Galileo System in China

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1. Introduction

Introduction

- Galileo Cooperation Agreement signed between NRSCC and GJU on 9th October, 2004.
- During IOV phase, 65 million Euros contribution from China.

Introduction

- Up to now,12 projects in IOV phase are ongoing, total valued about 33 million Euros.

- The most important project EEG is expected to be signed in the near future.

2. Presentation of CGI

Presentation of CGI

中国空间技术研究院
CAST

21%

21%

21%

21%

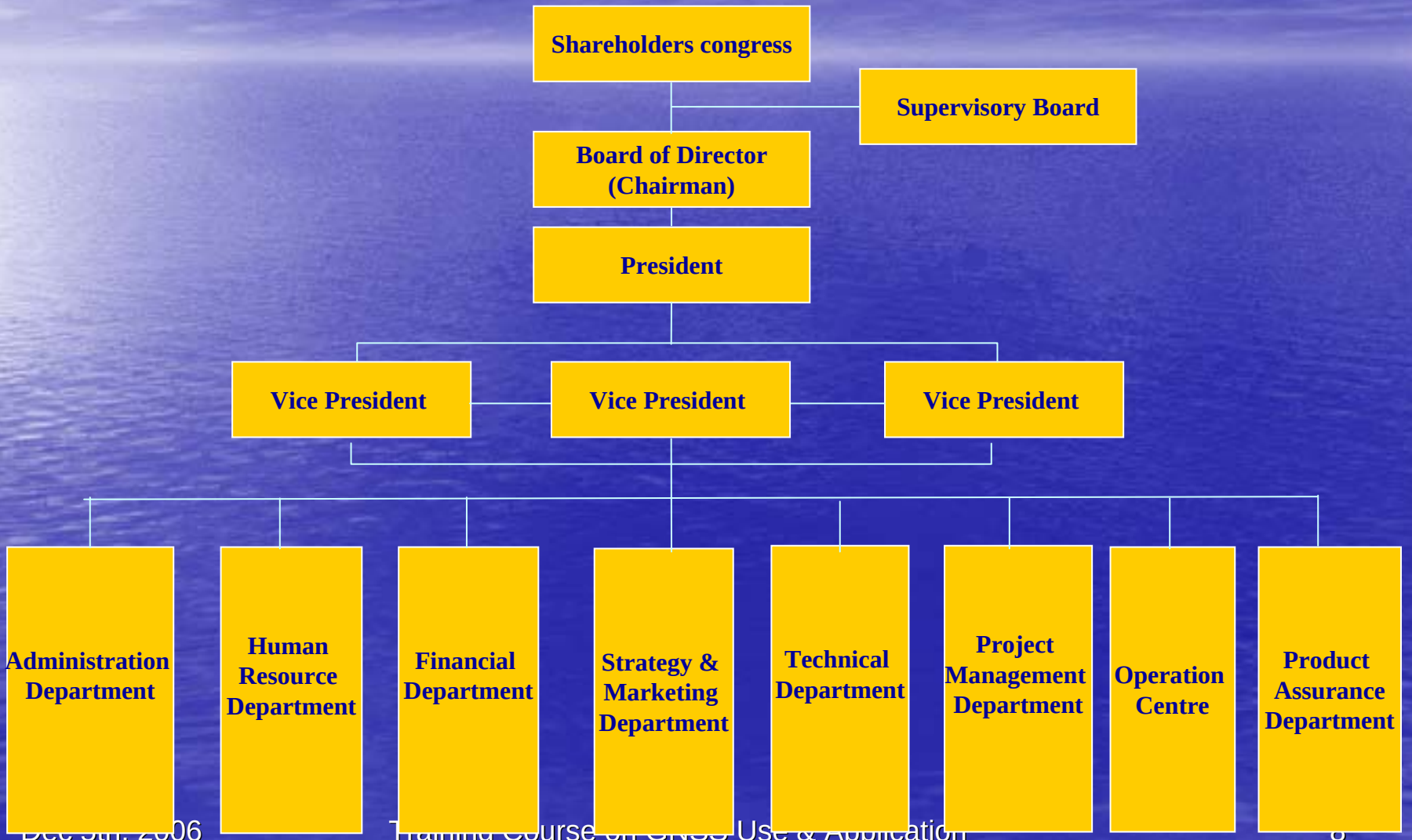
16%

Approved to be incorporated

by the State Council

in Dec. 2004

Presentation of CGI



Presentation of CGI

- CGI is the executor of the China's involvement in Galileo Program which includes the Space, Ground, Application segment development and the financing. Besides, CGI is endeavoring to be the Galileo Concessionaire in China.

