

# The Integration of BDS and 5G

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**1. New demands for Navigations**

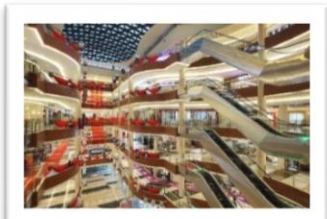
**2. The advantages of 5G for Navigations**

**3. The development of BDS**

**4. BDS + 5G provide better PNT services**

**5. Prospects**

# 1. New demands for Navigations



Indoor



Building



Underground



Under Bridge

**Last One Mile  
For 80% LBS application?**



Horizontal Positioning Accuracy: <1m

Vertical Positioning Accuracy: <1m

**Which Rooms and floors?**



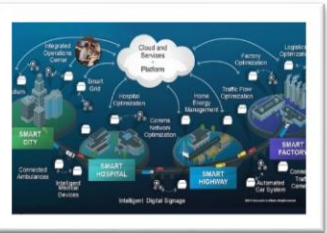
UAV



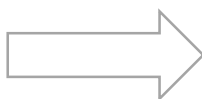
Positioning Accuracy: ~0.1m      **Avoid obstacles**

Mobility: 120km/h      **Enter highway**

Delay: ~5ms      **Rapidly brake**



IoT



Density: >10<sup>5</sup> km<sup>2</sup>      **Large amount**

Power: ↓1000 than LTE      **Small volume**

# 2. The advantages of 5G for Navigations



**Larger coverage**



**Higher accuracy**



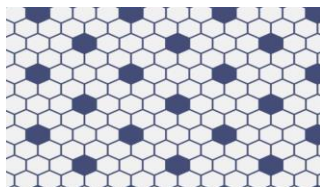
**Lower cost**



Synchronization accuracy	Station density	Delay	Bandwidth/Center Frequency
< 1.5 us	0.8/km <sup>2</sup>	30ms	20MHz
< 0.13 us	4/km <sup>2</sup>	~1ms	Sub 6G: 100MHz MMW : 400MHz



