



THE BDS APPLICATIONS ON CIVIL TRANSPORT AIRCRAFTS

Commercial Aircraft Corporation of China (COMAC)

JIANG, Xin

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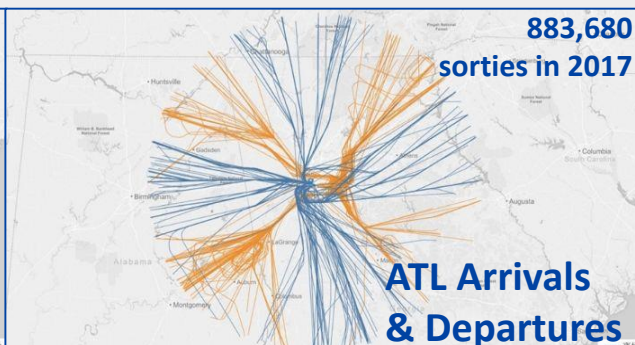
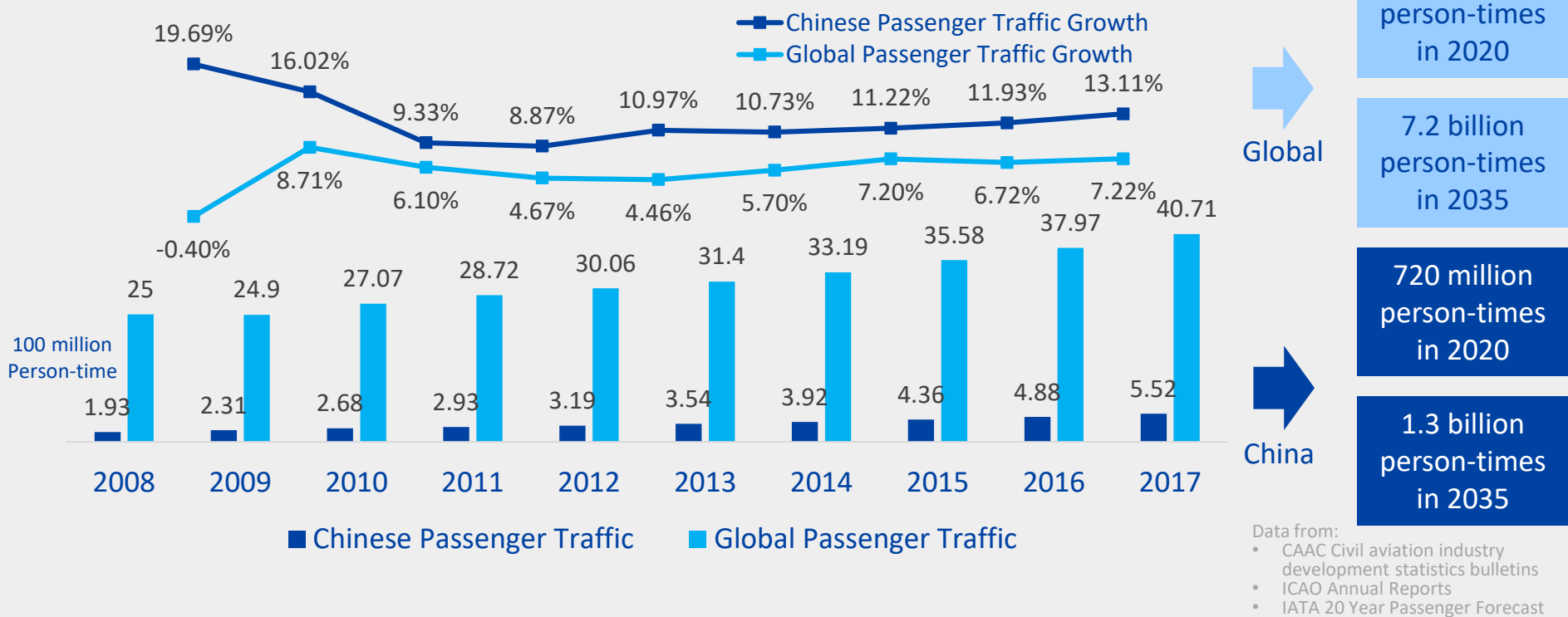
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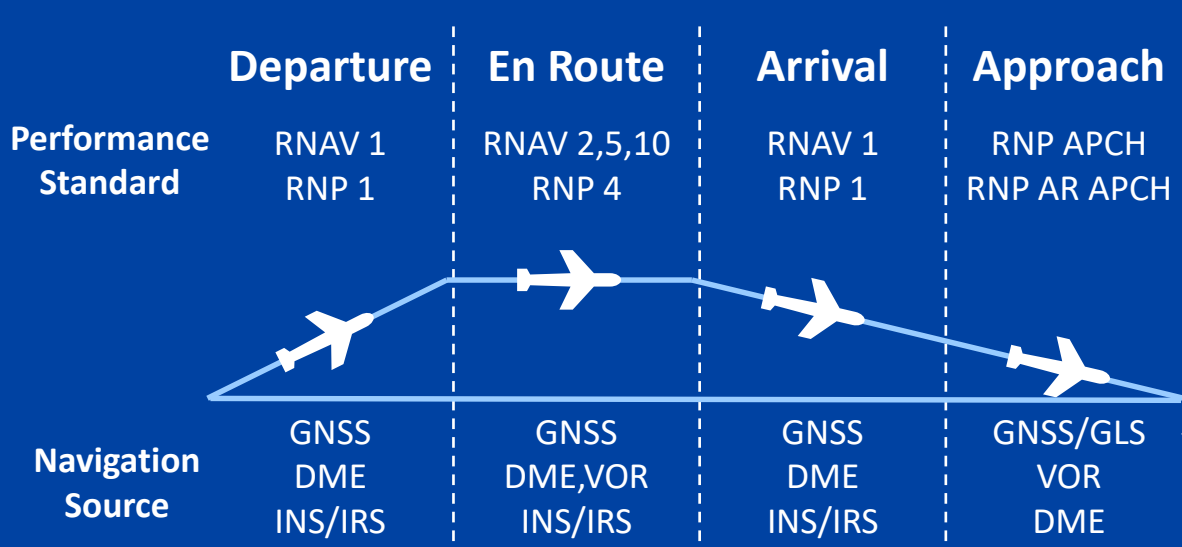
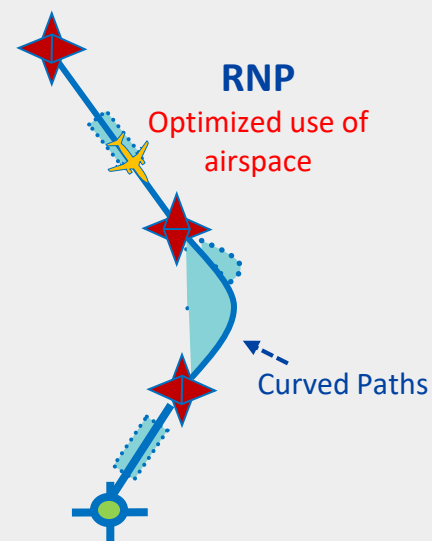
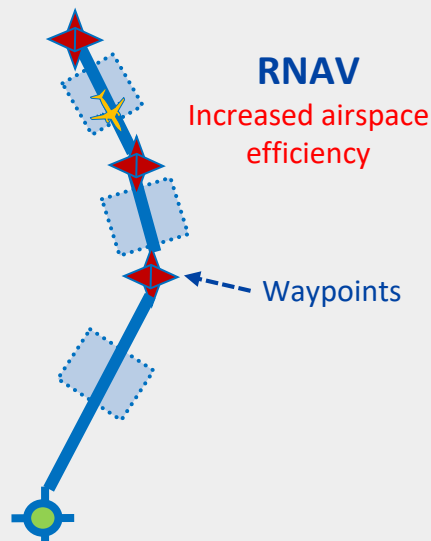
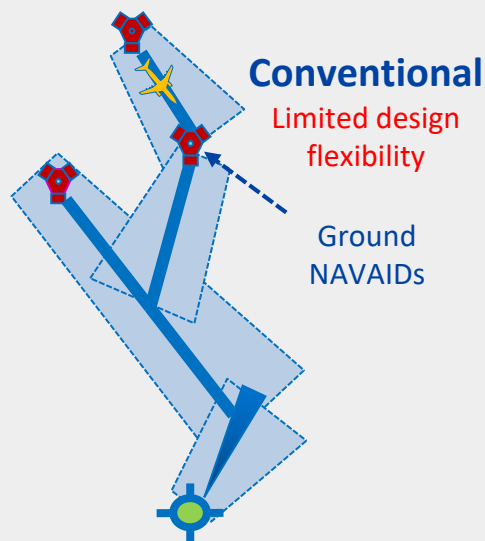
1 Requirements