- CGI is specialized in researching and developing of Satellite Navigation system, manufacturing and marketing of the navigation product and service, operating, providing other relevant service.

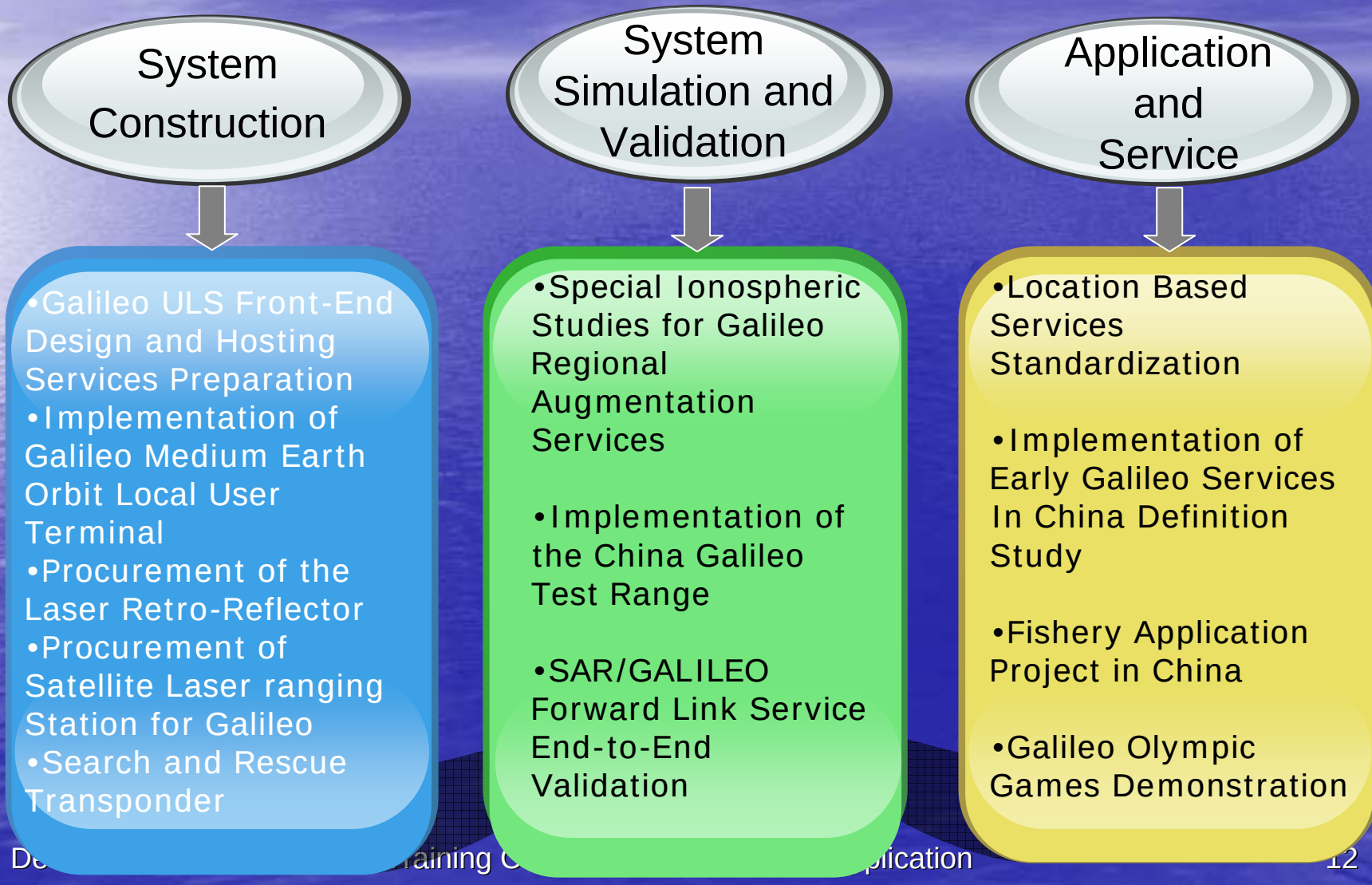
- CGI streamline all the Satellite Navigation resources in China to participate in the Galileo construction in a worldwide range. Under the leadership of China MOST, CGI is featured to be the Satellite Navigation leader in China.

