Update on the BeiDou Navigation Satellite System (BDS)

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System Status
The BDS-3 space constellation, consisting of 30 satellites (24MEOs+3GEOs+3IGSOs), were successfully deployed between November 5, 2017 and June 23, 2020.

Many state of art technologies, such as more reliable atomic clocks, inter-satellite links, and new navigation signals are added.

In addition to the fundamental PNT services, new services are implemented.

BDS enters a global era.
BDS-3 Was Formally Commissioned on July 31, 2020
China Satellite Navigation Office

System Status

The BDS Operational Satellites

There are 15 operational BDS-2 satellites (5 GEOs + 7 IGSOs + 3 MEOs), with open service navigation signals B1I/B2I/B3I, using PRN from 1 to 15, at the moment.

There are 27 operational BDS-3 non-GEO satellites (24 MEOs + 3 IGSOs) providing open service for global users with signals B1C/B2a/B1I/B3I/B2b, using PRN from 19 to 61.

There are 3 BDS-3 GEO satellites providing open service for global users with signals B1I/B3I, BDSBAS-B1C/BDSBAS-B2a and B2b-PPP.

www.csno-tarc.cn
System Status
The overall BDS performance

- Realize global coverage capability, with PDOP availability (PDOP ≤6) 100%
- Horizontally positioning accuracy is about 1.5m, vertical positioning accuracy is about 2.5m (global average, B1C single frequency), velocity accuracy is about 0.05m/s and timing accuracy is 9.8ns (95%)
System Status
The BDS Signal Availability in August 2020

B1I/B3I

B1C/B2a
System Status
The BDS SISRE in August 2020
## System Status

The BDS-3 Featured Services

<table>
<thead>
<tr>
<th>Type of service</th>
<th>Signal frequency</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic navigation services</strong></td>
<td>B1I, B3I, B1C, B2a</td>
<td>3IGSO+24MEO</td>
</tr>
<tr>
<td></td>
<td>B1I, B3I</td>
<td>3GEO</td>
</tr>
<tr>
<td><strong>BDSBAS</strong></td>
<td>BDSBAS-B1C, BDSBAS-B2a</td>
<td>3GEO</td>
</tr>
<tr>
<td><strong>Short-message communication services</strong></td>
<td>L (uplink) S (downlink)</td>
<td>3GEO</td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td>L (uplink)</td>
<td>14MEO</td>
</tr>
<tr>
<td></td>
<td>B2b (downlink)</td>
<td>3IGSO+24MEO</td>
</tr>
<tr>
<td><strong>International search and rescue service</strong></td>
<td>UHF (uplink)</td>
<td>6MEO</td>
</tr>
<tr>
<td></td>
<td>B2b (downlink)</td>
<td>3IGSO+24MEO</td>
</tr>
<tr>
<td><strong>Precise Point Positioning service</strong></td>
<td>B2b</td>
<td>3GEO</td>
</tr>
</tbody>
</table>
System Status

Short-message Communication Services (Regional)

- Offered by 3 GEO satellites
- Serve China and the surrounding regions
- System capacity is increased by 10 times:
  - System processing capacity of more than 12M/hour concurrent service requests.
  - 1,000 Chinese characters per message.
  - The user uplink transmission power is reduced by 90%.
System Status

Short-message Communication Services (Global)

- 14 MEO satellites
- Global coverage
- 40 Chinese characters per message
- Service capacity of more than 300,000/hour concurrent service requests.
System Status
International Search and Rescue Services

- Follow international standards
- 6 MEO satellites with the SAR payload
- Return-link capacity is proposed to COSPAS-MEOSAR.
- In July 2020, tests were conducted with the COSPAS-SARSAT ground station in Maryland and achieved satisfactory results.
System Status
Satellite-based Augmentation Services

- 3 GEO satellites
- Follow ICAO standards
- Serve China and the surrounding regions

![Map showing satellite coverage]
**System Status**

Satellite-based Augmentation Services

- BDSBAS-B1C(1574.42MHZ) signal for the single frequency SBAS service.
- BDSBAS B2a(1176.45MHZ) signal for the DFMC SBAS service.