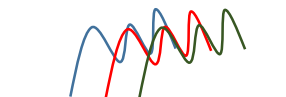
**Lower system positioning error**



**Multipath and NLOS effects reduction**



**Rapid response**



**Multi-frequency differential positioning**

**5G can be extended to applications of IOT and Smart city**

# 3. The development of BDS



## 4. BDS + 5G provide better PNT services



- High-accuracy positioning data

- High-accuracy timing and punctuality, synchronization accuracy reach 10ns

- Monitor 5G base station infrastructure

- Extend 5G services to no signal areas

- Broadcast BDS enhanced signal

- BDS+IMU+5G achieve seamless high-accuracy

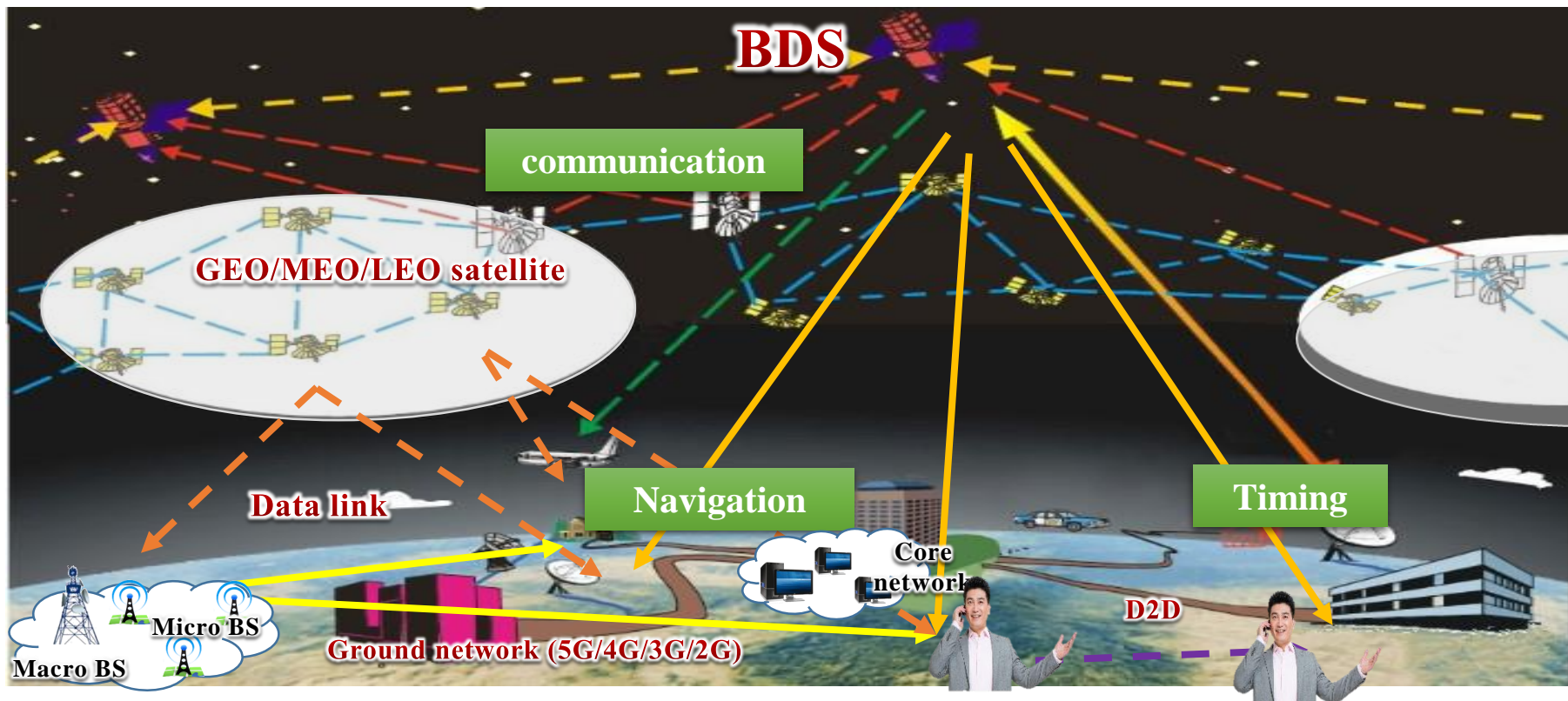
- Broadcast A-BDS/GNSS

- Utilizes information of 5G base stations

- Increase density of BDS station network

# 4. BDS + 5G provide better PNT services

## (1) Space-air-ground integration of BDS and 5G ( new PNT )



High accuracy

Low cost

Intelligence

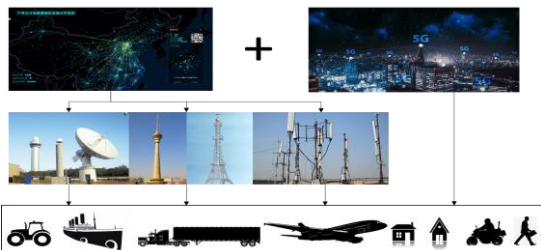
High reliability

Low power consumption

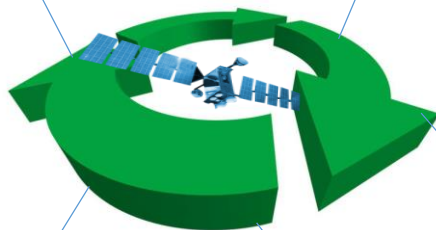
# 4. BDS + 5G provide better PNT services