3. Galileo Projects in China

Galileo Projects in China

Characteristics / Projects	Galileo System Products				system simulation and		Galileo System Application		
	Hardware			Software	Simulation	Test	Application	Augmentation	Incremental
	Ground	Space							
		Non-power Supply	Power Supply						
ULS-FE	✓								
MELOUT	✓								
LRR		✓							
SAR			✓						
Ionosphere				✓					
CGTR					✓				
EEV						✓			
LBS							✓		
EGSIC								✓	
Fishery									✓
Olympic									✓

Galileo Projects in China



Fishery Application (FAS)

- Overview:
  - > Implementation of a system based on GNSS to support applications in **Chinese offshore fishery**
  - > Provide information services (**weather, position, market and commercial data**); **Vessel monitoring and control; safety enhancement**
  - > Beneficial for governmental administration and fishermen

Fishery Application (FAS)

- **Aims:**
  - Analyze the market requirements, feasibility and application mode of the GNSS application in fishery
  - Deliver fishery information timely through GEO communication link for futures application
- **Undertaker:**

  China Satellite Communications Corporation (China Satcom)
- **Contract Price:**

  3.663 Million Euros

Duration 24 months

2005/07/28 Kick off

Ionosphere Study (IONO)

- **Overview :**
  - Investigate an effective Ionospheric correction for single frequency Galileo receivers on regional basis
  - Compile a set of Ionospheric data for validation of the approach
  - Study the influences of Ionospheric scintillations.
- **Undertaker:**

  China Galileo Industries (CGI)

- **Contract Price:**

  0.58 Million Euros

Duration 18 months

2005/07/28 kick-off

Location Based Services (LBS)

- **Overview :**
  - Extend the LBS standardization in 3GPP, 3GPP2 and OMA to support Galileo services and other satellite navigation systems.
  - LBS, driven by strict standardized procedures, acts as a great part of mass-market applications
  - Scientific Research project

- **Undertaker:**
  China Galileo Industries (CGI)

- **Contract price:**
  0.52 Million Euros

Duration 24 months

2005/07/28 kick-off

China Galileo Test Range (CGTR)

- **overview:**
  - develop and deploy a ground-based Galileo pseudolites infrastructure in China , which acts as:
    - A tool to perform analysis and research on the Galileo signal
    - Test environment for Galileo receiver and application development
    - Local augmentation system to deliver high performance positioning and navigation services
- **Undertaker:**

  China Electronics Technology Corporation (CETC)
- **Contract Price:**

  9.77 Million Euros

China Galileo Test Range (CGTR)

- **Aims:**
  - To establish indoor & outdoor testing environment
  - To act as one of the fundamentals for future GALILEO operations in China

Up-Link Station Front End (ULS-FE)

- **Overview:**
  - One of the main components of Galileo ground segments. It will be used for transmitting up-link signals in C-band for uploading mission related information
- **Undertaker:**

  China Aerospace Science&Industry Corporation (CASIC)
- **Contract Price:**

  0.68 Million Euros (Phase 1)

EEV & MEOLUT

- **Overview:**
  - End-to-End validation of SAR/Galileo system forward link service by demonstrating the system and evaluating its technical performances.
  - MEOLUT is a ground receiving station of SAR/Galileo system which shall forward SAR signals to the central processing centre.
- Currently, it is planed that two local user terminal stations to be established for system testing and validation in IOV phase. One station in Europe and the other in China.
- Galileo MEOLUT system is going to be brought into COSPAS-SARSAT global rescue system, Chinese MEOLUT can help increasing the ability of alert system in north-west Pacific area

EEV & MEOLUT

- **Undertaker:**
  China Academy of Space Technology (CAST)

- **Contract Price:**
  5.5 Million Euros (EEV)

  2006/03/09 kick-off

  Duration 38 months

  2.73 Million Euros (MEOLUT)

  2006/03/20 kick-off

  Duration 54 months

Early Galileo Service In China (EGSIC)

- **Overview:**
  - EGSIC project phase 0 makes a thorough investigation of potential Chinese market of different industries currently or potentially relying on the augmentation and integrity services. It also formulates the mission requirements and system requirements, followed by the introduction of architecture and operation planning.
  - Later phases of the project has been merged to the EGSIC/ERIS/GSS project scope.

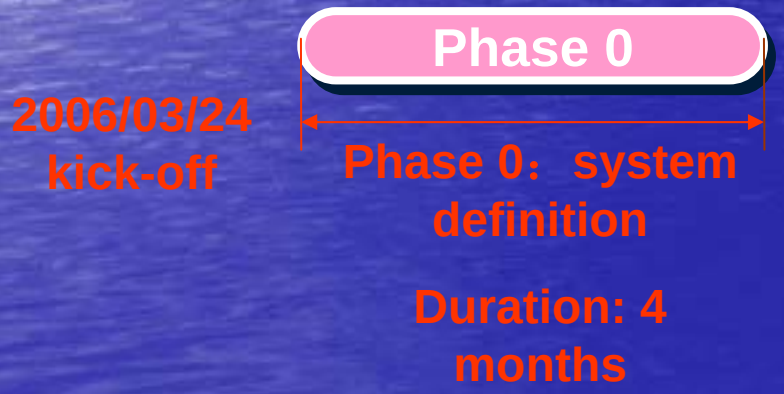
Early Galileo Service In China (EGSIC)