- Rapid growth of civil aviation requires safe & efficient navigation technologies



1 Requirements

- Performance Based Navigation (PBN)

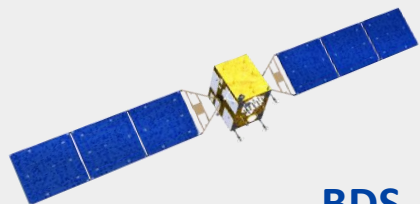


* CAAC PBN Roadmap

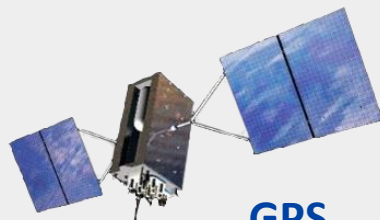
The PBN Space-based navaids include GNSS elements as defined in ICAO Annex 10 - Aeronautical Telecommunications.

-Doc 9613 PBN Manual

1 Requirements



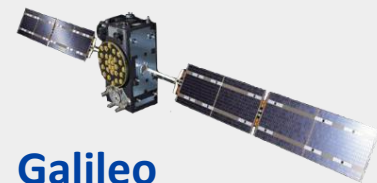
BDS



GPS



GLONASS



Galileo

- Onboard Navigation Equipment
- Advantages of Multi-constellation GNSS

Onboard Navigation	Pros	Cons	Equipment
Satellite-based	Global coverage High accuracy	Vulnerability from interference	GNSS
Ground-based	High reliability	Limited coverage Low accuracy	NDB, VOR, DME, ILS...
Inertial navigation	Work without external signal source	Error accumulation	IRS

