BDS High Accuracy Service of BDS Public Service Platform

China Academy of Information and Communication Technology

SHUO LIU

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On July 31st, 2020 the BeiDou Navigation Satellite System (BDS-3) was completed and commissioned.

At present, there are 45 satellites for BDS, including 15 satellites of BDS-2 and 30 satellites of BDS-3.

At present, the Beidou System provides seven types of services, including navigation, positioning, communication and data transmission.

Global: 3 Service

Positioning Navigation Timing

Global Short Message Communication

international Search And Rescue

In and around China: 4 Service

Satellite-Based Augmentation System

Ground-based augmentation

Regional Short Message Communication

Precise Point Positioning

Application of BDS

BDS has fully served the transportation, public security, disaster relief and mitigation, agriculture, forestry, animal protection, etc. It is integrated into electricity, finance, communications and other infrastructure, and produces remarkable economic and social benefits.

Public Consumption
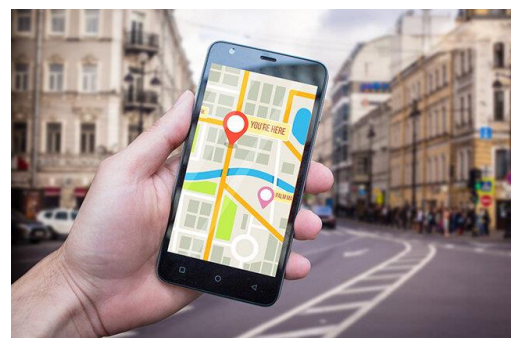
Since the commission of BDS, mainstream smartphone manufacturers including Huawei and Apple, have supported Beidou.

Health Care

"Integration of BDS and Health" is becoming a new hot spot in the current application, expanding its application to, telemedicine, smart elderly care and other aspects, and promoting the realization of intelligent health services.

Transportation

BDS is widely used in key transportation process monitoring, highway infrastructure security monitoring, port high-precision real-time positioning scheduling monitoring and other fields

Digital Construction

BDS combined multi-sensor and Internet technologies are widely used in the construction process of railways, highways, airports, ports, etc., significantly improving the quality and efficiency of engineering construction, reducing labor and material costs, and effectively improving the safety .

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Demand for high-precision positioning

With the gradual advancement of 5G network and the continuous improvement of terminals, the huge scale of smartphone users have an increasingly urgent demand for high-precision positioning.
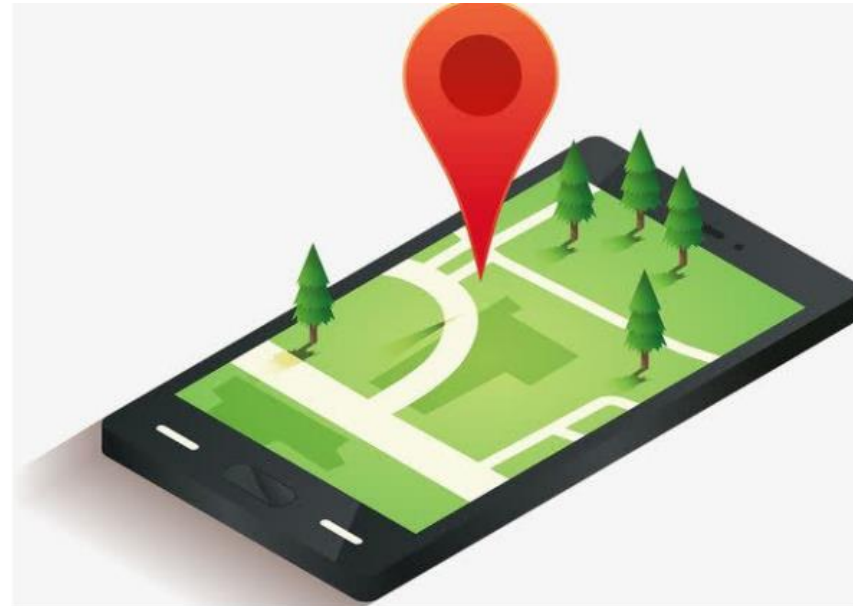

