Applications of BeiDou System in Transportation

ZHEN SONG

China Transport Telecommunications & Information Center

27th October 2021

Reporter

ZHEN SONG

CTTIC Deputy Director

ZHEN SONG, Professor, graduated in 1999 from World Maritime University with a Master of Science in Maritime Safety and Environmental Administration.

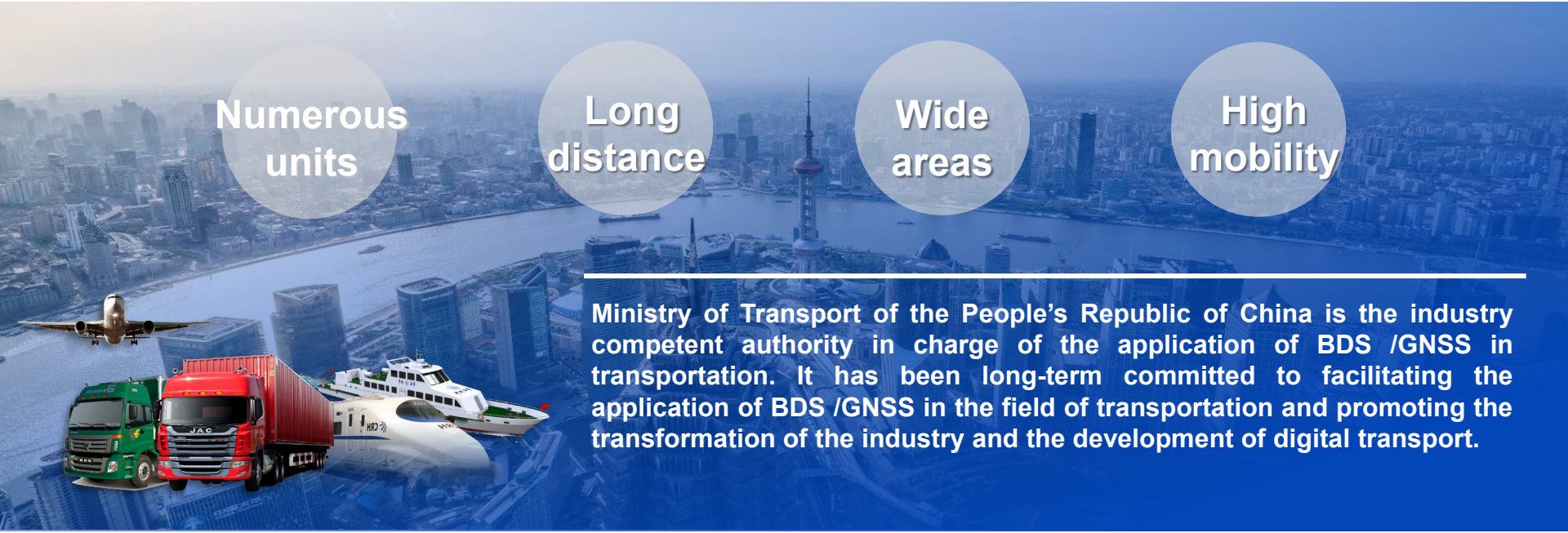
- **Deputy Director of China Transport Telecommunications & Information Center.**
- **Deputy Director of the Management Committee of BDS Application Development in Transportation.**
- **Standing Director of China Institute of Navigation.**

Content

Overview of BDS/GNSS Applications in the field of Transportation

01 Transportation is the key application field for BDS/GNSS

The essence of transportation is "purposeful spatial displacement of people and things". Transport industry, one of the biggest civilian users of the BDS/GNSS, has a huge demand for location-based services as it involves numerous units, long transportation distance, wide areas and high mobility.



Ministry of Transport of the People's Republic of China is the industry competent authority in charge of the application of BDS /GNSS in transportation. It has been long-term committed to facilitating the application of BDS /GNSS in the field of transportation and promoting the transformation of the industry and the development of digital transport.