Both signals are being broadcast to support non-safety applications (with Message Type 0 being broadcast in every 6s or less).
China Satellite Navigation Office

System Status

Precise Point Positioning Services

- 3 GEO satellites
- Serve China and the surrounding regions
- PPP-RTK in China and surrounding regions in the future
- Global PPP broadcast by MEO satellite in the future
System Status

Precise Point Positioning Services

- Use BDS-3 B2b signal to broadcasting orbit, clock, and DCB corrections;
- Support both BDS and GPS PPP capability;
- With accuracy of better than 0.3m(95%) in dynamic testing.
- Time to convergence for PPP is less than 30min.
Application Development
Application Development

The BDS Industries

The BDS contribution to core industrial output value

2019 RMB 345 billion

2020 RMB 400+ billion
Applications Development
Fundamental products

The sales of domestically made BDS-enabled chips reached over 80 million, with the domestic high-precision board chips and antennas being sold to over 100 countries and regions, and accounting for 30% and 90% of the domestic market respectively.
The BDS-enabled products have been widely used in traffic & transportation, public security, agriculture, forestry and fishing, hydrologic monitoring, weather forecast, communications system, generation dispatch and disaster response & relief, as well as national core infrastructure, which has greatly increased economic and social benefits.
Applications Development

Applications in traffic and transportation

- The world’s largest dynamic monitoring system for operational vehicles has been built
- Nearly 7 million registered operational vehicles
- 30,000 postal and delivery vehicles
- 80,000 buses
- Over 3,200 inland waterway navigation facilities
- Over 2,900 marine navigation facilities
Applications Development

Applications in agriculture, forestry and fishing

- The BDS-based equipment have been installed on over 70,000 sets of agricultural machinery.
- Precision farming output has increased by 5%.
- Income growth of RMB 60-90 per Mu.
- Positioning & short-message communication function helps to prevent forest fires.
- Over 70,000 boats have been equipped with BDS terminals and over 10,000 people have been rescued.
Applications Development

Applications in Disaster Response and Relief

- Six levels of business applications have been implemented
- Over 45,000 BDS terminals have been deployed
- Relevant disaster response information has been reported
- The resource management and logistic control capabilities for disaster relief have been improved
- The BDS-based technologies have played important roles in fighting against COVID-19.
Applications Development
Mass Market Applications
Applications Development
Mass Market Applications
Application and Development

The International BDS Applications

- Land rights confirmation in Indonesia
- Building construction deformation monitoring in Kuwait
- Homeland surveying and mapping in Uganda
- Agriculture in Myanmar
- Marine piling in Maldives
- Construction of piling in Singapore
- Land rights confirmation in Laos
- UAVs in Cambodia
- Postal services and e-commerce in Uganda
- Timing service in Pakistan airports
- Electricity patrolling and checking in Russia
International Cooperation
Open Cooperation

Resource Sharing
International Cooperation
The UN International Committee on Global Navigation Satellite Systems (ICG)

13th Meeting of the International Committee on Global Navigation Satellite Systems
International Cooperation

The China-US Cooperation

Three plenary meetings of the China-US Cooperation have been held. Working groups have been set up to discuss related topics.

“The Joint Statement on Civil Signal Compatibility and Interoperability between GPS and BDS” was signed in November 2017.
International Cooperation

The China-Russia Cooperation
China Satellite Navigation Office

International Cooperation

The China-Arab States BDS Cooperation
International Cooperation

International standards
International Cooperation

International Conferences
China Satellite Navigation Office

International Cooperation

Conclusion

Looking back on the past decade and looking into the new journey,

• During the past decade, BDS has gone global successfully, being developed from struggling to keep up with its peers, to matching its peers.

• The BDS/GNSS based technologies have played important roles in fighting against COVID-19.

• In the next decade, BDS will play a more active role in serving mankind and the world and keep contributing wisdom and strength to the world with its stronger abilities and better-quality services.
Thank you.

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