The Smartphone has gradually become an important terminal for the public to obtain high-precision location services

Mobile communication Standards of BDS

BDS-2 B1I signal

- Since 2013, the international standardization work of BDS in the mobile communication field was carried out.
- In June 2015，the development of 3GPP standards to support B1I signal was completed, including technical standards, performance standards and conformance testing standards

BDS-3 B1C/B2a/B3I signal

- In September 2018, the development of 3GPP standards to support B1C signal was started
- In September 2021, the development of 3GPP standards in Release 16 to support B1C signal was completed, including technical standards, performance standards and conformance testing standards
- the development of 3GPP standards in Release 17 to support B2a and B3I signals were completed soon
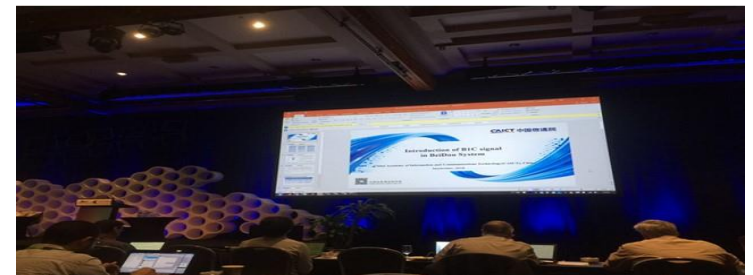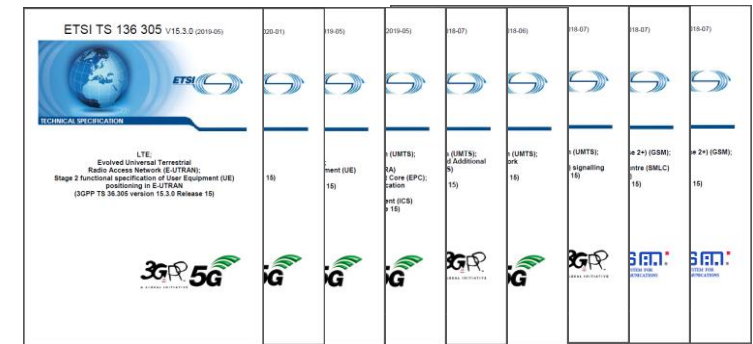
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GNSS Enhancement Service

In order to improve positioning accuracy and reduce the impact of various error terms, additional enhancement services are available independent of the GNSS system.

OSR: Observation Space Representation

◆ Technology: RTK, NRTK, etc.
◆ Service characteristics: regional Service, high accuracy, short convergence time

SSR: State Space Representation

◆ Technology: PPP, PPP-AR, PPP-RTK, etc.
◆ Service characteristics: global Service, high accuracy, long convergence time

PPP-B2b is the service signal of the BDS Precise Point Positioning (PPP) Transmitted by the BDS-3 GEO satellites, the PPP-B2b signal serves as the data broadcasting channel for correction parameters, such as satellite precise orbit and clock offset parameters of BDS-3 and other GNSS systems and provides PPP services for users in China and surrounding areas.

Target Service

1) BDS: CNAV1 navigation messages of B1C signal.

2) GPS: LNAV navigation messages.

3) Galileo: I/NAV navigation messages.

4) GLONASS: L1OCd navigation messages.

北斗卫星导航系统

空间信号接口控制文件

精密单点定位服务信号PPP-B2b（1.0版）

中国卫星导航系统管理办公室

二〇二〇年七月

BeiDou Navigation Satellite System
Signal In Space
Interface Control Document
Precise Point Positioning Service Signal PPP-B2b
(Version 1.0)

China Satellite Navigation Office
July, 2020

北斗卫星导航系统
WWW.BEIDOU.GOV.CN

PPP-B2b Signal Characteristics

PPP service information is broadcast on the open service signal PPP-B2b. The PPP-B2b signal broadcasts the I-component and the Q-component, and the first three BDS-3 GEO satellites only broadcast the I-component.