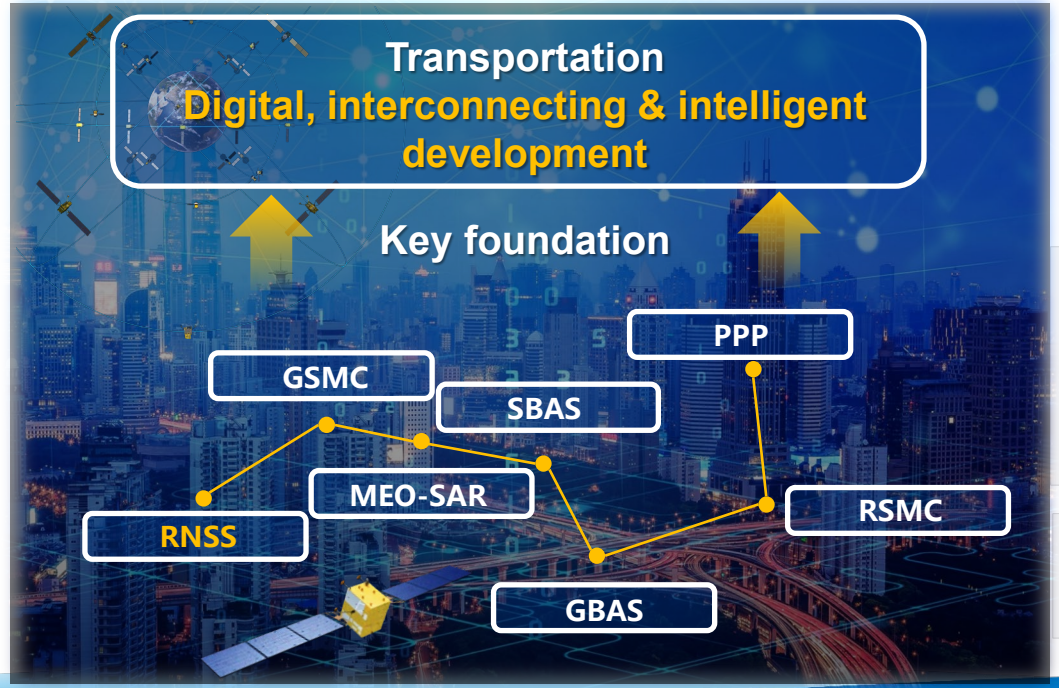
02 Demand of accuracy on satellite navigation and positioning from the transportation industry

Application field		Accuracy demand (m)
Road transportation	Refined vehicle monitoring	<1.5
	Driving assistance	0.1-1.5
	Driver training	0.05-0.1
	Navigation	1-20
	Automatic vehicle monitoring	0.1-30
	Automatic vehicle identification	1
	Public safety	0.1-30
	Collision avoidance	0.1
	Accident investigation	0.1-4
	Emergency response	0.1-4
Highway	Engineering survey	0.01
	Construction machinery control	0.05-0.1
	Infrastructure monitoring	0.005
	Highway tolling	3

Application field		Accuracy demand (m)
Inland river	Marine navigation	2 - 5
	Waterway engineering	0.1- 5
Port	Marine navigation	8-20
	Container handling	0.01-0.1
	Ocean engineering	1-5
Aviation	Airway	2 nautical miles
	Non-precision approach	220
	Precision approach	1
Railway	Precise scheduling	<1
	Train integrity monitoring	<1
	Rear-end approaching warning	<1
Public service	Online car-hailing monitoring	1.5-5
	Shared bike monitoring	1.5-5
	Mobile navigation	1-20

03 Spatio-temporal information provided by GNSS is the foundation for the development of digital transportation.

BDS/GNSS is a key tool to facilitate the informatization and modernization of transportation and has been fully integrated into the service system of Chinese transportation industry.



Vehicle monitoring, free-flow highway toll collection, side slope monitoring, positioning in tunnels, automatic piloting

Vessel monitoring, maritime search and rescue, short message communication, maritime safety information broadcast, remote monitoring and control of aids to navigation

Port automation, autonomous container car ……

PART TWO

Application Cases of BDS/GNSS in the field of Transportation


01
Applications of BDS in
Road Transportation

01 Application cases of BDS/GNSS in the field of road transportation

Difficulty and sore point in monitoring key operating vehicles

- Overload, overspeed, overcrowding, random parking, fatigue driving
- Lack of capacity in dynamic whole-process supervision
- Difficulty in identifying safety risks
- Lack of information sharing and management mechanism

Key operating vehicles : passenger bus, tourist bus, dangerous goods transport vehicle and heavy-duty trucks over 12 tons.

