The Development of China's Beidou Navigation Satellite System (BDS) Technology to Counter the United States' Global Positioning System (GPS)

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ABSTRACT

China successfully launched the third phase of construction in June 2020, making them the third country to independently have their own satellite in orbit after the United States and Russia. The satellite parts, which total 24 satellites, are placed in three different orbits and at the same time make them the owners of the satellites who place the satellites in the three orbits. Beidou has a system that provides higher accuracy and very precise location positioning when compared to GPS navigation satellite systems. The availability of excellent features such as short message service is the main concern in the Beidou feature. Beidou was able to make rapid progress in China's economic and military fields, making it the driving force of China's national security on the mission of becoming a great power country. The comparison is made by placing the GPS satellite system, the world's first navigation satellite which is currently dominantly used in civilian use and military use throughout the world. Beidou's presence led to the view that his presence could counteract the GPS system. With the success of Beidou, creating a new competition between the United States and China in the field of navigation satellites.

Keyword: *Beidou, GPS, Navigation, Satellite, China*

INTRODUCTION

China's Rising Power has a satellite navigation system called Beidou. Beidou is taken from the Chinese term Beidou which means the Big Dipper, the Big Dipper was used by the Chinese in ancient times to find directions. The Beidou satellite navigation system was created by China with the aim of national security and for social and economic development in China. China initially started doing research on navigation satellite systems in the early 1980s until they finally succeeded in making an initial innovation from the Beidou satellite design. In 2000, the BeiDou Navigation System was successfully created by China as well as making them the third country to have their own satellite system after the United States and Russia. China finally accelerated the framework of the satellite and navigation system and launched a satellite on October 25, 2012 by launching 16 satellites. On June 23, 2020, Beidou has launched the last satellite, namely the Geostation Satellite Earth Orbit (GEO) and has completed the satellite orbiting mission. Beidou also has a mission to be the most superior among other satellites in space. Beidou wants to make a fight against the Global Positioning System navigation system owned by the United States. GPS is the first satellite navigation system that operates in outer space. GPS satellites are in service for both military and civil society uses. GPS services for civil society are provided freely for the needs of users around the world while military GPS is used by the US military. This study aims to analyze the strength of the Beidou satellite navigation system in competing with GPS satellite navigation systems.

RESEARCH METHODS

In this study, we will use a qualitative research methodology to describe the phenomenon of the emergence of the Beidou network system against the GPS network system. Researchers also take from previous studies or previous studies that discuss the same as our journal. In our

qualitative research methodology we explore important data related to the advantages of the Beidou network system. The instruments used in this study refer to secondary data sourced from journals, official government documents and credible websites that can support our research. We collect journals relevant to research. Meanwhile, we are looking for related state documents from official government sites that are legal to access. In the process of collecting data, it is carried out through literature study sourced from previous journals. Data was collected by analyzing key points from previous journals to be re-analyzed with the current situation. In the process of data analysis we select and focus data contained in journals, documents and other empirical materials to strengthen our analysis. We present the data using an illustrated table to compare the data and present it descriptively on the table and conclude our research results.

RESULT AND DISCUSSION

1. Beidou Navigation Satellite System

The Beidou navigation system has 3 interconnected satellite parts. The first part is in GEO (Geostationary Earth Orbit) which consists of 3 satellites, the second part is in IGSO (Inclined Geosynchronous Orbit) which consists of 3 satellites and the third part is in MEO (Medium Earth Orbit) which consists of 24 satellites. The construction of the three satellite sections was last launched in June 2020 to finalize the performance of the Beidou satellite navigation system. Inside the satellite there is a room that is directly connected to the control room, synchronization room, monitoring room and direct connecting room to earth. Beidou provides global navigation services with time positioning, weather viewing systems, navigation services and time and weather positioning systems with high accuracy. The Beidou satellite has the capability to stabilize the navigation network connecting system with low capacity to high capacity. Beidou also has a global reach capability that has been enhanced and adapted to the daily needs of internet users as well as business and military needs. The

ISL (Inter Switch Link) service system as a link for the orbit satellite network to be distributed to the earth has a high-class signal space. Beidou was created by China as part of their National Interest to protect China's social and economic interests. In economic interests, Beidou has economic value for the development of smartphone technology. Smartphone users in the world at this time still tend to use the navigation system and GPS network. However, the presence of Beidou adds options for smartphone users to use the navigation system and network on their smartphones. This will have an impact on the Chinese economy because their navigation system is used by the global community via smartphones. In fact, most smartphones in China already use the Beidou navigation system. The Beidou system is considered better than the GPS system with significant technology improvements. The technology in the Beidou navigation system used on smartphones in China can improve the process of developing their smartphone archipelago industry. According to the NDRC (National Development and Reform Commission), smartphones with navigation systems and the Beidou network in 2021 will reach 324 million smartphone units with a calculation reaching 94.5%.

