United Nations/China/ European Space Agency Training Course on the Use and Applications of Global Navigation Satellite Systems 4 – 8 December 2006

GNSS Receiver Technology and Development Toolkits

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Navigation Satellites

- US: GPS-I、GPS-II(24+2)、GPS-IIR、GPS-III
- RUSSIA: GLONASS（24）
- Europe: Galileo v.s. GPS III
- China: BeiDou-1（3）、BeiDou-2（30+5）

Elevation Mask	Galileo SVs In View	GPS SVs In View	GLONASS SVs In View	BeiDou2 SVs In View	Total SVs In View
5°	**13**	**12**	**12**	**13**	**50**
10°	**11**	**10**	**10**	**11**	**42**
15°	**9**	**8**	**8**	**9**	**34**

Current Status:Between Second and Third Generation

GNSS Satellite and Receiver Technologies

Satellite Lifetime: 3, 7, 15 years

Orbit: 21000-26000km from the earth center

Adjust Period: 2 Hours-180 Days

Frequencies: 1.1GHz to 1.7Hz

Ranging Code: Standard and Precision

Accuracy: 10m, 1m, 10cm, 2cm

Applications:Aeronautics,Astronautics,Seafaring, Weapons, Car Navigation, Personal Positioning devices, Measurement and Precision timing

Accuracy, Continuity, Availability, Integrity

Update every 3-5 years up to 2030

Seven Major GNSS Applications

Aeronautics,Astronautics,Seafaring,Weapons, Car Navigation, Personal Positioning, Measurement and Precision timing

Different Apps need different receivers:

Accuracy, Continuity, Availability, Integrity,

Update period:

3 to 5 years

Common problems:

No Integrity information.

Future Receivers:

More Accurate, Smaller size, Power consumption,

High Sensitivity, Dynamic, Anywhere Anytime,

PVT output reliable.

Integrity info are require by receiver users

Aeronautic Application

Replacing Traditional Navigation Systems, GNSS is becoming prime navigation method.

Five Phases of the flight: En Route, Terminal Flight, Cat-I/II/III Approaches, Automatic Landing, Slide on the ground.

GNSS Satellite systems must be augmented for the aviation usage.

Satellite-Based Wide-Area Augmentation System: WAAS, EGNOS, MSAS,GAGAN, etc.

Ground-Based Local-Area Augmentation System: LAAS

SBAS Base Stations: North America,Europe,Japan, China, India, Australia, etc.

GBAS Base-Stations: 3 to 4 stations for every air port.

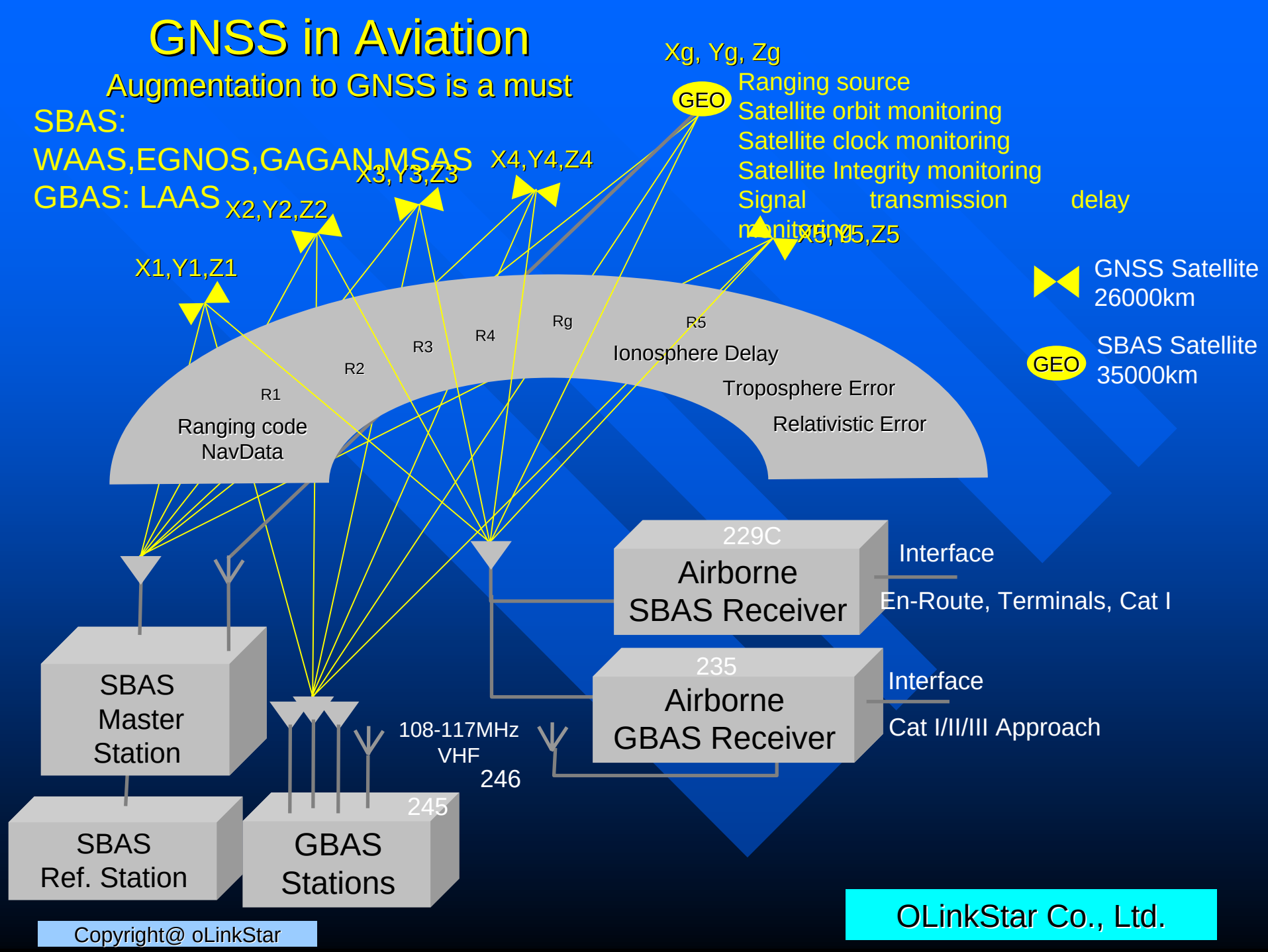
Air-borne Receivers: SBAS Receiver and GBAS Receiver