Structure of the PPP-B2b signal

Signal	Component	Carrier frequency (MHz)	Modulation	Symbol rate (sps)	The first three GEOs	Subsequent GEOs
PPP-B2b	I	1207.14	BPSK(10)	1000	available	available
	Q	1207.14	TBD	TBD	N/A	available

PPP-B2b Message Content

The message type is used to distinguish the information contents broadcast in the valid data field.

Table: Defined message types

Message types	Information content
1	Satellite mask
2	**Satellite orbit correction**
3	**Differential code bias**
4	**Satellite clock correction**
5	**User range accuracy index**
6	Clock correction and orbit correction - combination 1
7	Clock correction and orbit correction - combination 2
8-62	Reserved
63	Null message

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BDS Public Service Platform

launched in September 2017 and became the first service platform to provide A-BDS service in the world.

Capacity：210 million daily active users and more than 3 billion daily services

☐ Operating time: 5 years

☐ Number of service: 1.5 trillion

☐ Supported Chips: Hisilicon, MTK, Qualcomm

☐ Service Category: A-GNSS (BDS/GPS/GLONASS/Galileo) and PPP (BDS/GPS)
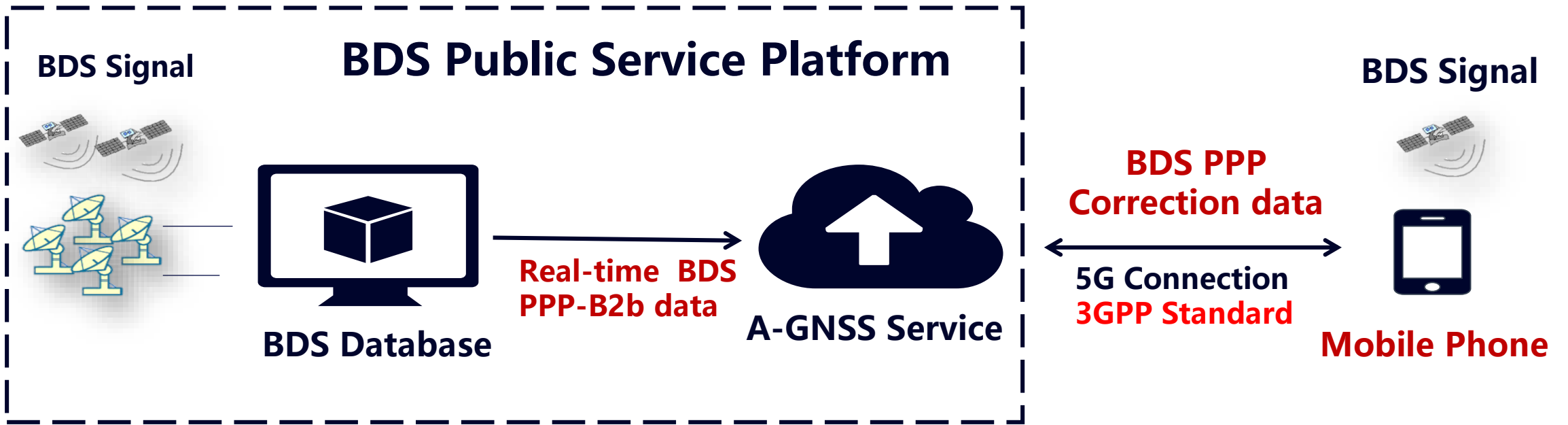