Beidou capabilities are not limited to the smartphone industry, other industries such as agriculture, animal husbandry, forestry, disaster prevention and transportation are also mobilized in the use of sophisticated Beidou navigation systems. As in the case of transportation, the Beidou service has software that can be connected to the main device chipset with the aim of delivering goods from land, sea and air. The Beidou Navigation System has been used on a total of 7.9 million vehicles in China according to the NDRC. Beidou also has a positive impact on improving the performance of the Chinese Military. Through the satellite system, it can facilitate navigation in military aircraft, missiles, and military submarines. Beidou has the technology to direct missiles and bombs freely without interference from other navigation systems, high accuracy has been used in missile systems. China can also position its missiles flexibly at far and near targets precisely. China can also control its commandos

through Beidou which displays the locations where soldiers are. Beidou also provides military attack mitigation services by predicting enemy attacks. The system used by Beidou sends signals from satellites to Earth without having to send signals back to satellites to trick the enemy because they are invisible. Beidou became one of China's tools to become a Great Power Country and compete with the United States. With the presence of Beidou, it allows a balance of power in terms of technological sophistication of satellite navigation systems between Beidou and GPS.

2. Global Positioning System

The United States became the first country to spark the idea of a satellite navigation system in the world at this time. With GPS, the United States has become a Great Power among other countries in the field of technology. The construction of the GPS satellite was first launched by the United States in 1978 for military purposes. The military objective is intended as a means of navigation and positioning of the United States troops from enemy threats. However, in its development until the finalization stage in April 1995, the navigation satellite can be used by civil society freely and operates globally. Even today, GPS for civilian use outweighs GPS for military use. The GPS system initially numbered 24 satellites and grew to 31 satellites until 2023. This satellite rotates around the earth once every 12 hours and functions to determine notifications of time, location, position. GPS plays an important role in explaining detailed location information and conditions on Earth through satellite signals. For those of us who don't know what an area looks like, now it can be seen directly through maps using GPS technology and helps users to see the distance and time from one place to another.

GPS also plays a role in current United States military operations in conducting precise range determination and tracking of enemies and conducting search and rescue of allies. In military transportation, GPS plays a role in navigating moving vehicles without soldiers as navigators. GPS provides uninterrupted navigation services for the smooth running of

civilian and military users. This US-owned navigation system affects US economic and military security and even the international community can feel the benefits of this technology freely. GPS makes a difference on the military side of both the United States and the world, namely it makes a military balance. With GPS, other countries cannot move freely to attack other countries using GPS navigation. The United States as a country that has a navigation system is able to stop unexpected attacks carried out by other countries through GPS navigation. If the country's condition is intended for positive things, it will have a good effect on military development. However, if it threatens world peace, the United States can be able to stop the navigation system to prevent things that are not desirable. The existence of GPS has also created rapid economic benefits both for the United States and globally. Today's daily life relies heavily on navigation systems to determine distance and time. When you are on a business trip and use a plane, the plane is assisted by GPS satellite navigation to make it easier for the plane to reach its destination.

3. Comparison of BDS and GPS Technologies and Their Implications for United States - China Relations

Technology Features	China's Beidou	United States's GPS
PNT	✓	✓
GSMC	✓	○
SAR	✓	✓
RSMC	✓	○
PPP	✓	○
SBAS	✓	○
GBAS	✓	✓
RNSS	✓	✓

Source: Self-managed by researchers with various sources

Information:

- ✓ Available
- o Unavailable

- Satellite Positioning, Navigation and Timing Service (PNT)
- Global Short Message Communication (GSMC)
- Synthetic Aperture Radar (SAR)
- Regional Specialized Meteorological Centre (RSMC)
- Precise Point Positioning (PPP)
- Satellite-based Augmentation Systems (SBAS)
- Ground-based Augmentation System (GBAS)
- Radio Navigation Satellite Service (RNSS)