## (2) Integration of network, information, services, terminals and applications

### Network integration



**BDS+5G  
PNT**



### Information integration

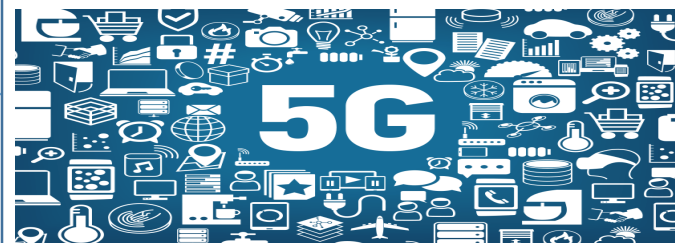
Time + Positioning +

Image + communication

### Service integration



### Terminal integration



### Application integration

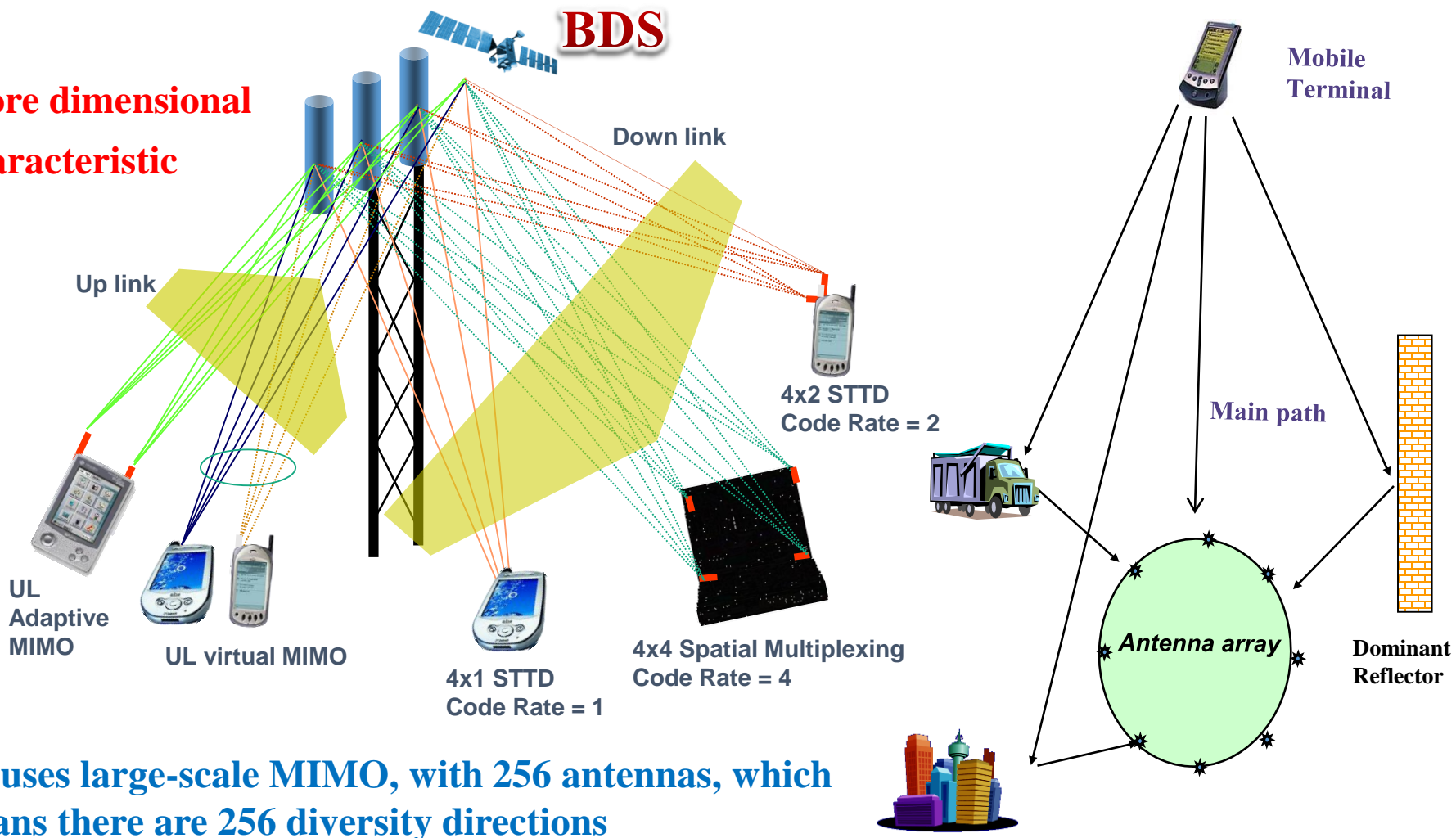




# 4. BDS + 5G provide better PNT services

## (3) Network integration: new global radio network

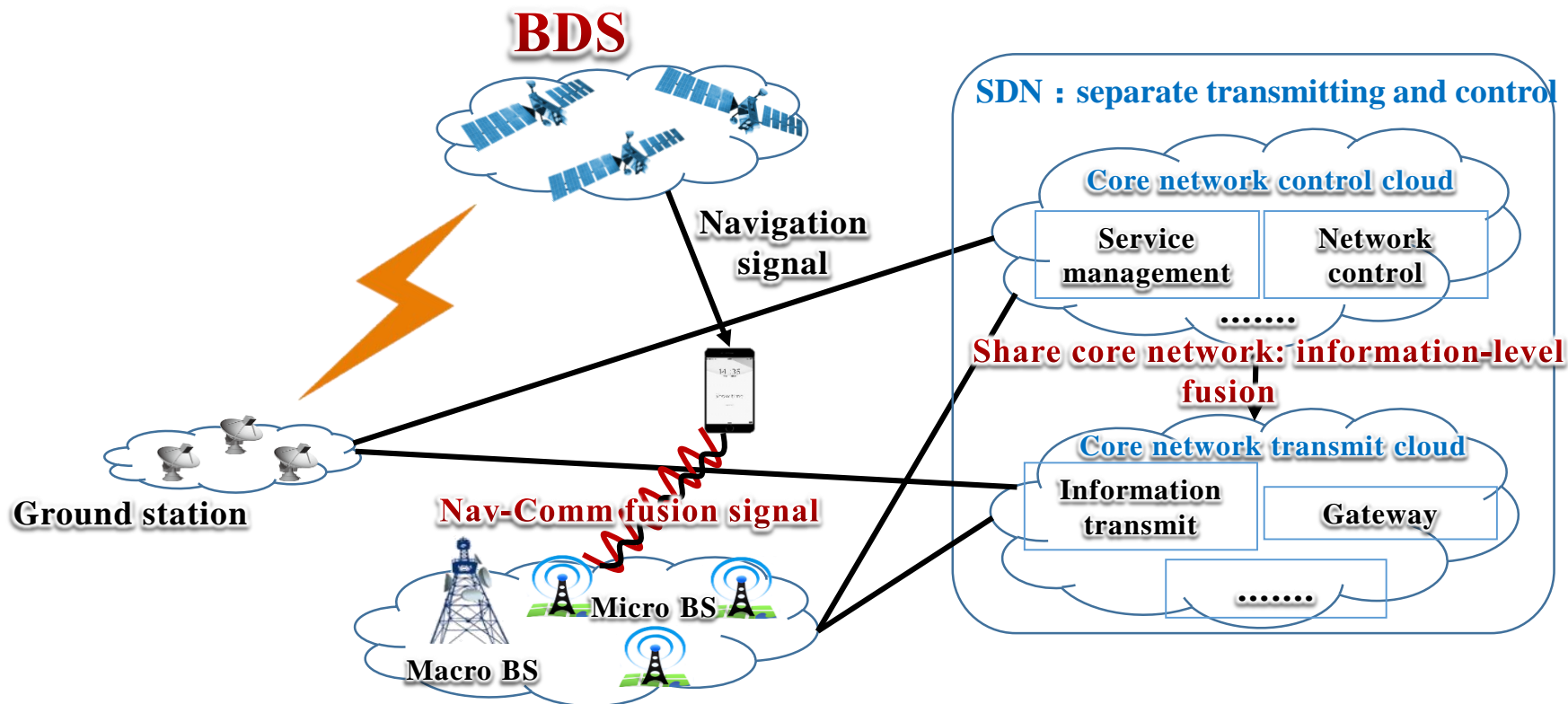
More dimensional characteristic



5G uses large-scale MIMO, with 256 antennas, which means there are 256 diversity directions