1995-2006 Research, Spec, Testing. Sept.1,2006.

GNSS in Aviation

Augmentation to GNSS is a must

SBAS:
WAAS,EGNOS,GAGAN,MSAS
GBAS: LAAS



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Seafaring

Radio Beacon Network (RBN) along the coast around the world has been in operation and provide continuous services from the year of 2001.

DGPS Receiver: 10m，3m, 1m depending on how far of the ship was from the RBN stations.

RBN:Providing Services in December 2001.

Astronautics

Speed：8000m/s（Compare to 515m/s）

Altitude: 3000km

Acceleration：30g

Positioning Update Rate: 100Hz

Receivers: Can work at high speed and overload.

High dynamic, High Update Rate

Weapon System

Dynamic,Interfering,Evil signals,extreme conditions,size, power consumption, Storage, etc.

Modern v.s. Traditional Missiles 1:600

Car Navigation

Current Market: Around 40% of the GNSS market was dominated by Car Navigation because it is easier compared to other applications both in receiver technologies and deployment.

Future: Market shares will be getting down eventually while other apps doing up.

Receiver Features: Continuity is the key feature.

Continuity, GNSS/DR, GIS.

Handheld GNSS Equipments

Cellphone users: 1.5 Billion around the world, 410 Million in China.

Features: High sensitivity with -150dBm or better

Current Solution: A-GPS

Future: A-GPS + L2C + L5, etc.

Key technics: Low Price, Small Size, Low Power Consumption, High Sensitivity.

Handhelds: 1.5 Billion 410 Million in China

Measurement and Precise Timing Facility

Accuracy 10cm，2cm

Precision: 20ns

Receiver Technics: Differential, RTK, etc.

Accuracy, Quality, Waterproof, etc.

Internet, Mobile Communication, GNSS

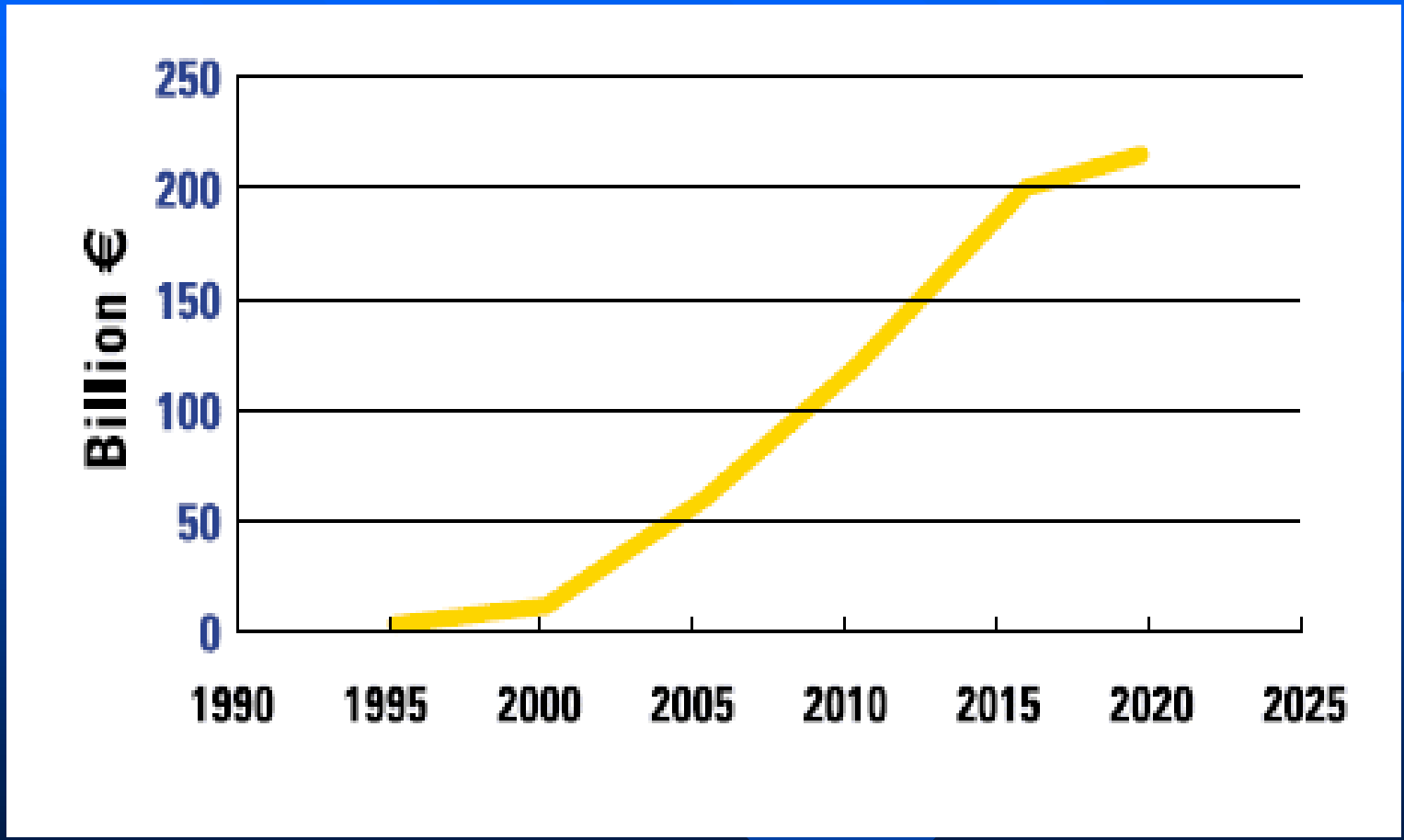
Three fundamental industries in the information age.