The table shows that the Beidou navigation satellite system has all the new and old technology features. This technological feature can be used both in the Asia Pacific and Global regions with limited area coverage. GSMC, RSMC, PPP and SBAS features are the newest features that GPS satellite navigation systems do not have. GPS only relies on PNT, RNSS, SAR and GBAS as old features of the satellite system. It is an advantage for Beidou users to freely use features, especially in supporting daily activities which are currently not only limited to using distance and time navigation and positioning. Beidou users can now enjoy more accurate and reliable satellite system services to support activities in both the economic and military sectors.

Compared to GPS, which only has satellites in Medium Earth Orbit, it is different from Beidou, which has satellites in three orbits, namely Geostationary Earth Orbit, Inclined Geosynchronous Orbit and Medium Earth Orbit. Laying satellites in these two additional parts allows Beidou to process data transmission activities that are relatively balanced. Beidou also has an advantage in terms of accuracy compared to GPS because it can trace the network up to the Asia Pacific region as far as five meters compared to other areas which take a distance of 10 meters. In comparison, the accuracy of the data information generated by Beidou is

more precise because it can provide data within one meter. In contrast to GPS, the accuracy of the resulting data is further away because it takes a distance of three meters. Data accuracy is very important in the process of civil activities such as the use of agriculture, animal husbandry, transportation and other activities. This activity requires navigation and positioning tools that are very accurate in informing data from satellites to Earth. Another advantage that Beidou has is that it uses a two-way frequency which makes the system safer from interference from electronic devices and the robustness of the building. In contrast to GPS, which only has a one-way frequency, it is vulnerable to interference from other electronic devices and makes it difficult to penetrate solid and very deep buildings. Even though you are in a remote and uninhabited place, such as in the interior of a forest, in the mountains or in a cold arctic region, Beidou is still able to operate with the short message service feature to communicate with people in stable signal areas through the navigation system. Something that is not owned by the GPS system, even in cities sometimes the system can be disrupted due to many users or interference by other electronic devices.

The system owned by Beidou is able to overcome these problems with the short message service feature. When there is an accident such as being in a mountainous area and you need help but there is no signal or network on your smartphone to ask for help, the short message service feature can be sent to the rescue team to provide up-to-date information regarding the location of the incident. Another feature in military needs, Beidou is able to send signals and communications that are reliable in predicting enemy attacks such as withstanding jamming attacks, namely satellite destroyers that can attack military electronics. This feature is not owned by GPS because it sometimes experiences electronic interference due to jamming attacks.

The presence of Beidou with sophisticated technological features raises a strategic challenge for the United States. The challenge is that the United States must create new, more dominant features to turn things around again. Beidou is actually still in the process of introducing and

enhancing features because the limited coverage area of the satellite navigation network system can be used by the United States to make features that complement the old features used in satellite network systems. Beidou is also a challenge for the United States in the military field because with its own satellite network system, China is now free to target their rivals or enemies through their Beidou navigation. Prior to Beidou, China was very limited in carrying out military activities that required a satellite network because monitoring from the United States military would disrupt the course of military missions by China.

Great power competition between China and the United States could have occurred through competition for navigation satellites. China's mission to be top class in all respects, including the satellite system that they are currently developing, can become a new competitive arena for the two countries. Competition between the two countries in the navigation satellite system will have an impact on the economic and military development of each country. The impact of navigation satellites on a country's economy can create a large addition to national income because the output generated from the satellite system is very large. The military impact will be an unavoidable risk if the two countries go to war by demonstrating the capability of each satellite in military activities, there will be a new round of military trials that have never been wanted.

CONCLUSION

China's Beidou Satellite Navigation System is able to prove that they are capable of creating capable satellite technology even though they are a new player in the creation of satellite systems. With our research that collected a total of 8 features and some of them are excellent features that distinguish this navigation system from the United States' GPS navigation system. We value this achievement as China's success in creating new challenges for the international community, especially the United States. China has also indicated that they are really serious about becoming a great power country with capable technological development and

competing with the United States and globally. Suggestions for our research to further intensify this research for the following years when China has re-developed the Beidou satellite navigation system and suggest further research to more comprehensively discuss the real competition that will occur as a result of the Beidou navigation system.

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