# 4. BDS + 5G provide better PNT services

## (4) Information integration

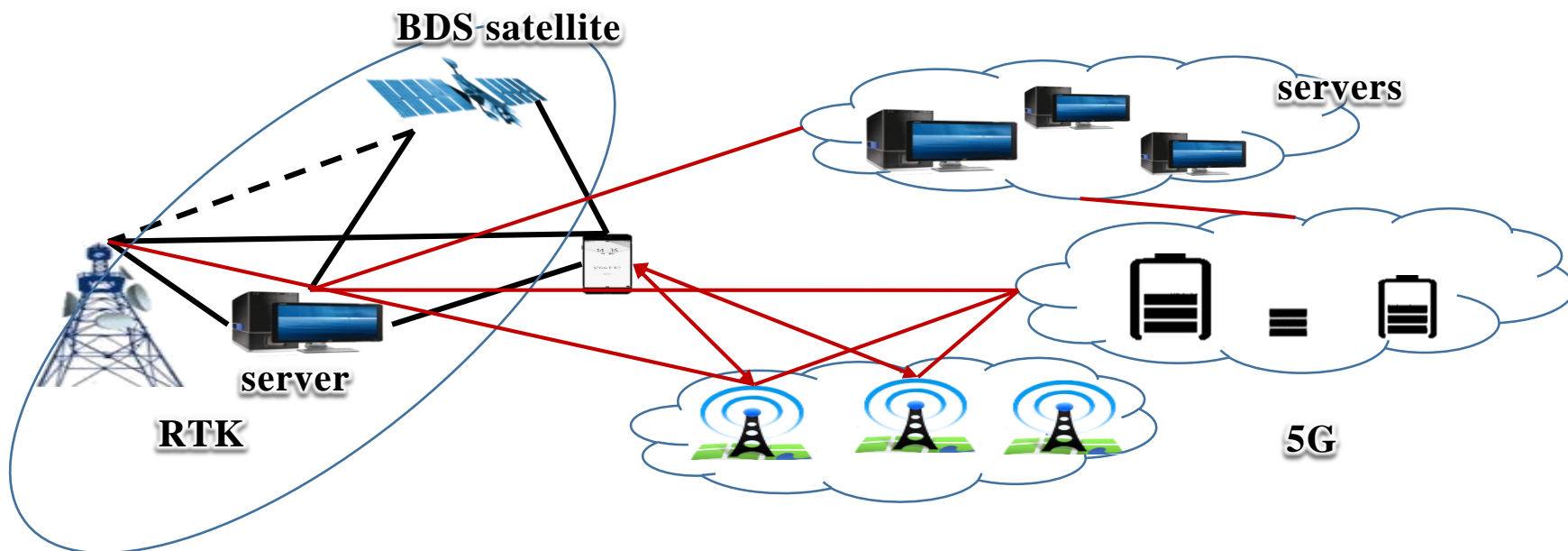


**Information-level fusion: share control information among BDS + 5G networks**

# 4. BDS + 5G provide better PNT services

## (5) Service integration

**Indoor and outdoor seamless service: network RTK/ multi-frequency differential**