Redundant backup

Reduced signal acquisition time

Improved position and time accuracy

Ability to resist single GNSS system fail

NDB



VOR/DME



Instrument Landing System

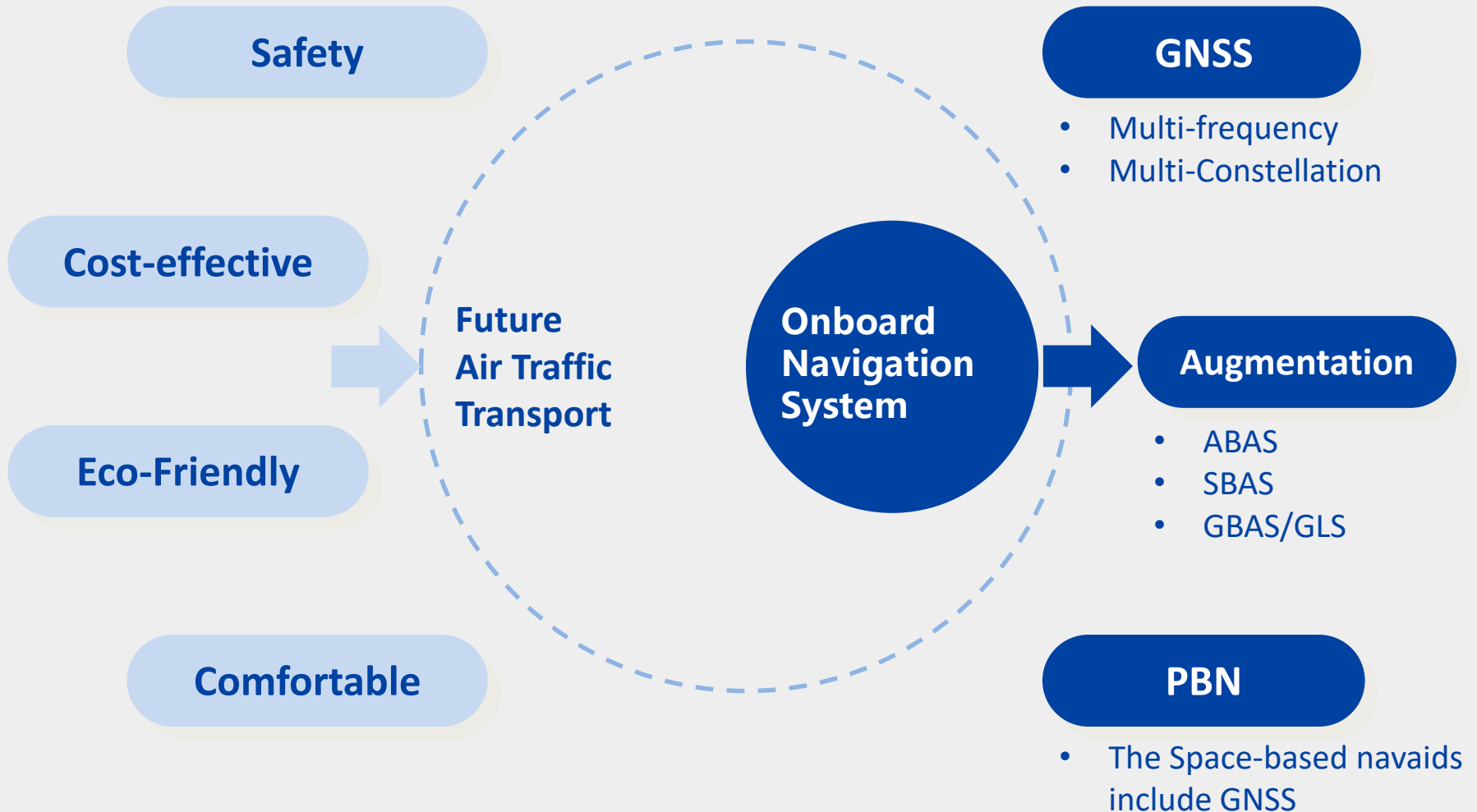


Inertial navigation



1 Requirements

- Aviation Requirements for Multi-constellation GNSS





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- The BDS Applications in COMAC
- Future Plan in COMAC

3 | Conclusions

2.1 The BDS Applications in COMAC

- **COMAC Civil Transport Aircrafts**



ARJ21

A turbofan regional aircraft

- Layout: 78 to 90 seats
- Range: 2225 to 3700 KM
- Production Certificate (PC) from CAAC
- Route operation



C919

A large civil jet aircraft

- Layout: 158 to 168 seats
- Range: 4075 to 5555 KM
- Finished the first test flight
- Will be delivered in 3 to 4 years



CRJ929

A dual-aisle civil aircraft

- Layout: 280 seats
- Range: 12000 KM
- The Joint Conceptual Development Program of CRJ929 has been initiated

2.1 The BDS Applications in COMAC

- New Multi-Mode Receiver (MMR) Prototype Development and Flight Experiment Modification



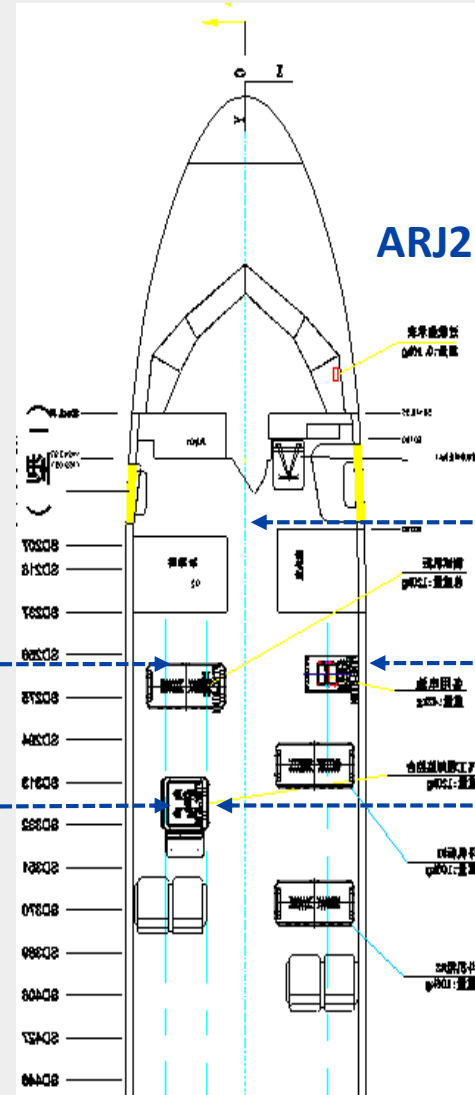
New MMR prototype supporting BDS/GNSS



BDS/GNSS Cabinet#1

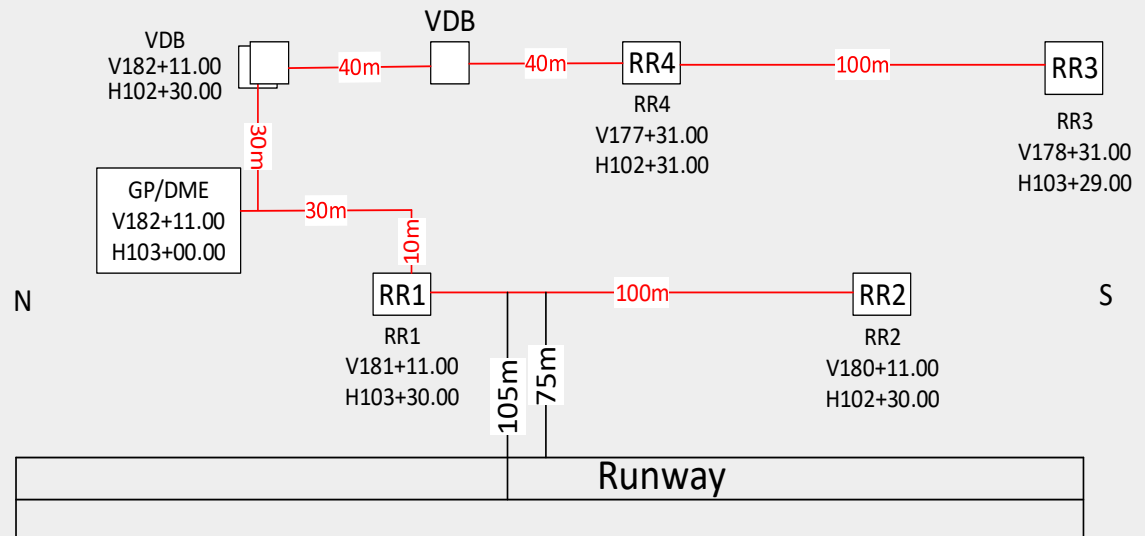


BDS/GNSS Cabinet#2



2.1 The BDS Applications in COMAC

- BDS/GNSS Based GBAS Installation in Dongying Airport

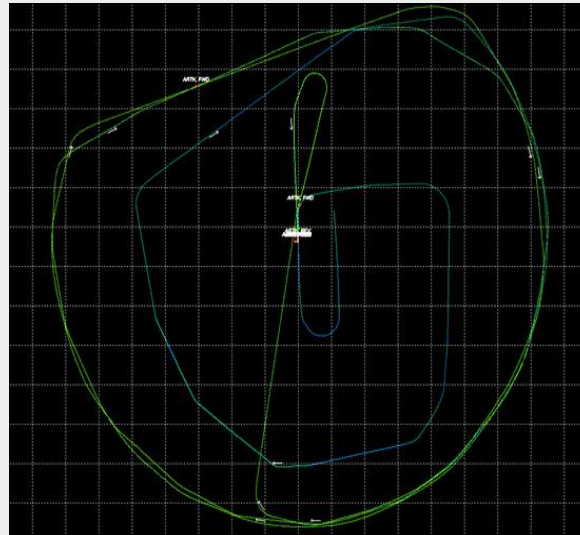


2.1 The BDS Applications in COMAC

- Flight experiment at Dongying airport (Oct. 2017)