- **Undertaker:**

  China Aerospace Science & Industry Corporation (CASIC)

- **Contract Price for phase 0:**

  0.6 Million Euros



Satellite Laser Ranging Services (SLRS)

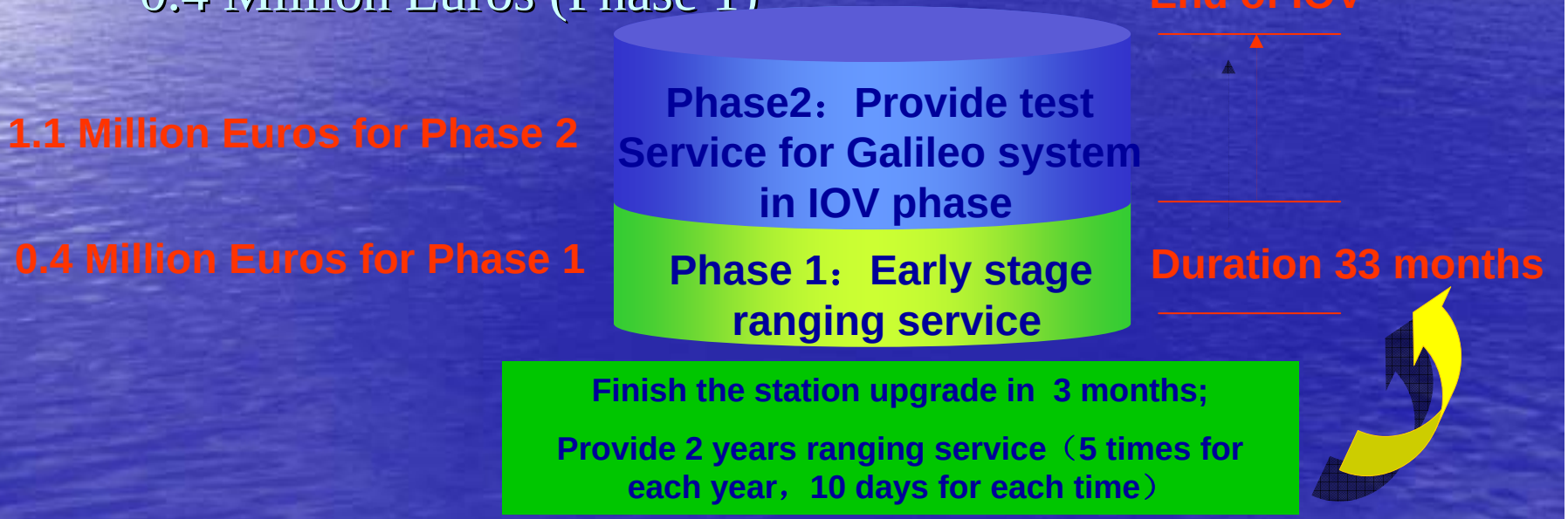
- **Overview:**

Procure a SLR station in China for achieving accurate orbit estimation of Galileo satellites and on-board clock error measurement. This station will be included in the global network of SLR stations.

Satellite Laser Ranging Service (SLRS)

- **Undertaker:**
  China Electronics Technology Corporation (CETC)

- **Contract Price:**
  0.4 Million Euros (Phase 1)



Laser Retro-Reflector (LRR)

- **Overview:**

  enable the accurate range-finding between the Galileo satellite and the laser ground station

- **Undertaker:**

  China Electronics Technology Corporation (CETC)

- **Contract Price:**

  1.3 Million Euros

Search and Rescue Transponder (SART)

- **Overview:**
  - First navigation satellite equipped with SAR Transponder.
  - Active payload
  - Deliverables: 1 EQM, 4 FM, 1 RF suitcase.

- **Undertaker:**
  China Academy of Space Technology (CAST)

- **Contract Price:**
  7.095 Million Euros

Galileo Olympic Game Demonstration (GOGD)

- **Overview:**
  - To define the requirements and architecture of Galileo application demonstration in Beijing 2008 Olympic Games.
  - It is a good opportunity for Galileo system to be introduced to public all over the world.
  - To involve demonstration planning in Shanghai 2010 World Expo.
- **Undertaker:**

  China Satellite Communications Corporation

  (China Satcom)
- **Contract Price:** 0.9 Million Euros
- **Duration:** 5 months

4. Galileo System Integration in China

Integration Objectives

- To provide Global Contribution to Galileo System
- To ameliorate Galileo System Performance In China