01 Application cases of BDS/GNSS in the field of road transportation

- ✓ Key operating vehicle monitoring and management service system based on BDS/GNSS

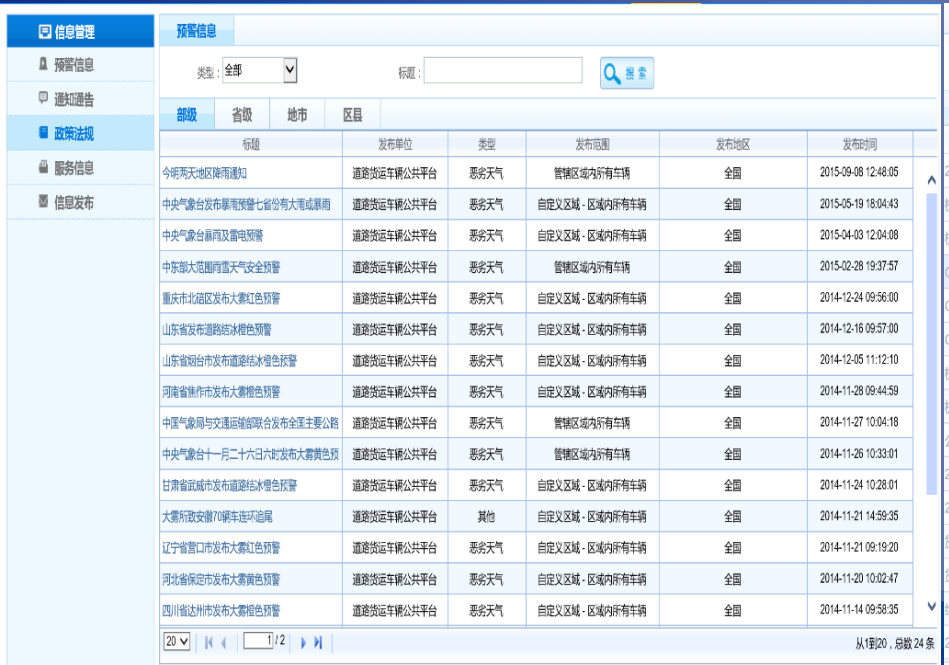
- ✓ Form a complete dynamic monitoring mechanism for road transportation;
- ✓ Achieve information interconnection and data sharing among China's cities, provinces and departments;
- ✓ Promote the installation of 7.6 million BDS/GNSS vehicle-borne terminals;
- ✓ Effectively reduce the accident rate in road transportation, especially the number of serious accidents and death rate;

01 Application cases of BDS/GNSS in the field of road transportation

Vehicle monitoring function: collect and record historical dynamic data information of vehicles. Traffic and public security management departments can view vehicle track playback according to the needs to investigate accidents.

01 Application cases of BDS/GNSS in the field of road transportation

Electronic fence information release function: When a certain area requires road closure or traffic control due to extreme weather or major events, the traffic management department can delimit the area through the system and send reminders to the terminals installed on vehicles entering the area to suggest the drivers to choose the right route or detour according to the road conditions.



01 Application cased of BDS/GNSS in the field of road transportation

Overspeed and fatigue driving warning function: when the platform detects a vehicle's illegal driving behavior, it will carry out a series of actions automatically. First, it sends information to the vehicle-borne BeiDou terminal to warn the driver. If the driver refuses to respond and take appropriate actions, the company and traffic management department of the vehicle will be notified in turn.

Continued violation

Continued violation

Vehicle-borne BeiDou terminal warns the driver

Notify the vehicle company, and the company requires the driver to stop the violation