Supported Smartphones

HUAWEI vivo OPPO 荣耀 honor mi 小米 xiaomi.com MEIZU 魅族

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BDS High Accuracy Service

BDS Public Service Platform

BDS Signal

BDS Signal

BDS PPP Correction data

Real-time BDS PPP-B2b data

A-GNSS Service

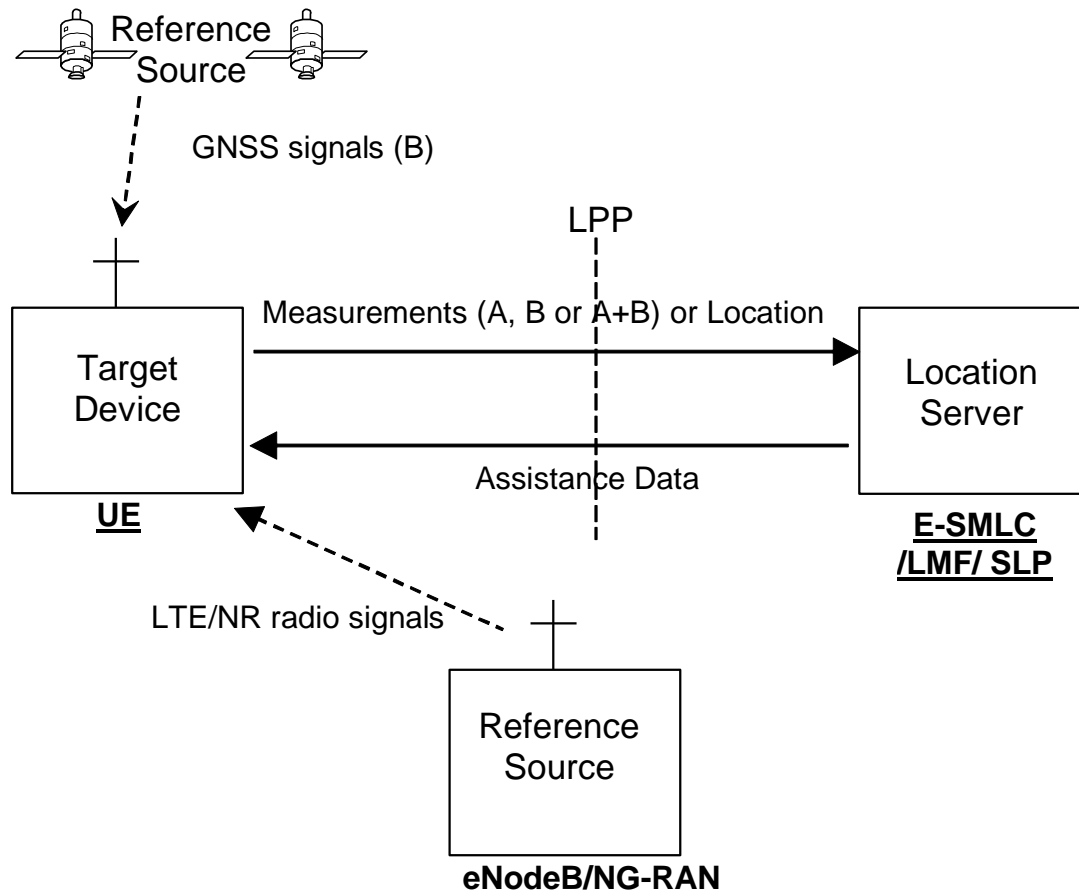**5G Connection 3GPP Standard**

BDS Database

Mobile Phone

☐ The use of mobile phones to obtain BDS High Accuracy Service has entered formal commercial use

❑ Based on open and international standard: Based on 3GPP LPP protocol in Release 16 and provides Beidou and GPS dual system SSR correction;

❑ Support BDS-2 and BDS-3: Support B1I and B1C signal ephemeris delivery

❑ Provide 4 types of SSR parameters: GNSS-SSR-OrbitCorrections, GNSS-SSR-ClockCorrections, GNSS-SSR-CodeBias and GNSS-SSR-URA;

❑ Positioning accuracy: After testing, based on the 4 types of corrections, the positioning accuracy can be corrected to 1.2m in the open environment, the effect is significant.