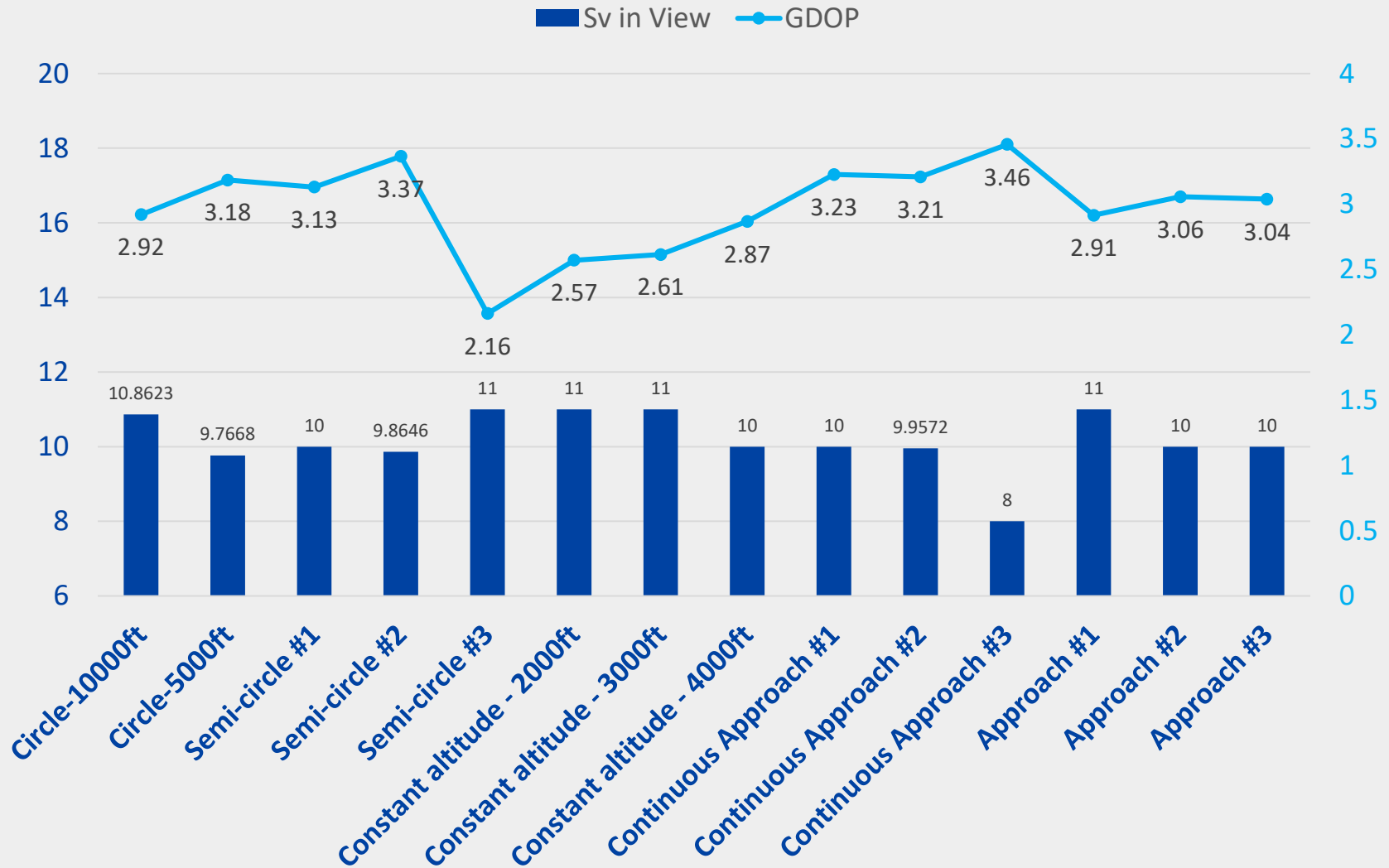
- 5 days
- 4 sorties
- 10 hours data

No.	Test subjects	Altitude
1	Circle Flight	10000ft
2	Circle Flight	5000ft
3	Arc Flight	2000ft
4	Level Flight	2000ft
5	Level Flight	3000ft
6	Level Flight	4000ft
7	Approach/ Continuous Approach	As required