The information of the vehicle is sent to the traffic management department

02 Applications of BDS/GNSS High Precision Services in Smart Ports

02 Applications of BDS/GNSS High Precision Services in Smart Ports

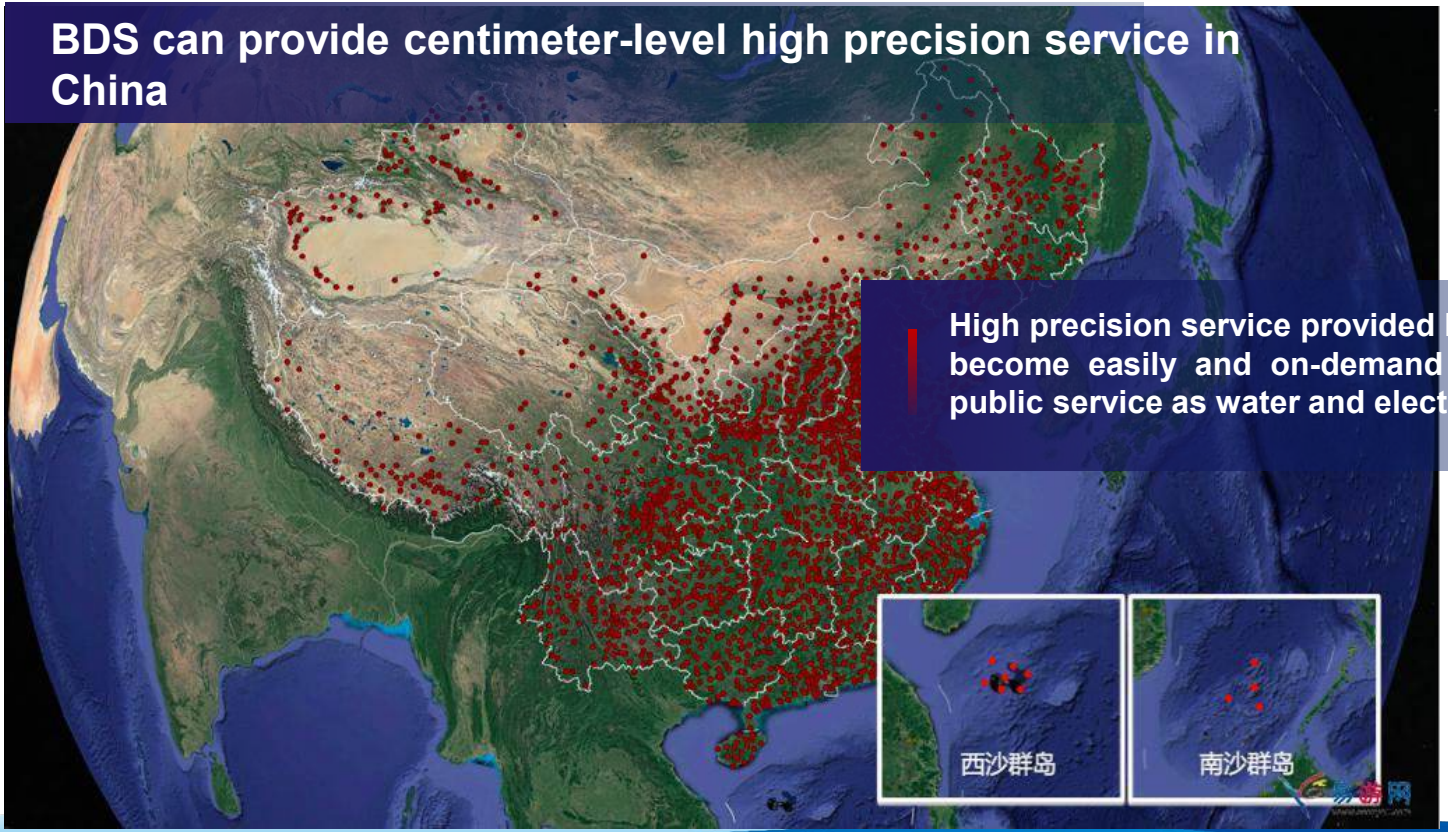
Application demands

- The construction and maintenance cost of traditional magnetic nail navigation is high
- Labor costs increase the demand for unmanned operations in ports
- Demand in improving operational efficiency and safety
- Demand in port transformation and digitalization

Precise positioning is an essential foundation for the construction of smart ports, and location data is the cornerstone of intelligence.

02 Applications of BDS/GNSS High Precision Services in Smart Ports

BDS can provide centimeter-level high precision service in China



High precision service provided by BDS has become easily and on-demand accessible public service as water and electricity.

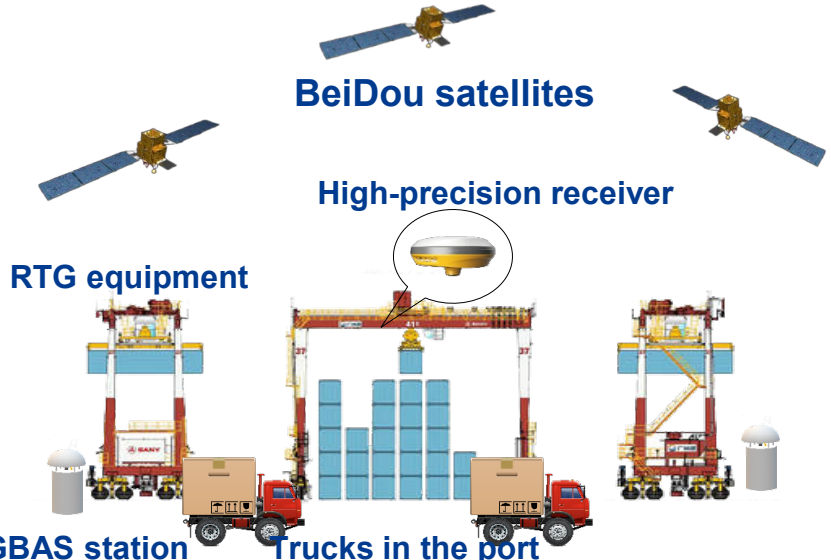
02 Applications of BDS/GNSS High Precision Services in Smart Ports