Technical Implementation

- To Set up
  - Global GSS Station
  - SLRS station
  - MEOLUT station
  - Regional Integrity and Augmentation system
  - Local Integrity and Augmentation system
  - Test Environment

Primary Functions

- **Global Contribution**
  - **Provide required information for Global Galileo system**
  - **Provide Satellite Laser Ranging service for Galileo navigation system**
  - **Receive and Transmit the rescue signal from MEO satellite around Asian area for COSPAS-SARSAT organization.**

Primary Functions

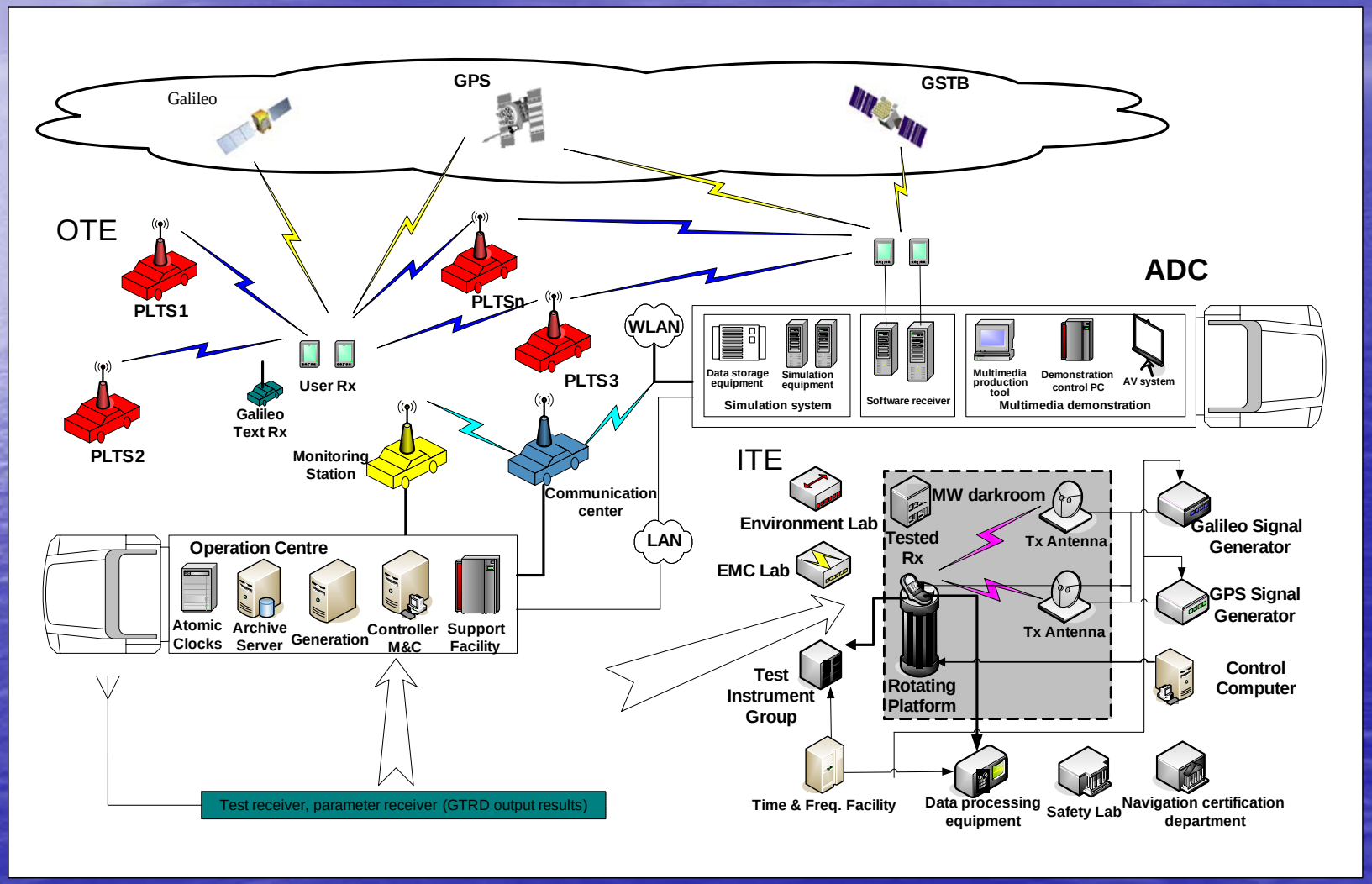
Regional Integrity and Augmentation

- Provide integrity and augmentation signal in China area
- Provide synchronous accurate positioning and navigation service in China area

Primary Functions

- **Local Integrity and Augmentation**
  - **Provide higher accuracy signal in specific area**
  - **Provide higher accuracy signal for specific industries**