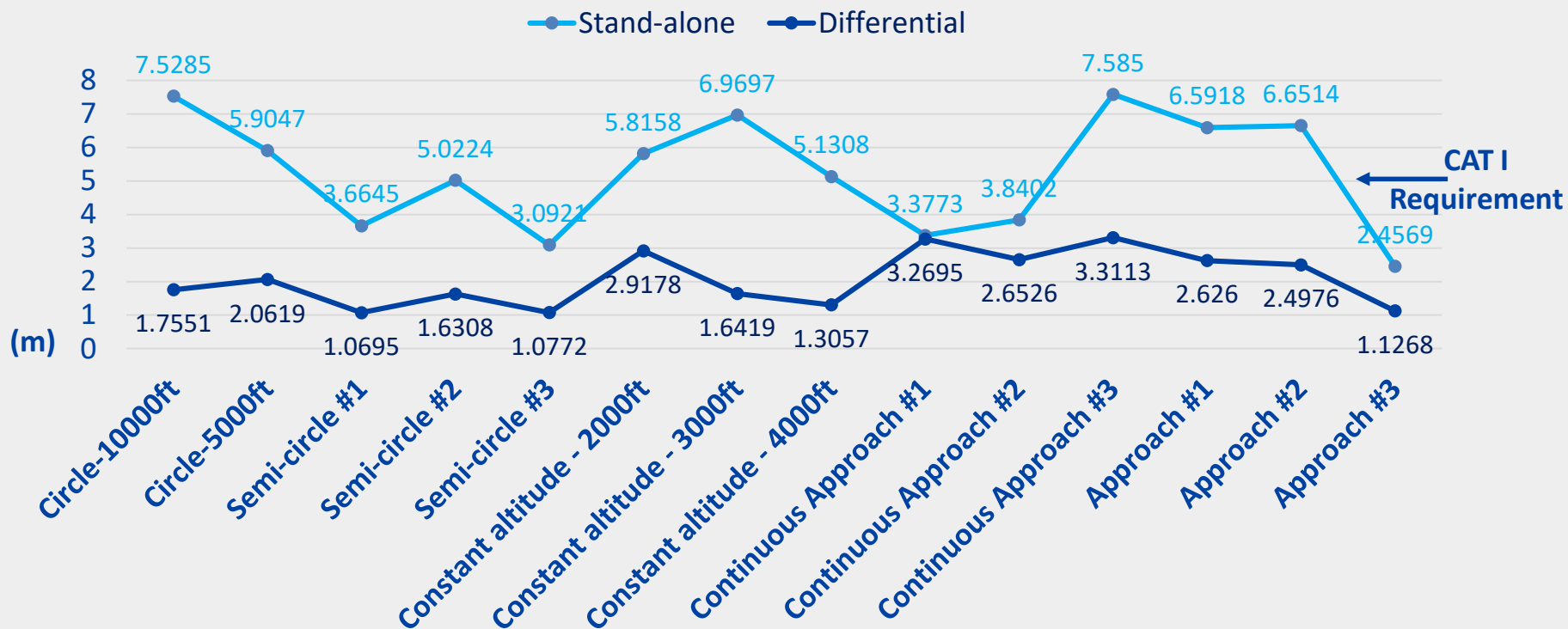
2.1 The BDS Applications in COMAC

- Average number of BDS satellites in view & GDOP



2.1 The BDS Applications in COMAC

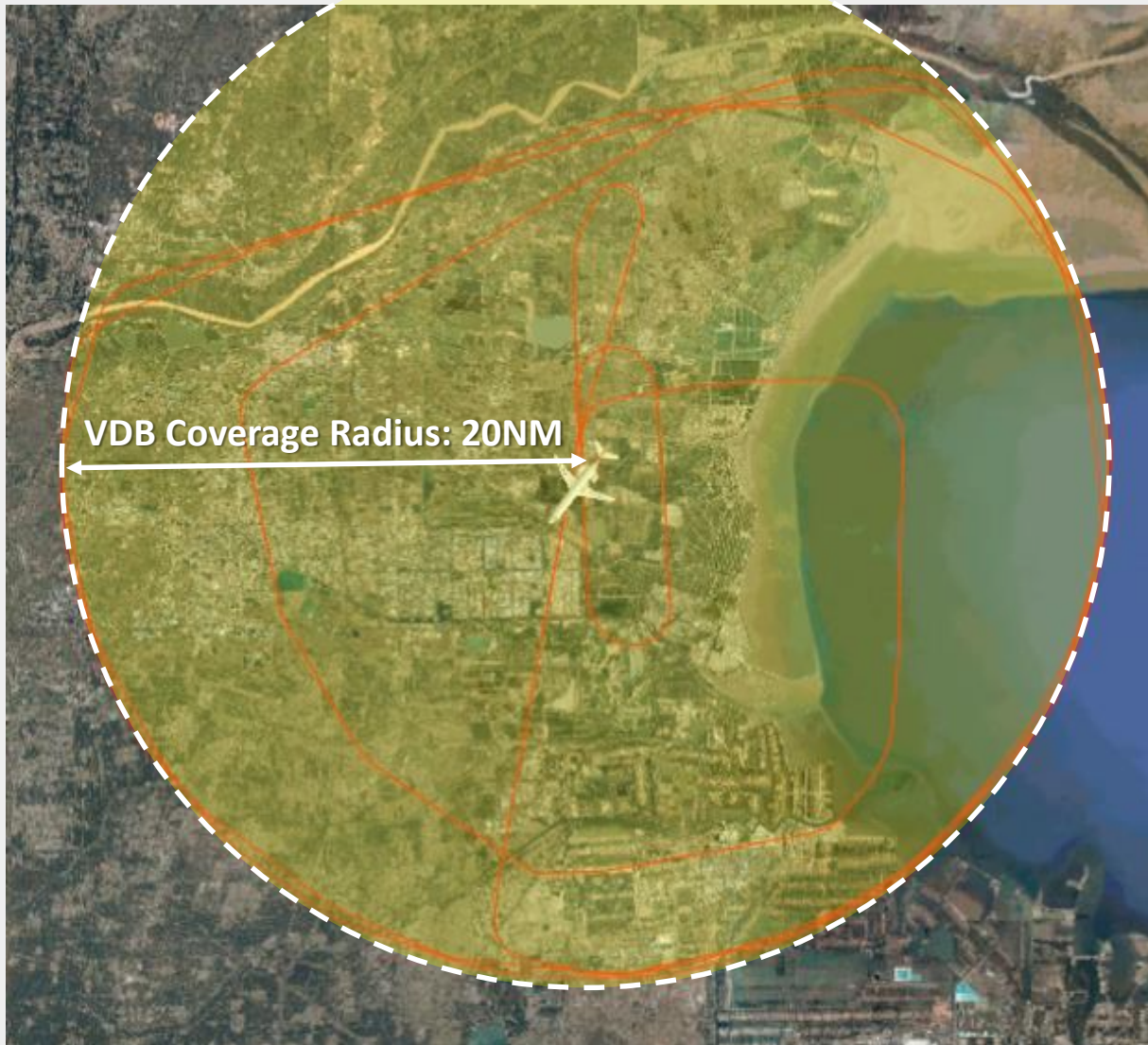
- BDS vertical positioning accuracy of every sortie



GPS & BDS Accuracy (95%)		GPS	BDS
Stand-alone	Horizontal Positioning Accuracy	1.2~3.9m	1.1~3.2m
	Vertical Positioning Accuracy	1.2~7.5m	2.1~8.5m
Differential	GLS Horizontal Positioning Accuracy	0.3~2.0m	0.6~2.0m
	GLS Vertical Positioning Accuracy	0.8~3.0m	1.1~3.3m