3GPP LTE Positioning Protocol (LPP)

LPP is used point-to-point between a location server (E-SMLC, LMF or SLP) and a target device (UE or SET) in order to position the target device using position-related measurements obtained by one or more reference sources.

Reference Source

GNSS signals (B)

LPP

Measurements (A, B or A+B) or Location

Target Device

UE

Assistance Data

Location Server

E-SMLC /LMF/ SLP

LTE/NR radio signals

Reference Source

eNodeB/NG-RAN

Supported Position Methods
- OTDOA (based on LTE signals)
- **A-GNSS**
- E-CID (based on LTE signals)
- Sensor
- TBS
- WLAN
- Bluetooth
- NR E-CID
- NR DL-TDOA、DL-AoD、Multi-RTT

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The 3GPP R16 and later versions of the LPP protocol has already supported the transmission of SSR parameters to terminals through A-GNSS technology to achieve real-time PPP positioning technology, including the following seven types of parameters.

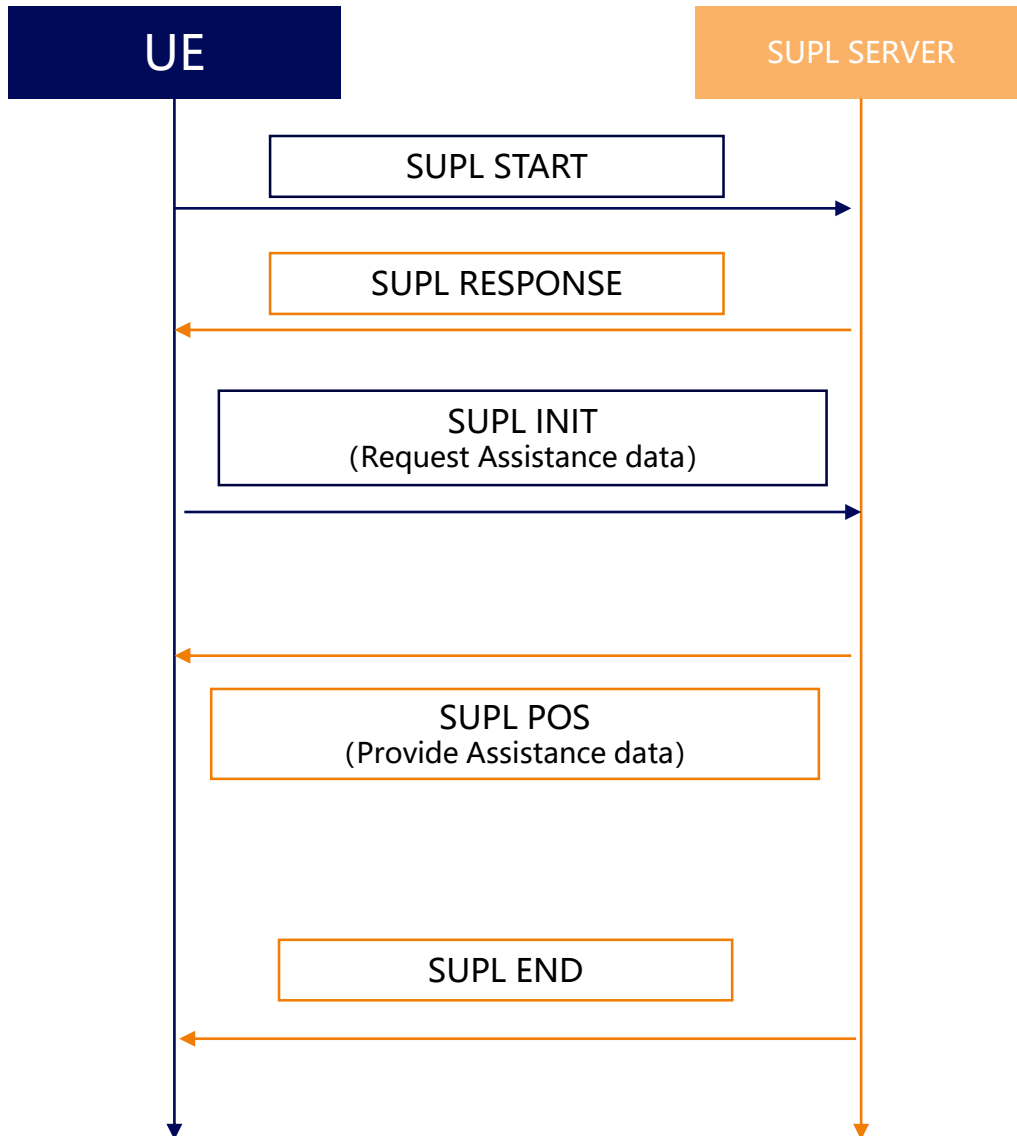- ✓ **SSR-OrbitCorrections**
- ✓ **SSR-ClockCorrections**