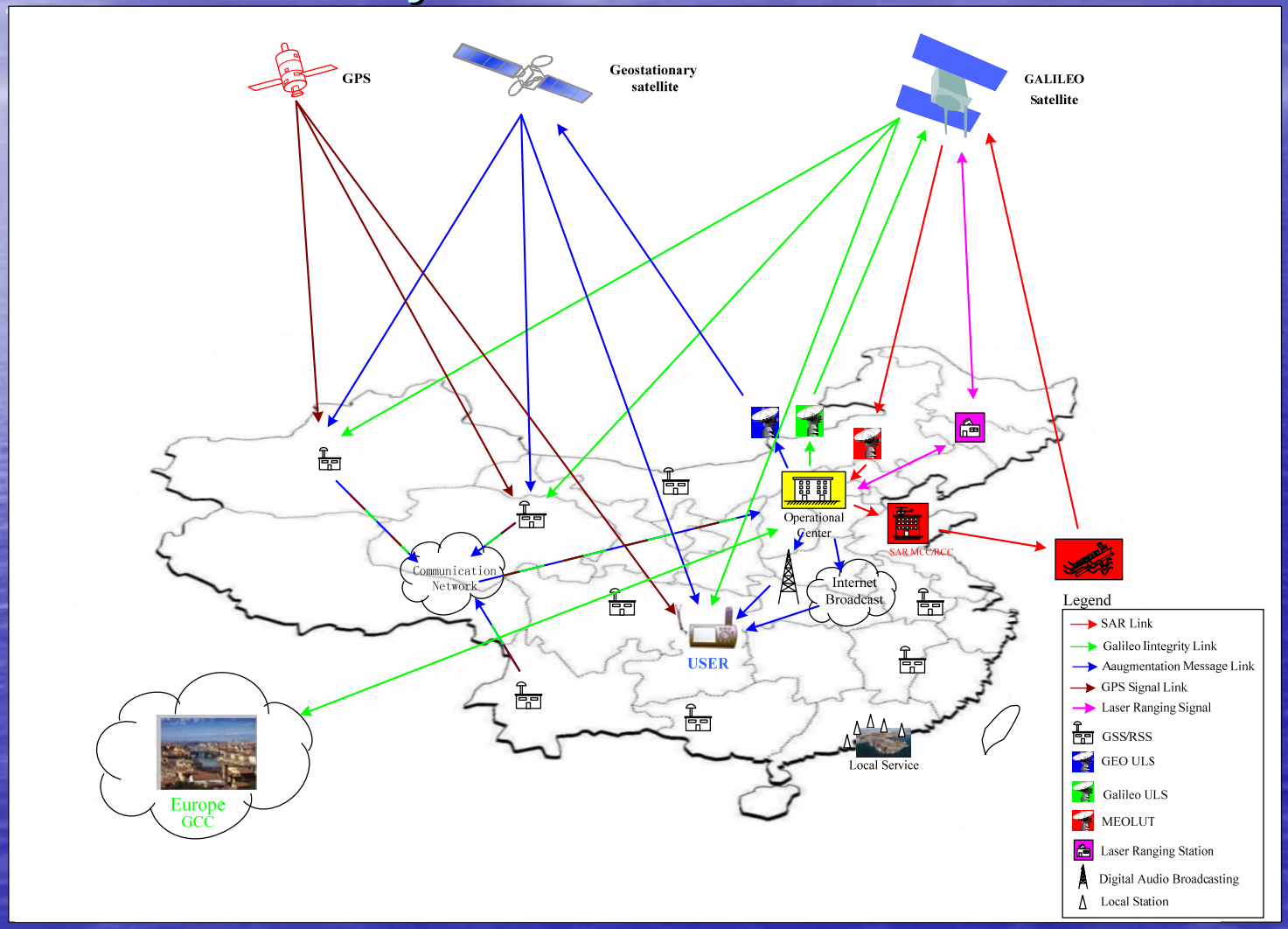
Test Environment



Regional Integrity and Augmentation System Components

- Reference station network
  - State wide reference station network
  - Local reference station
- Operation service center
  - Information processing center
  - Service center
- Information dissemination system
  - Geostationary communication satellite
  - Ground broadcast network
  - Internet & mobile communication network