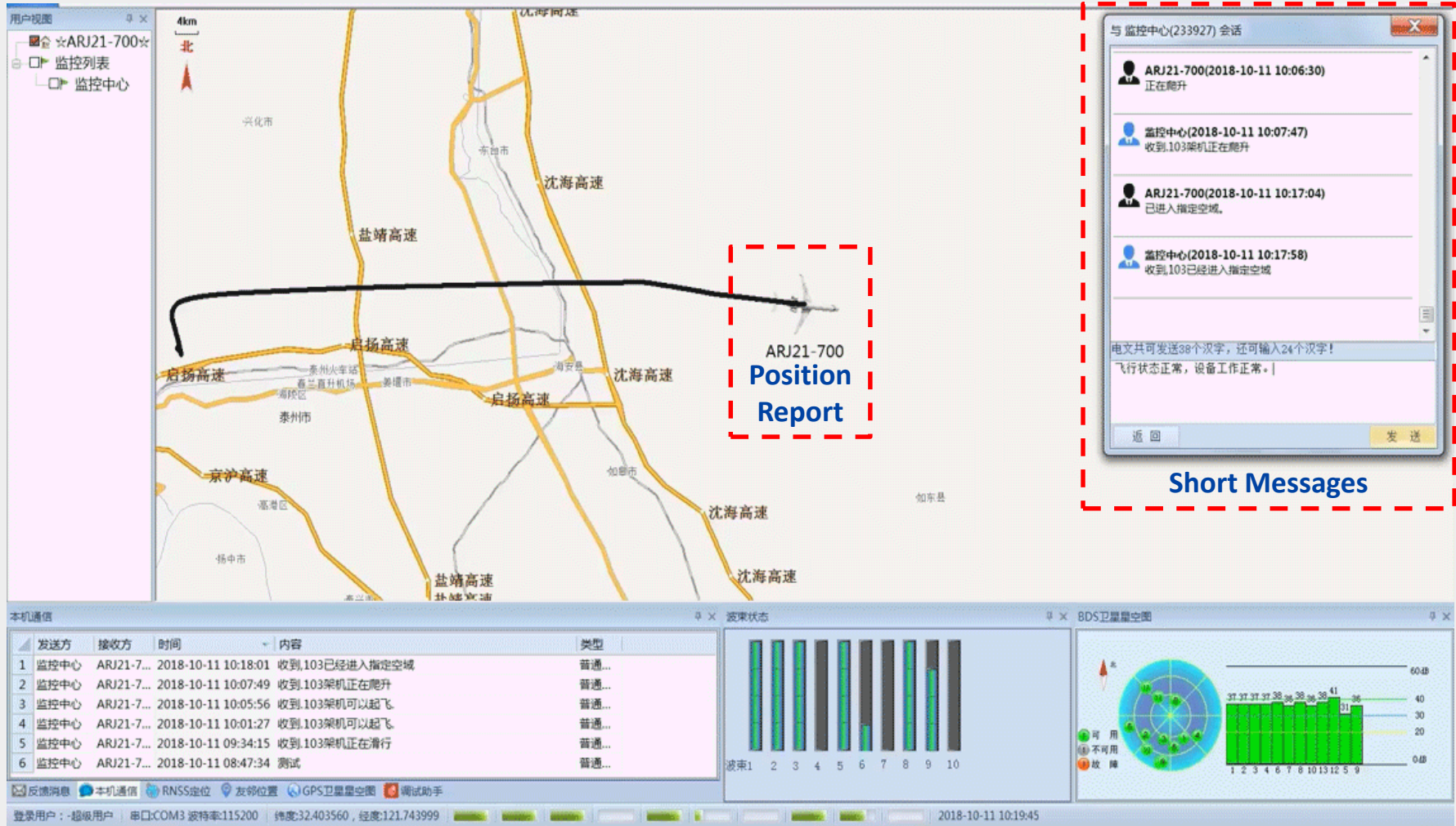
2.1 The BDS Applications in COMAC

- GBAS Signal Coverage Range



2.1 The BDS Applications in COMAC

- BDS short message flight tracking experiment at Yangtai airport (Oct. 2018)



- The unique short message function of BDS provides a new technological approach of real-time flight surveillance, tracking and emergency communication.

2.1 The BDS Applications in COMAC

- BDS short message flight tracking experiment at Yangtai airport (Oct. 2018)

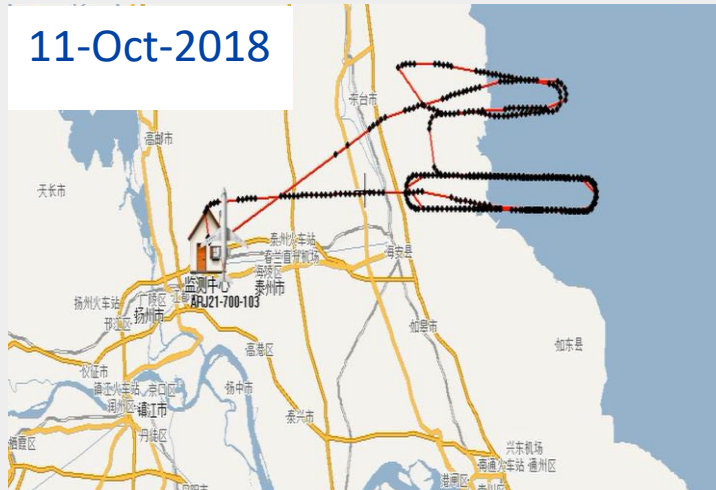
Date	Test Subjects	Time
11-Oct-2018	Taxiing & Circle Flight (10000ft)	3 hours
12-Oct-2018	Circle Flight (30000/32000/35000ft) Through Field (600ft)	3 hours
13-Oct-2018	Circle Flight (10000ft) Through Field (600ft)	2.5 hours



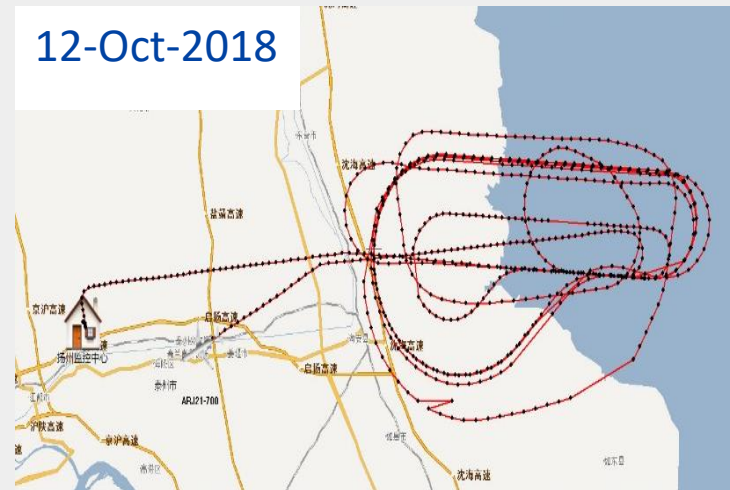
2.1 The BDS Applications in COMAC

- BDS short message flight tracking experiment at Yangtai airport (Oct. 2018)

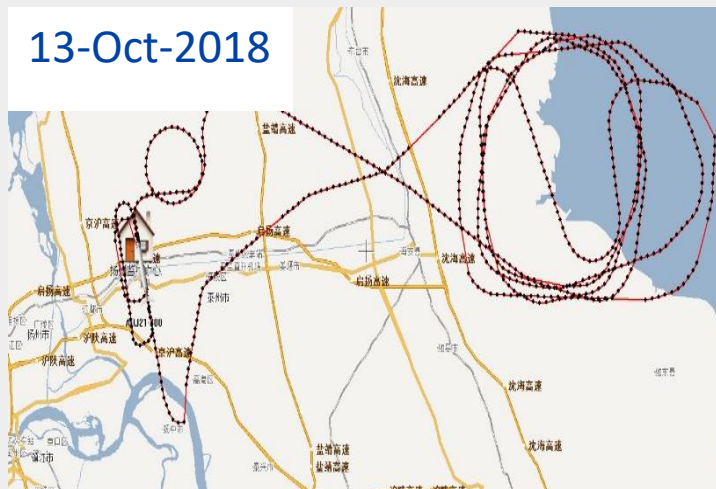
11-Oct-2018



12-Oct-2018



13-Oct-2018



Test results show that short message success rates meet the designed objectives.