High precision services provided by BDS support the upgrade and transformation of mechanical automation in port operations. BDS high precision positioning terminal is installed on trucks in the port, and in combination with 3D laser scanning and visual detection technologies, the automatic loading and unloading of goods in the yard has been realized.

95%
The single capture success rate of RTG exceeds

15%
Operational efficiency improved

50%
Labor cost saved



02 Applications of BDS/GNSS High Precision Services in Smart Ports

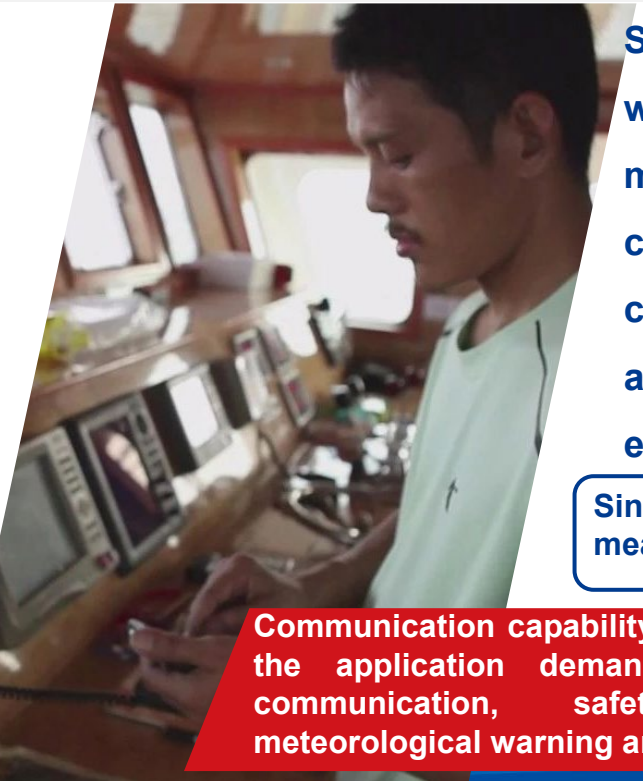
Combined with the high precision map of the port, the operation process can be watched on the bi- and three-dimensional visualization software.

Video: visual scene of port operations


03
Applications of BDS Message Service in Maritime Safety

03 Applications of BDS Message Service in Maritime Safety

Application demand



Shipping is the most important mode of freight transportation in the world, accounting for nearly 90% of global trade. The diversification of maritime vessel communications will enrich maritime safety communication means, effectively improve maritime safety communication capabilities, strengthen maritime emergency response and search and rescue, and improve maritime transport management efficiency and capability of maritime business and information service.

Single maritime communication means, limited coverage area

Expensive traditional satellite communications equipment and services

Communication capability of BDS message service meets the application demand of maritime distress alert communication, safety information broadcast, meteorological warning and dynamic monitoring

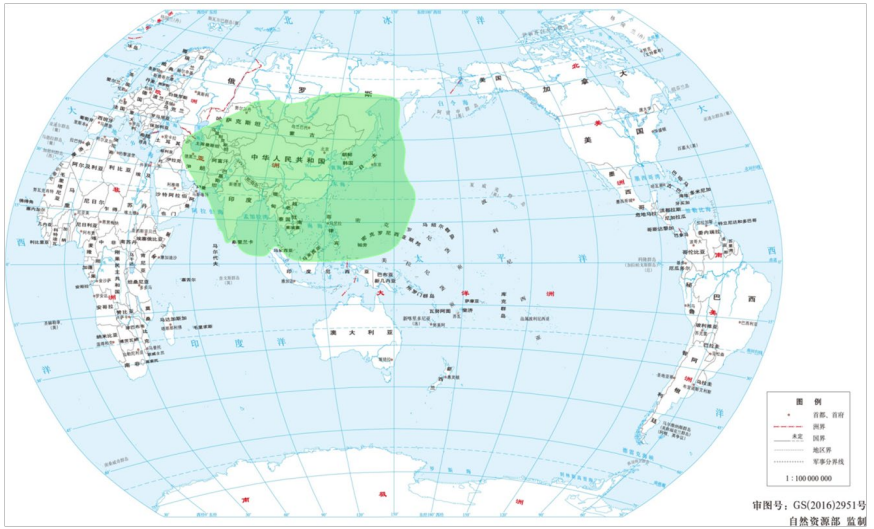
Latency in maritime safety and distress alert transmission