System overview



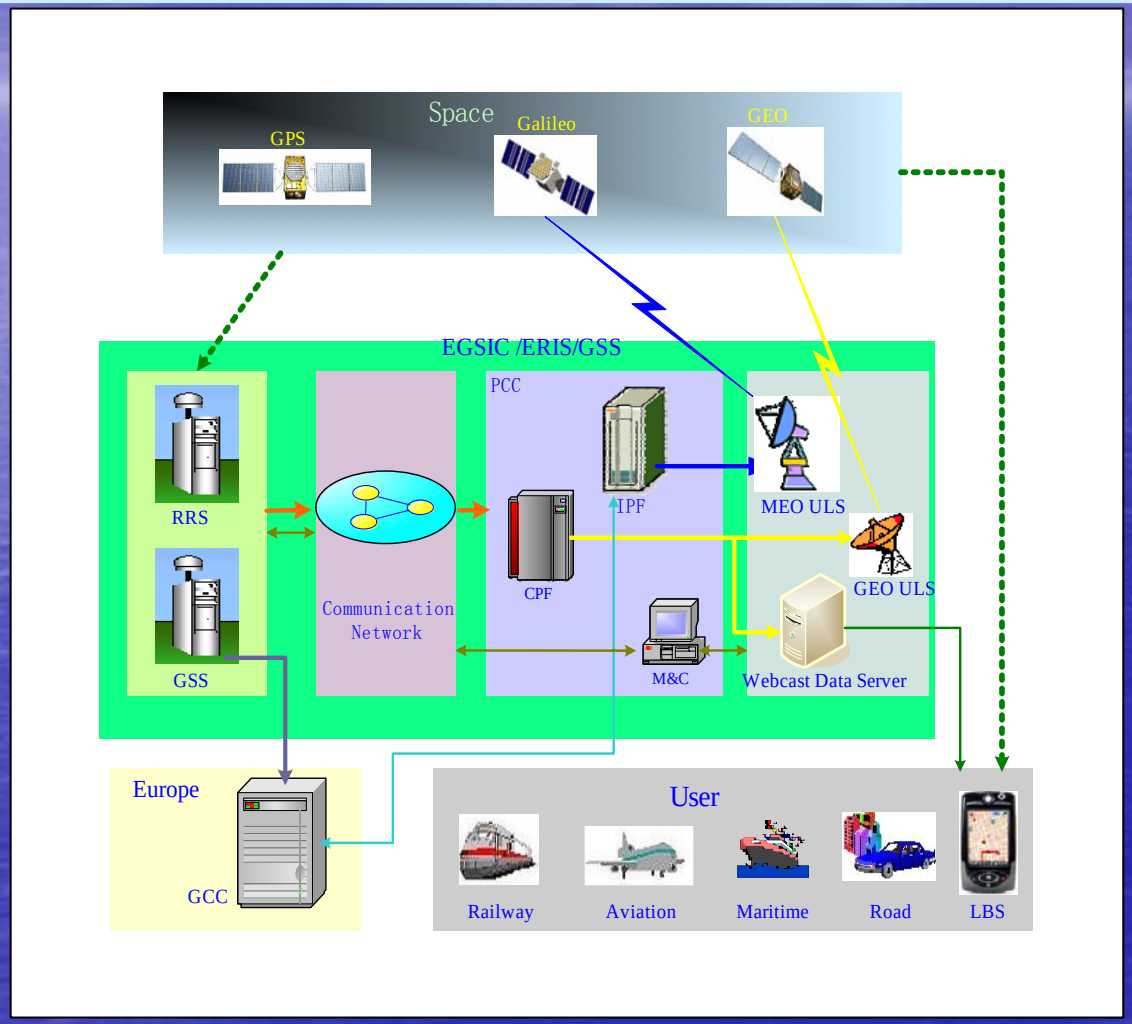
Key Technologies (1)

- Navigation satellite synchronous accurate orbit determination technology
- Synchronous accurate satellite clock correction assurance technology
- Synchronous acquisition and pretreatment technology based on internet navigation data
- Accurate Navigation information coding and key dissemination technology

Key Technologies (2)

- High accurate synchronous modification model of ionosphere and troposphere
- Monitoring technology for precise positioning and the integrity of Navigation service system
- Integrated signal receiver terminal
- Operation technology of Precise positioning and Navigation service system

EEG project overview



Objectives and Tasks

Focusing on EEG project with the system extension to build infrastructure to provide Integrity and Augmentation signals in china and provide test services for Global Galileo system in IOV phase. Including:

- 11 GPS reference stations
- 1 Central Processing Facility
- 1 Monitoring and Control Station
- 1 Optional dissemination via GEO up-link station
- Internet distribution
- 11 Galileo/GIOVE type reference stations
- 1 ERIS Processing Facility
- 1 Monitoring and Control Station
- 1 MEO Up-Link Station (ULS)

5. Galileo System Application in China

The characteristics of Galileo System Application (1)

- Galileo System for civil use
  - The Galileo system is the first satellite navigation system that provide guaranteed commercial use.
  - The concessionary mode is used to implement commercial operations.