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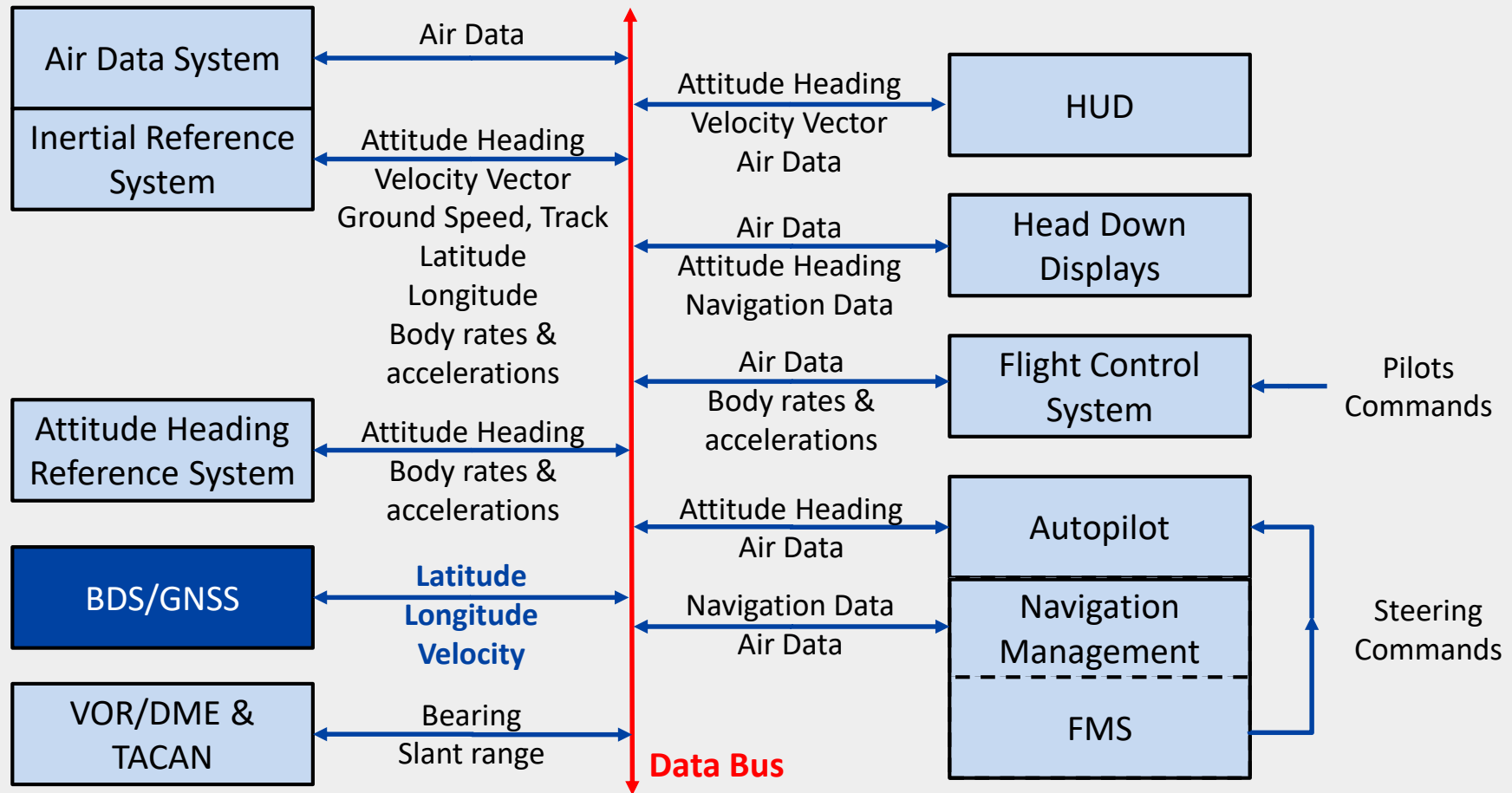
- The BDS Applications in COMAC
- **Future Plan in COMAC**

3

Conclusions

2.2 Future Plan in COMAC

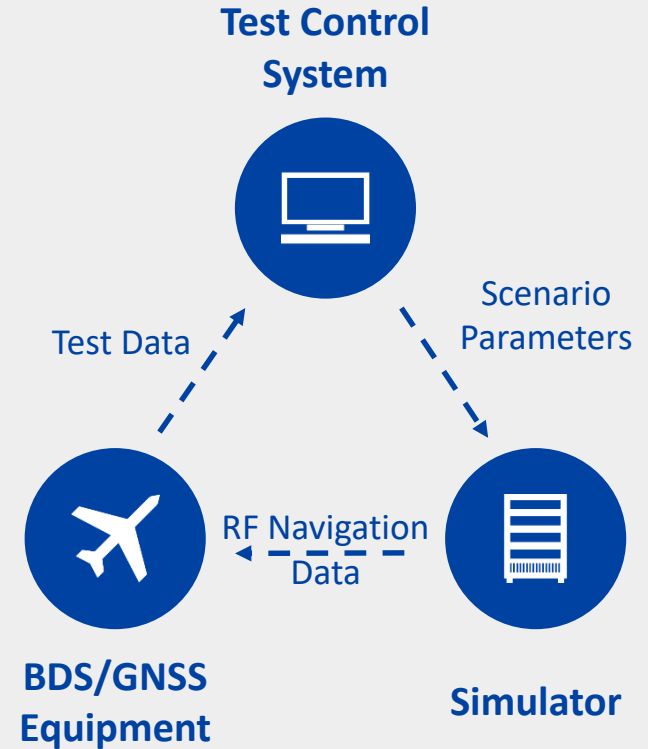
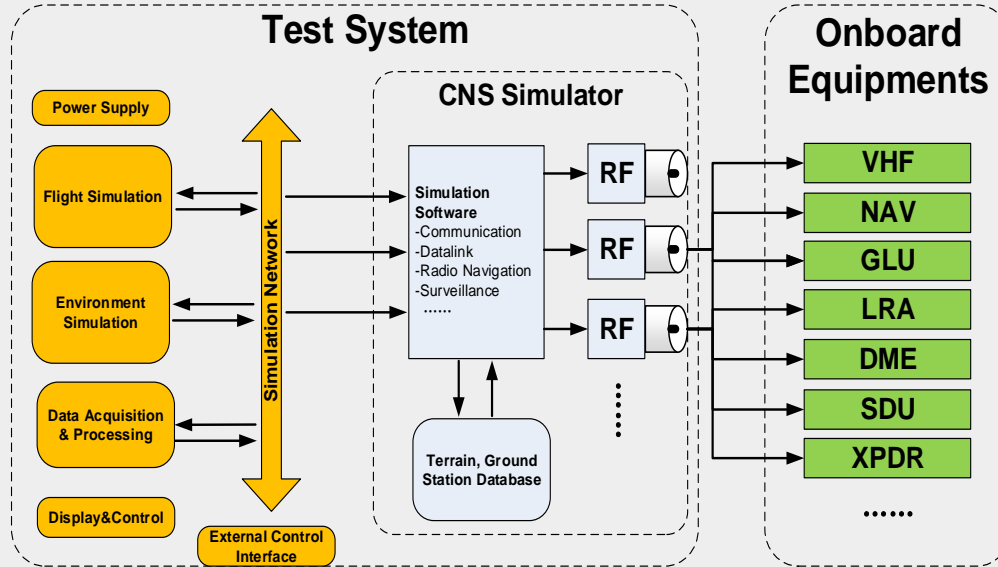
- Future plan focus on BDS/GNSS avionics system integration