- ✓ **SSR-URA**
- ✓ **SSR-Codebias**
- ✓ SSR-PhaseBias

- ✓ SSR-STEC-Correction
- ✓ SSR-GriddedCorrection

```
gnss-SSR-OrbitCorrections-r15
                                GNSS-SSR-OrbitCorrections-r15    OPTIONAL,    -- Need ON.
gnss-SSR-ClockCorrections-r15
                                GNSS-SSR-ClockCorrections-r15    OPTIONAL,    -- Need ON.
gnss-SSR-CodeBias-r15           GNSS-SSR-CodeBias-r15            OPTIONAL     -- Need ON.


gnss-SSR-URA-r16                GNSS-SSR-URA-r16                 OPTIONAL,    -- Need ON.
gnss-SSR-PhaseBias-r16          GNSS-SSR-PhaseBias-r16          OPTIONAL,    -- Need ON.
gnss-SSR-STEC-Correction-r16    GNSS-SSR-STEC-Correction-r16
                                                                 OPTIONAL,    -- Need ON.
gnss-SSR-GriddedCorrection-r16  GNSS-SSR-GriddedCorrection-r16
```

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Protocol Flow

UE

SUPL SERVER

SUPL START

SUPL RESPONSE

SUPL INIT
(Request Assistance data)

SUPL POS
(Provide Assistance data)

SUPL END

□ Applicable version: UE needs to support 3GPP LPP protocol in R16 and OMA SUPL Protocol in v2.0.4.

□ Protocol Process:

1. The UE and Server determine the session ID of the session through the **START** and **RESPONSE** messages.

2. UE requests assisted data according to its own capabilities through **SUPL INIT** message. This message can request BDS/GPS SSR data, and BDS /GPS ephemeris data.

3. The Server delivers assisted data according to UE request content through **SUPL POS** message. If periodic delivery is required, multiple **SUPL POS** messages are triggered (optional).