03 Applications of BDS Message Service in Maritime Safety

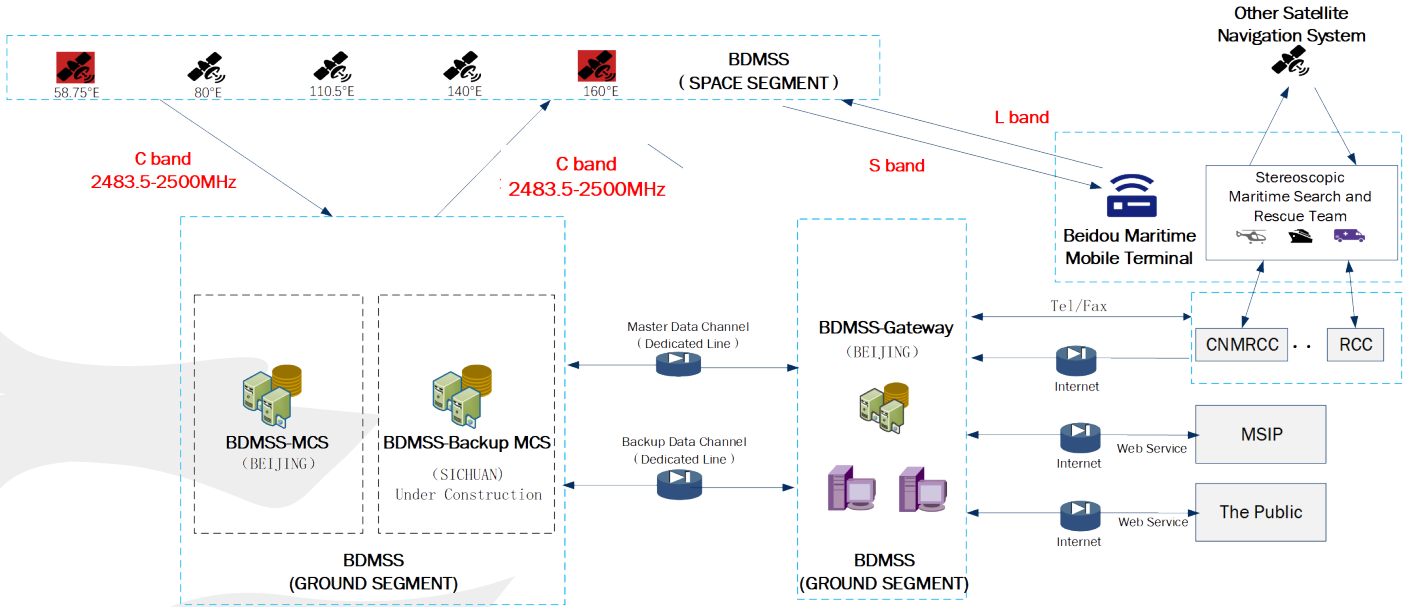
BDS RSMC provides services to the Asia-Pacific region.

Message size: 1000 Chinese characters

Terminal transmitting power: ≤3 watts



Coverage area： China and the surrounding region



Based on Regional Short Message Communication Service (RSMC), China has built the maritime distress management and search and rescue command system, which has been used in maritime and search and rescue systems in China. The application of RSMC has significantly increased the efficiency of maritime search and rescue, decreased the number of injuries and deaths, and protected the safety of maritime operations, life and property. More than 1500 persons have been saved in the past three years and 1 billion yuan of economic losses were retrieved.

03 Applications of BDS Message Service in Maritime Safety

Internationalization efforts of BDS under IMO

2014.11 94th session of IMO Maritime Safety Committee

Adopted the Circular of Recognition of RSMC as a GMDSS service provider

2018.05 MSC 99 approved the application by China for the recognition of RSMC for use in GMDSS.

Process of recognizing RSMC as a GMDSS service provider was initiated.

2020.01 7th session of NCSR Sub-Committee

NCSR 7 considered the proposal by China, noted the general support and invited IMSO to conduct the assessment of RSMC.

Pursuing recognition of RSMC as a GMDSS service provider.