**Beidou provides outdoor PNT services**

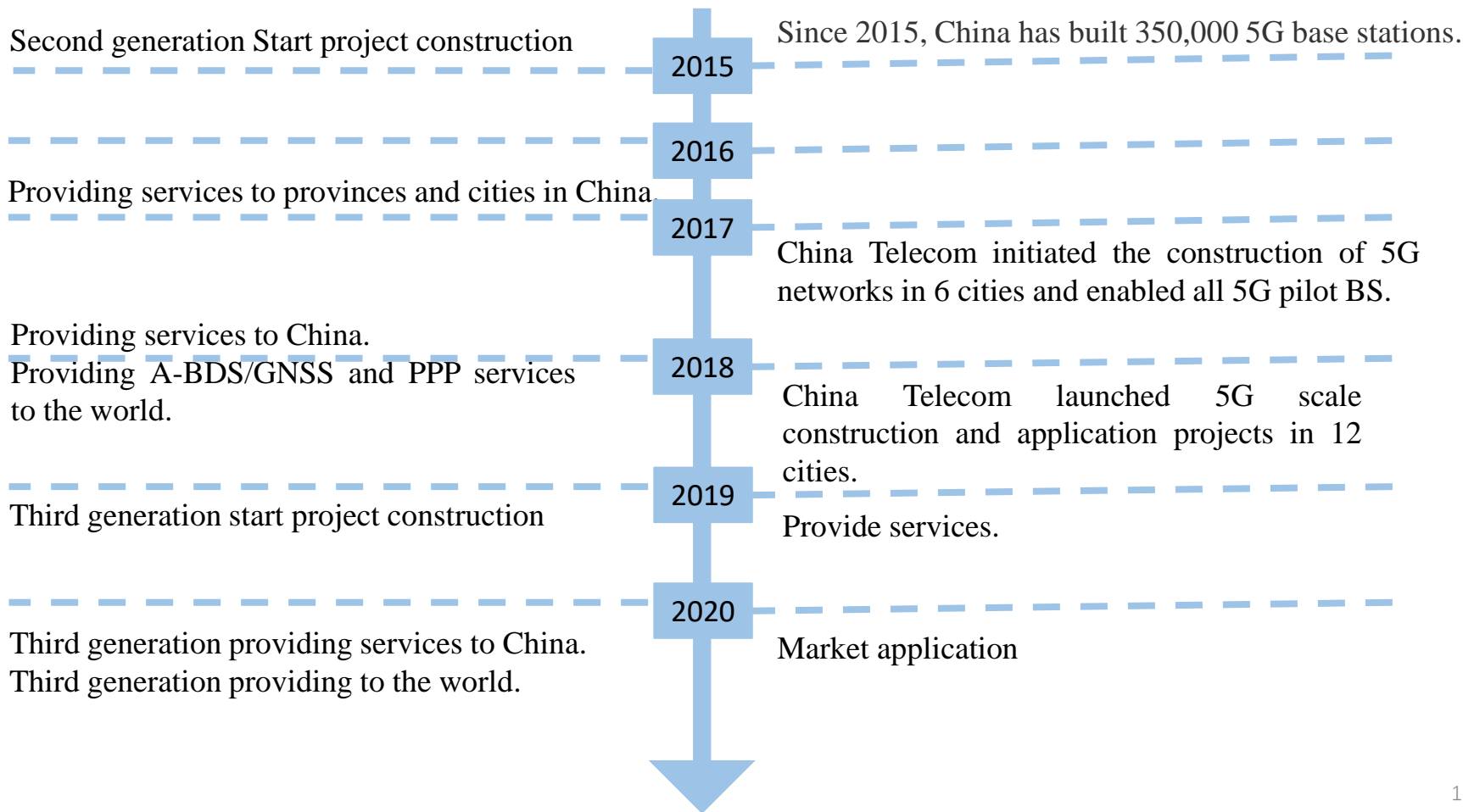
**5G provides indoor PNT services**

# 4. BDS + 5G provide better PNT services

## (6) Standard unifying is the basis for integration of terminals and applications

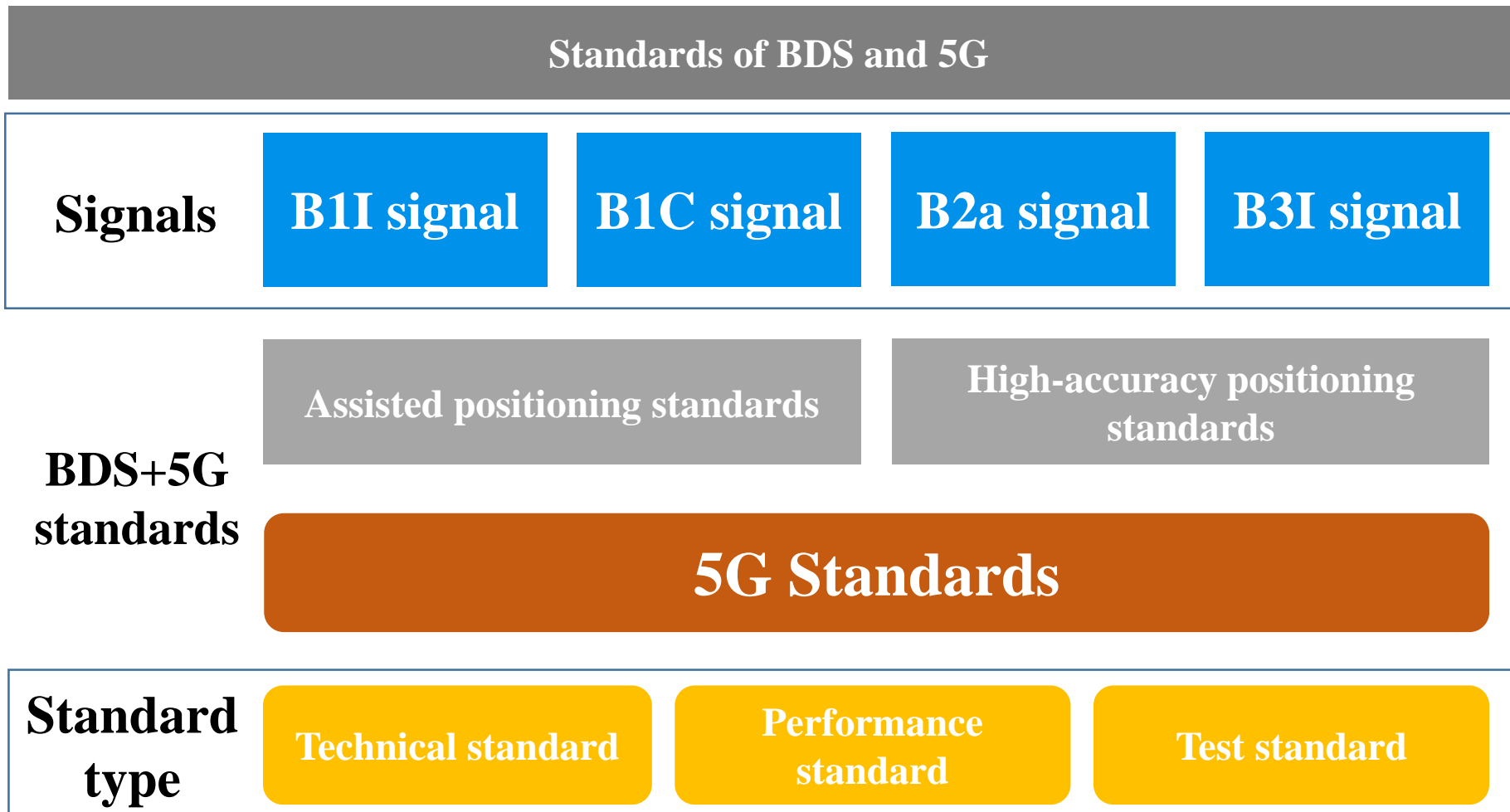
### BDS ground augmentation system

### 5G



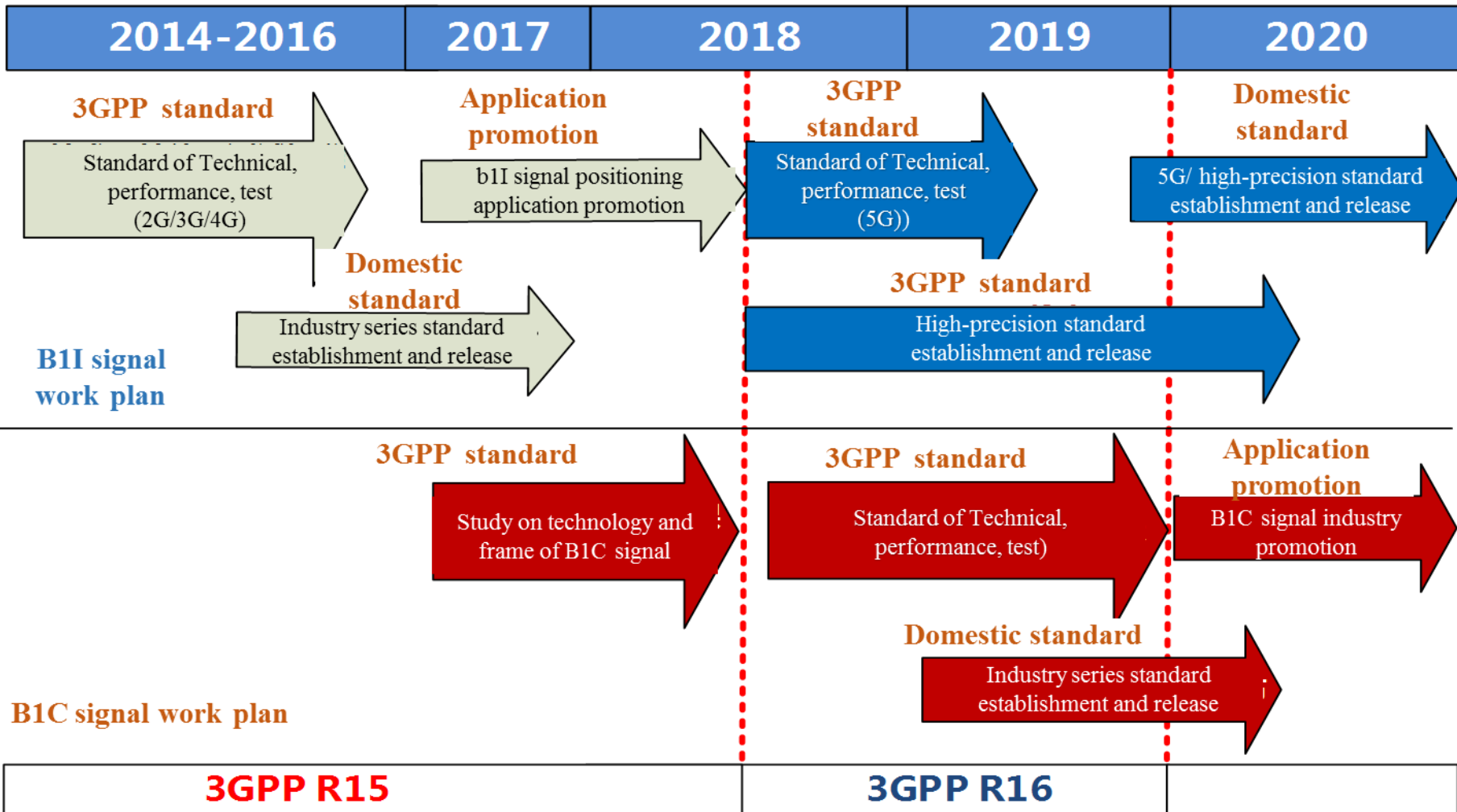
# 4. BDS + 5G provide better PNT services

## (6) Standard unifying interface

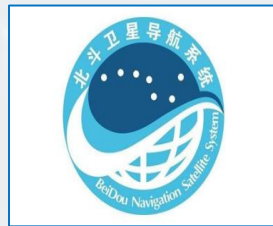


# 4. BDS + 5G provide better PNT services

## (6) Standard unifying milestones



# 5. Prospects



**BDS**

+



- ❑ **Positioning with high accuracy, high reliability and high availability**
- ❑ **Support for LBS in all-space-domain, all-time-domain and all-frequency-domain**
- ❑ **Space-air-ground integrated Navigation, positioning, timing, communication and control integration (PNTCC)**
- ❑ **The integration of network, service, terminal, information and application of PNTCC**
- ❑ **Formulation and promotion of international and national standards**