4. The Server terminates the session with the **SUPL END** message.

CAICT 中国信通院

2 types of mobile phones were used to carry out dynamic measurement of BDS High Accuracy Service. The route of dynamic measurement is 100km long in Beijing.
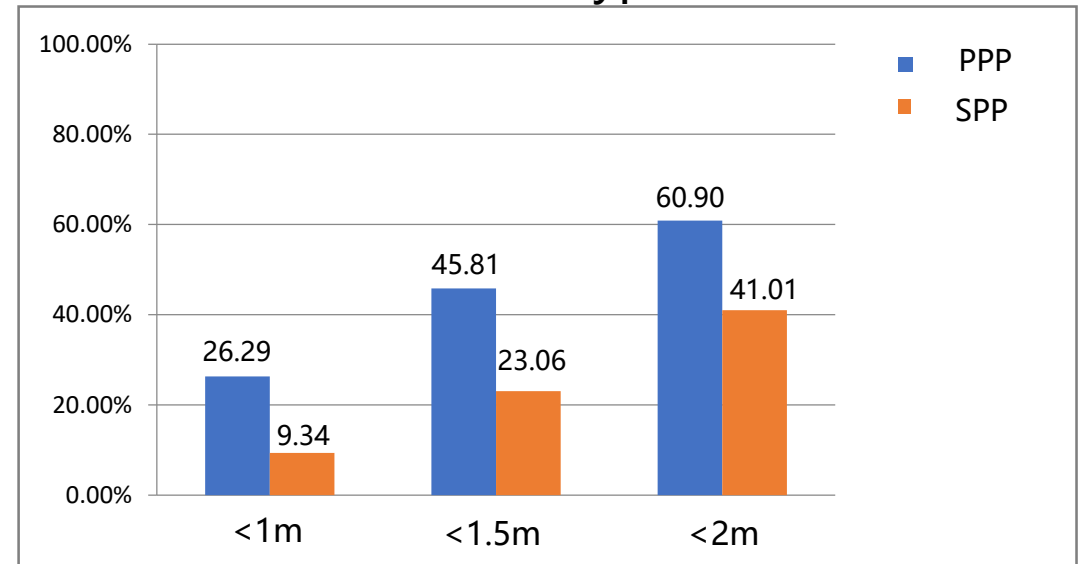
Measurement Route

Type1
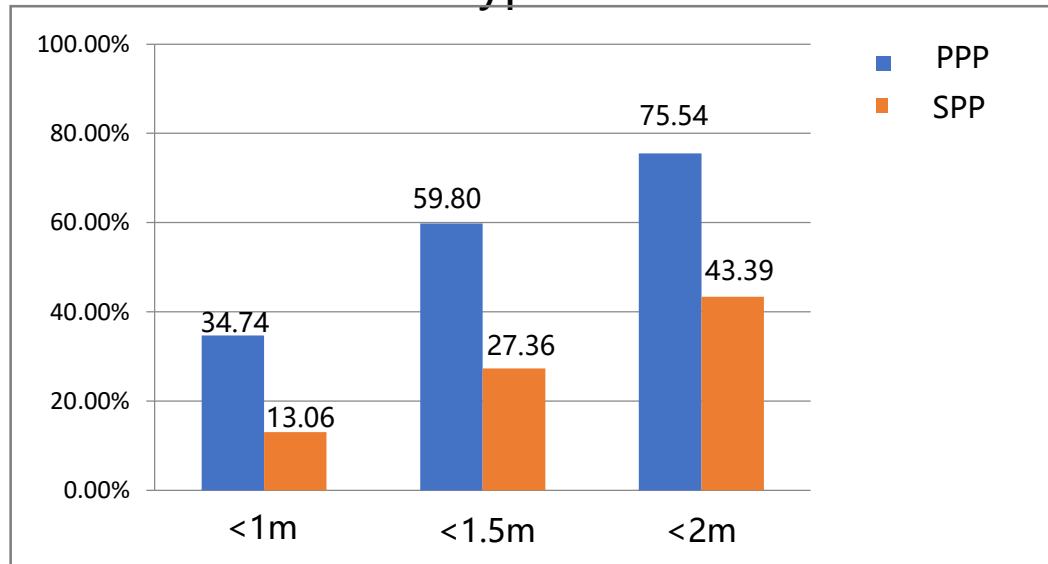
Type2

The result of PPP in 1m is 35% and in 2m is 75%, which is better than SPP.

The result of PPP in 1m is 26% and in 2m is 61%, which is better than SPP.

Commercial Use of BDS High Accuracy Service

BDS Public Service Platform promotes the application of low-cost and standard BDS High Accuracy Service in the field of public consumption.

In May 2023, MediaTek released Dimensity 9200+ baseband chip, which supports BDS High Accuracy Service.

In August 2023, Xiaomi released the Redmi K60 "ZhiZun" version of mobile phone, which supports BDS High Accuracy Service.

感谢观看
THANKS