04

Applications of BDS International Search and Rescue Service

04 Applications of BDS SAR Service

BDS MEOSAR system development

2016.02 **Carry out demonstration of BDS MEOSAR system**

The Ministry of Transport, as the user unit, proposed the demand of carrying mid-orbit search and rescue payloads on BeiDou satellites.The Ministry of Transport and China Satellite Navigation Office established a joint demonstration group.

2017.10 **Submit application to COSPAS-SARSAT on JC 31**

Declare to COSPAS-SARSAT that China is willing to launch 5 to 6 BeiDou satellites with SAR payloads.

2018.02 **BDS is added in MEOSAR Implementation Plan**

The 59th session of Council of COSPAS-SARSAT reviewed and approved the MEOSAR Implementation Plan.

2018.06 **Completed BDS-GALILEO frequency coordination**

China officially announced to use 1544.21MHz for BDS MEOSAR payloads.

As a functional part of BDS, BeiDou MEOSAR system is capable of providing MEOSAR and return link communication services in accordance with COSPAS-SARSAT standards.

On 31st July 2020, COSPAS-SARSAT MEOSAR service provided by BDS-3 was officially launched. BDS MEOSAR service detection probability is better than 99%.

Frequency coordination

Space and ground equipment deployment

In-orbit test

Ground segment of BDS MEOSAR system

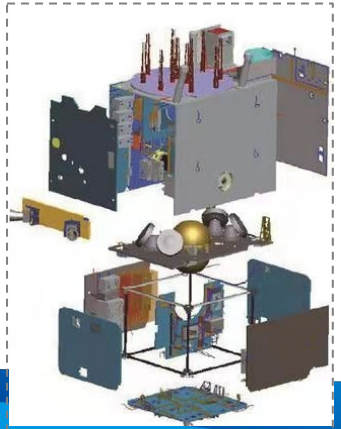
C/S China MCC

04 Applications of BDS SAR Service

Space segment of BDS MEOSAR system consists of SAR payloads carried by BDS MEO satellites. BDS MEOSAR payloads characteristics are shown below.

Orbital plane / Orbital position	A	B	C
1		MEO-13 launched	
2			
3		ME0-14 launched	MEO-23 launched
4			
5			MEO-24 launched
6	MEO-21 launched		
7			
8	MEO-22 launched		

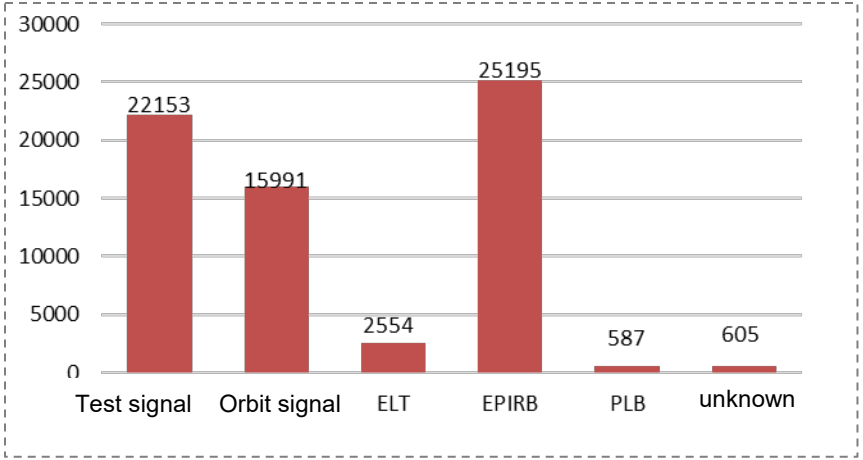
Service types	Center frequency	Satellites
Forward link alert message service	Uplink 406.05 MHz	6 MEO
	Downlink 1544.21 MHz	
Return link	Downlink B2b 1207.14 MHz	24 MEO + 3 IGSO



04 Applications of BDS SAR Service

SAR live exercise

In 2021, China carried out the national SAR live exercise. The functions and performance of BDS international search and rescue service in practical conditions were demonstrated and the full service and whole process of distress alerting were verified.



Statistic of signals received during test operation

By early September 2021, the BDS MEOSAR System had received a total of 67,085 distress alert test signals from 1,352 beacons during its test and trial operation.

04 Applications of BDS SAR Service

BDS RLM signals are transmitted from 3 inclined geosynchronous orbit (IGSO) and 24 MEO satellites via B2b signal for global RLS coverage. The actual bit rate is 436 bps, hence BDS RLS has enough capacity for broadcasting.