- Test the **interface**, **functions** and **performance** of onboard BDS/GNSS equipment
- Verify the **interaction** between BDS/GNSS equipment and Flight Management System (FMS) & Core Process System

2.2 Future Plan in COMAC

• Functions and Performance Test



What to test



Time to First Fix



Sensitivity



Reacquisition
Time



Accuracy



Resilience to
Interference



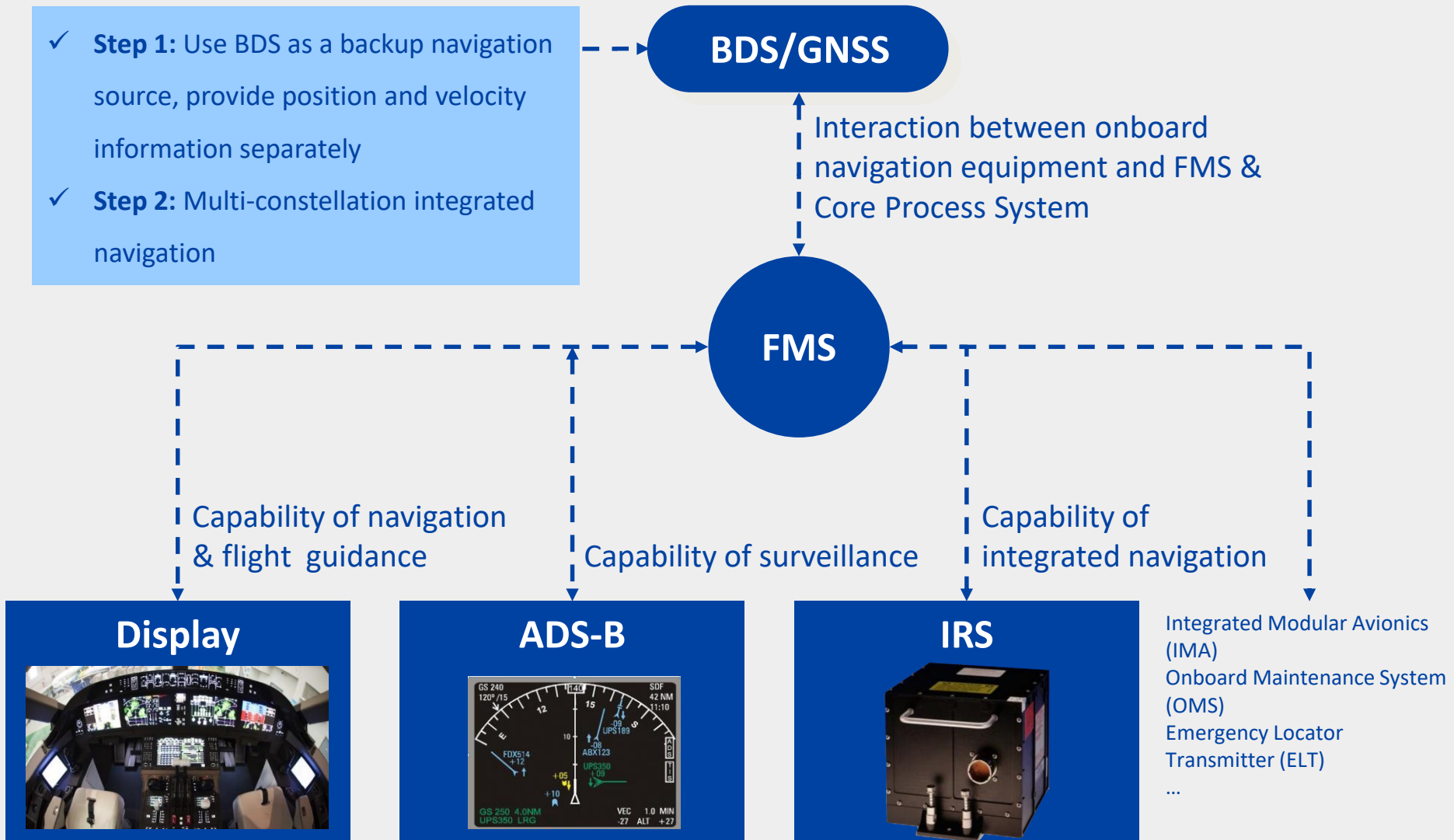
Integrity

...

2.2 Future Plan in COMAC

• Interaction Verification

- ✓ **Step 1:** Use BDS as a backup navigation source, provide position and velocity information separately
- ✓ **Step 2:** Multi-constellation integrated navigation



2.2 Future Plan in COMAC

- Flight test plan

2017-2018

**No
Interactions
to other
system**

- Installed in main cabin
- Not affect other avionics
- Verify functions and performance under real environment
- BDS short message flight tracking experiment

2018-2020

**Partly
integrated
to other
system**

- Installed in forward EE cabin
- Partly integrated with avionics
- Verify integration, navigation & guidance capability

2020-

**Totally
integrated
flight test**

- Complete integration
- Verify performance of aircraft when using BDS/GNSS as navigation resource





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- COMAC will definitely push forward the applications of BDS/GNSS on domestic civil aircraft.
- We suggest to strengthen international cooperation, and co-ordinate resources with navigation system service providers and airborne system providers.
- We will work with international experts to make BDS onboard equipment MOPS and other related RTCA standards get approved, so BDS can provide better service to international civil aviation.



THANK YOU !