The characteristics of Galileo System Application (2)

- **Reliability of Galileo System**
  - **Galileo commercial navigation signal will never shut down in any circumstances.**
  - **Galileo system equipped with advanced space satellite navigation system aims to provide satellite navigation services to anywhere of the world.**

The characteristics of EGSIC/ERIS/GSS (1)

- EEG Phase I (EGNOS Similar) OS Performance will reach:
  - Galileo Constellation is not available
  - *The 99% Availability will only be achievable in high density area.

Parameter	*Nominal*
Accuracy (m) (95%)	3 - 4 (H) 6 - 8 (V)
Availability (%)	99 *
Alert Limit (m)	50 (H & V)
Integrity Risk	2×10^{-5}/h
Time to Alert (s)	10
Continuity Risk	N/A

The characteristics of EGSIC/ERIS/GSS (2)

- EEG Phase II (EGNOS + Galileo Augmentation) Extended-OS Performance will reach:
- Galileo Constellation is partially available (At least 12 satellites)
- *The 99% Availability will only be achievable in high density area.

Parameter	*Nominal*
Accuracy (m) (95%)	1 - 3 (H) 2 - 4 (V)
Availability (%)	99 *
Alert Limit (m)	50 (H & V)
Integrity Risk	2×10^{-5}/h
Time to Alert (s)	10
Continuity Risk	N/A

The characteristics of EGSIC/ERIS/GSS (3)

- EEG Phase III (GPS/Galileo) SoL Performance will reach:
- Galileo Constellation is completely available
- *The 99% Availability will only be achievable in high density area.
- The integrity performance increases with the scarifies to accuracy

Parameter	*Nominal*
Accuracy (m) (95%)	16 (H) 4 (V)
Availability (%)	99 *
Alert Limit (m)	40 (H) 10 (V)
Integrity Risk	1 - 2 x 10^{-7}/150 s
Time to Alert (s)	6
Continuity Risk	1 - 8 x 10-6/15 s

Market estimation of Galileo System before 2020

- Results of market research and estimation show that the number of users of Galileo system will increase to 2.5 billion, 90% of them will use mobile phone integrated with GNSS and vehicle Telematics

- Until 2010, the products and service of satellite navigation will be worth with 10 billion Euros, it will reached 25 billion Euros in 2020. Products income is estimated to be saturated by 2015. The major income of satellite navigation will come from service after 2015.

- From long-term view, two killer applications will contribute to the triumph of Galileo system, which are vehicle Telematics and Location Based Services.

The estimation of Global Galileo Concession market from 2006 to 2024(2)

- Transportation service will take 32% of the market and Location Based Services will take 18% of the market. The amount of these two service will be more than half of the whole market
- Public administration will take 25%， professional market will take 10%, aviation will penetrate 7%.
- The rest will be 8%.

Analysis market of China Galileo application

- Galileo system will be better applied in LBS market due to the provision of precise position and integrity service.
- Galileo system will take overwhelming advantage in road service market, as compatibility of receiving terminal of GPS, GLONASS and etc..
- The application on Surveying requires signals with higher integrity and positioning accuracy , Galileo system will become more competent than GPS.
- The SAR signal of Galileo system will be widely used in the market of emergency alert, including guard against theft & alert system and special vehicles.
- It will be widely used in the other consumer markets, which are especially required higher accurate positioning handset, watch, the equipment of people searching and products of weather sounding.

Market of China mobile positioning from 2006 to 2010

- It is estimated that the market of China mobile positioning will increases 72.2% and reach 0.693 billion Yuan.
- In the following five years, the market of China mobile positioning will raise by 69.26% and reach 6.03 billion Yuan until 2010.

Fractionizing market scale and increase of China mobile positioning from 2006 to 2010(1)

	2006	2007	2008	2009	2010
Personal Market (100 Million Yuan)	2.83	5.65	11.86.	18.94	29.00
Rate of Increment	87.48%	99.5%	109.9%	59.7%	53.17%
Market (100 Million Yuan)	5.09	9	15.96	22.61	30.81
Rate of increment	80.18%	77.7%	77.04%	41.96%	37.4%

Fractionizing market scale and increase of China mobile positioning from 2006 to 2010(2)

- In the fractionizing market, it is estimated that personal mobile positioning market will reach 0.283 billion Yuan with increase of 87.48% and business mobile positioning market will rise to 0.509 billion Yuan with increase of 80.18%

- Until 2010, the personal mobile positioning market will go up to 2.9 billion Yuan, the overall increasing rate is 80.58% in five years. The business mobile positioning market will rise to 3.087 billion Yuan with overall increase of 61.71% in five years.

Thank you
for your attention