As an advanced function, the return link service provides the ability of distress confirmation and two-way SAR information interaction, enhances the confidence and survival probability of people in distress and reduces the false alert rate

Prototype of BDS RLM beacon

Enhance survival confidence, assist SAR operations and reduce false alert rate

To better understand distress situations and obtain additional information about the person in distress, the environment and equipment.

Guide people in distress to areas where rescue operations are easier to be conducted

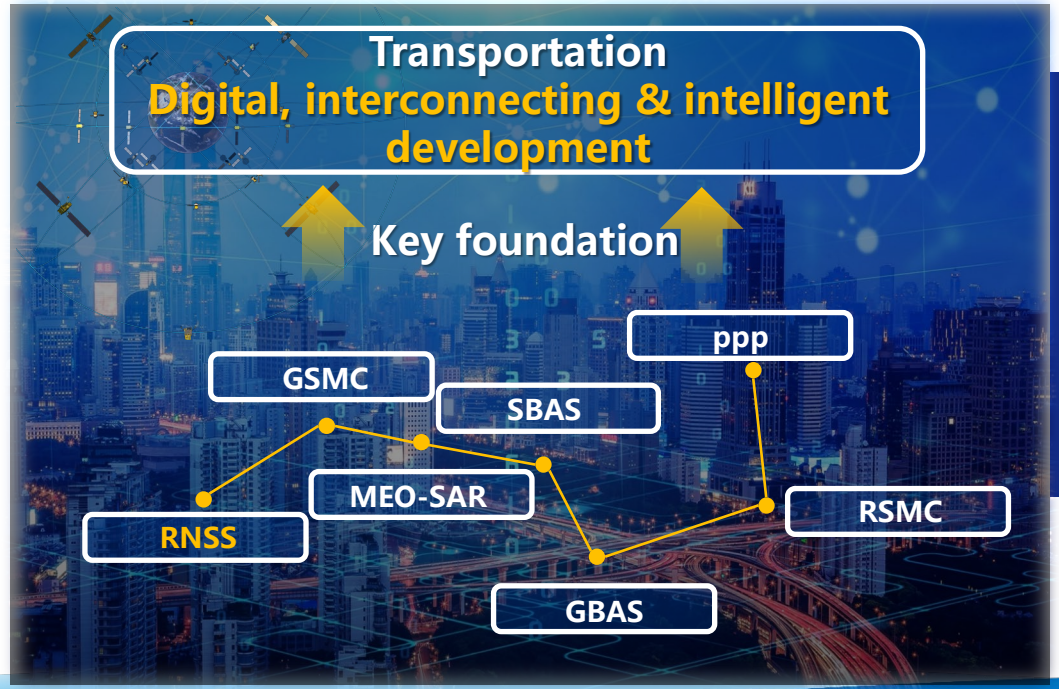
Inform and guide people in distress to save themselves to maximally improve their chances of survival.

When beacon is activated manually, confirm the distress situation to avoid false alert.

PART THREE

Prospects of BDS/GNSS Application in Transportation

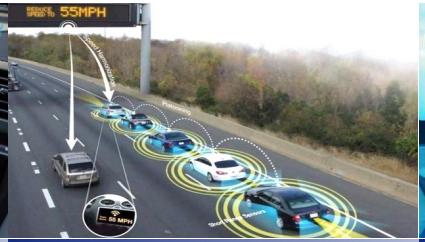
01 BDS is the foundation of digital transportation development



With the obvious trend in digital, interconnecting, and intelligent development of the transportation industry, the application demand for satellite navigation systems in the transportation industry will be released in a higher speed.

02 Intelligence and interconnection empowers transportation

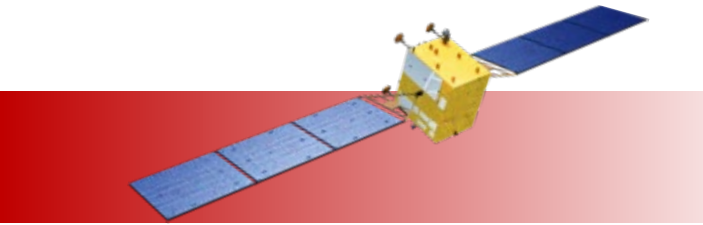
BeiDou+autopilot



BeiDou+ vehicle-road synergy

BeiDou+smart highways

BeiDou+ smart logistics



BeiDou+ smart shipping

BeiDou+ digital travel

BeiDou+ smart city

CTTIC

Thank you!