Current GNSS will represent in future something an innovation comparable to the microprocessor in the eighties, or the GSM mobile communication in the nineties.

By the year of 2030: Anywhere, Anytime

GNSS v.s. 80286, 7 Intel, 7 Microsoft?

Market Prediction



20 to 30 years rapid growth.

How to design and develop GNSS Receivers

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Design and Develop GNSS Receivers

1. Familiar with Advanced design method
2. Understand User's requirement
3. Find state-of-arts development platforms, tools, hardware, software, algorithms, etc.
4. Build Fast Prototype
5. Intensive Testing, Modifying before release

Fast Prototype: 3-6 Months

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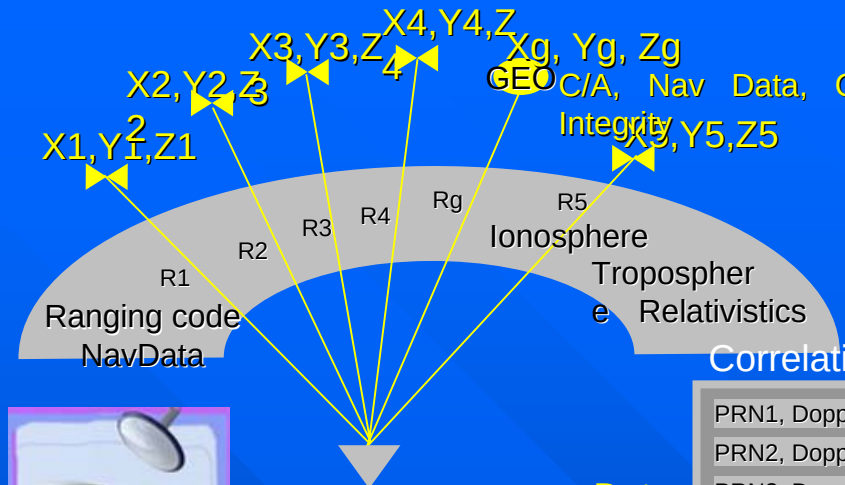

RF, IF, Correlation, Algorithms, Software

GNSS Design and Develop Platforms

NS-TTS
GNSS Signal Repeater

Downconvert
ADC

Data Stream

NewStar210
GNSS IF Signal Digitizer

Correlation

PRN1, Doppler1
PRN2, Doppler2
PRN3, Doppler3
PRN4, Doppler4
PRN5, Doppler5
PRN6, Doppler6
PRN7, Do
PRN8, Do
PRN9, Do
PRN10,
PRN11,
PRN12, Doppler12

Commands
Data

Base Band Software

Search
Tracking
C/N0
PSR
Carrier
ta
S

GPSTime
PSR
Carrier
NavData
W

PVT Solution

SV ECEF
SV Clock
Ionosphere
Troposphere
Relativistic

Position
Velocity
Time

NewStar180
GNSS Signal
Simulator

NewStar210A
GNSS IF Signal
Digitizer with Replay

NewStar200I
GNSS Base Band
Unit

NewStar100
GNSS RCVR Dev
Platform

NewStar150
GNSS Receiver
Development Training
Device

oLinkStar Design and Develop GNSS Tools and Platforms

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Thanks!