1,L2,L2C,L3/B1,B2,B3/E1,E5a,E5b,AltBOC,E6
Graftek Müh.	Trimble SPS555	GPS/GLONASS/GALILEO/BeiDou	L1 C/A ,L2C,L2E,L5 /L1 , L2 C/A,L1 ,L2P /L1 CBOC,E5A,E5B, E5 ALTBOC /B1,B2
Gnss Teknik	Chcnav i50	GPS/GLONASS/ BeiDou /GALILEO	L1 C/A ,L2C,L2E,L5 / L1 C/A, L1P, L2 C/A ,L2P,L3 /B1,B2 / E1,E5A,E5B
Adastek Müh.	Comnav G200	GPS/GLONASS/BeiDou/SBAS	L1 C/A,L2C,L2P /L1 C/A, L1P,L2 C/A, L2P / B1,B2/WAAS,EGNOS,MSAS,GAGAN
Adastek Müh.	Comnav T300	GPS/GLONASS/BeiDou/SBAS	L1 C/A, L1C,L2P,L5 /L1,L2/B1,B2,B3/WAAS,EGNOS,MSAS,GAGAN
GNSS Teknik	Chcnav i90 İmu	GPS/GLONASS/GALILEO/BeiDou	L1,L2,L5 /L1,L2 / E1,E5a,E5b /B1,B2,B3
Geomatics Group	Spectra Precision SP	GPS/GLONASS/ BeiDou /GALILEO	L1,L2 /L1,L2/ B1,B2 /E1,E5b
Geo Teknik	Dji Matrice 300 Rtk	GPS/BeiDou/GLONASS/Galileo	L1,L2 /B1,B2 /L1,L2 / E1,E5a
Gnss Tekn	Phantom 4	GPS/BeiDou/GLONASS/Galileo	L1,L2 /B1,B2 /L1,L2 / E1,E5a
Paksoy Teknik	Topcon Hiper Sr	GPS/GLONASS/QZSS	L1,L2,L2C/L1,L2,L2C/L1,L2C
Leo Müh.	Nv08c-Csm	GPS/GLONASS/GALILEO	L1 C/A ,L1C, L2C,L2E,L5 / L1 C/A , L2 C/A ,L2P/E1,E5 ALTBOC,E5a,E5b,E6
Geomatics Group	Spectra Precision	GPS/GLONASS/GALILEO	L1 C/A ,L1P,L2C,L2P,L5 / L1 C/A,L1P,L2 C/A,L2P,L3 /E1,E5A,E5B
Geomatics Group	Spectra Precision	GPS/GLONASS/SBAS	L1 C/A ,L1P,L2C,L2P,L5 / L1 C/A,L1P,L2 C/A,L2P,L3 / L1 C/A,L5
Geomatics Group	Spectra Precision	GPS/GLONASS/BeiDou	L1 C/A ,L1P,L2C,L2P,L5 / L1 C/A,L1P,L2 C/A,L2P,L3 /B1,B2
Ifa Grup Müh.	Sokkia GRX2	GPS/GLONASS/SBAS	L1 CA,L1 , L2 P - code ,L2C/L1,L2 CA,L2P-code/WAAS,EGNOS,MSAS,QZSS
GNSS Tekn	Chcnav Lt6	GPS/GLONASS/ BeiDou	L1 C/A ,L2C,L2E,L5 / L1 C/A ,L1P, L2 C/A ,L2P,L3 /B1,B2
Leo Müh.	Nv08c-Rtk-A	GPS/GLONASS/BeiDou	L1 C/A ,L1C, L2C,L2E,L5 / L1 C/A , L2 C/A ,L2P/B1,B2,B3
Satlab Geosolut	Satlab SL600	GPS/GLONASS/SBAS	L1 C/A, L1C,L2P,L5 /L1,L2 / WAAS,EGNOS,MSAS,GAGAN
Graftek Müh.	Trimble Geo 7x	GPS/GLONASS/SBAS	L1 C/A ,L2C,L2E / L1 C/A,L1P,L2 C/A / L1 C/A
Graftek Müh.	Trimble SPS461	GPS/SBAS	L1 C/A,L1-L2 / 4 Kanal

Using Table 1, a ranking was made from the device that sees the least satellite system and signal to the maximum and a visual graph was created (Figure 1). As a result, it has become easier to examine the device that

receives the most signals and sees the most satellite systems via the corresponding table. Accordingly, it has been seen that the most ideal device for our country is the Kolida K58 Pus device, which can work with systems

such as GPS /GLONASS /SBAS / GALILEO / QZSS / BEIDOU and receive signals from many satellites of these systems (Figure 1).



Figure 1. Number of Satellite systems and signals used (■ The number of signals it sees, ■ the number of satellites he has seen)

4. Conclusions

The importance of satellite-based position systems in terms of their application in the cartography sector has been increasing in recent years. Although each country wants to produce its own satellite system, the important thing is that these satellite systems can be used by other countries. In this study, first of all, the general characteristics of satellite systems and their ability to work throughout our country are summarized. Then, the current state of use of these satellite systems in our country was determined by contacting public and private sector users by phone, website and mail, which of their respective devices have seen how many satellite systems and which signals they have received. Then, based on this table, a ranking was made from the device that sees the least satellite system and signal to the maximum and a visual graph was created. As a result, it has become easier to examine the device that sees the most signals and sees the most satellite systems via the table. According to this;

it has been seen that the most ideal device for our country is the device called Kolida K58 Pus, which can work with systems such as GPS /GLONASS /SBAS / GALILEO /QZSS /BEIDOU and receive signals from many satellites of these systems.

References

- [1].URL-1: <https://pgm.uab.gov.tr/uploads/pages/tezler/emrecen-kuresel-ve-bolgesel-konumlama-sistemleri-teknolojileri-ve-uygulamalari.pdf>
- [2]. URL-2: <https://tr.wikipedia.org/wiki/GPS>
- [3]. URL-3: <https://tr.wikipedia.org/wiki/GLONASS>
- [4]. URL-4: <https://tr.wikipedia.org/wiki/GALILEO>
- [5]. URL-5: <https://tr.wikipedia.org/wiki/BEIDOU>
- [6]. URL-6: <https://tr.wikipedia.org/wiki/QZSS>
- [7]. URL-7: <https://tr.wikipedia.org/wiki/IRNSS>