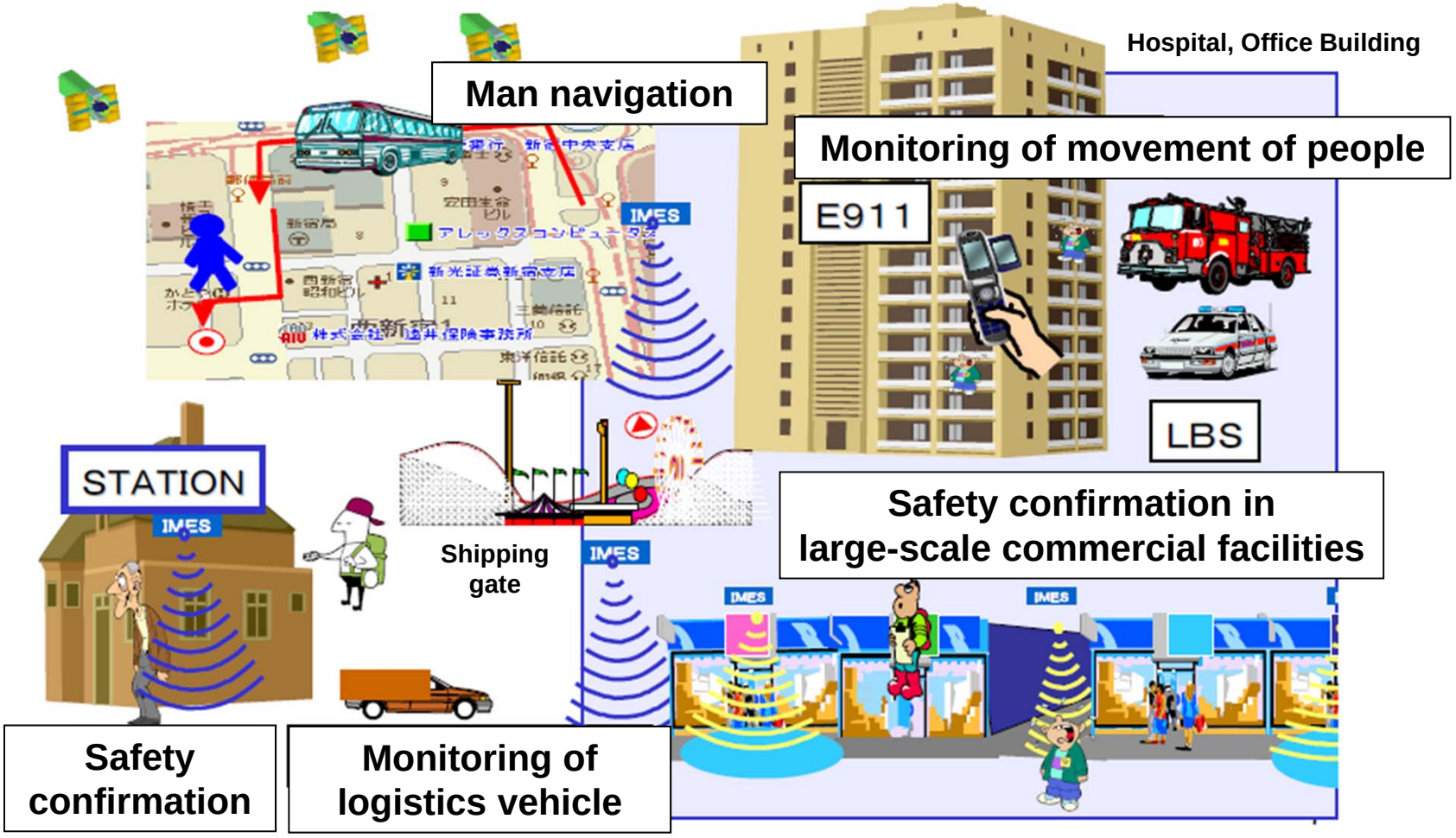
Seamless Navigation Demonstration Using Japanese Quasi-Zenith Satellite System (QZSS) and IMES

ICG WG-B Application SG Meeting
Munich, Germany
March 12, 2012

Satellite Positioning Research and Application Center
（SPAC）

Necessity of seamless positioning

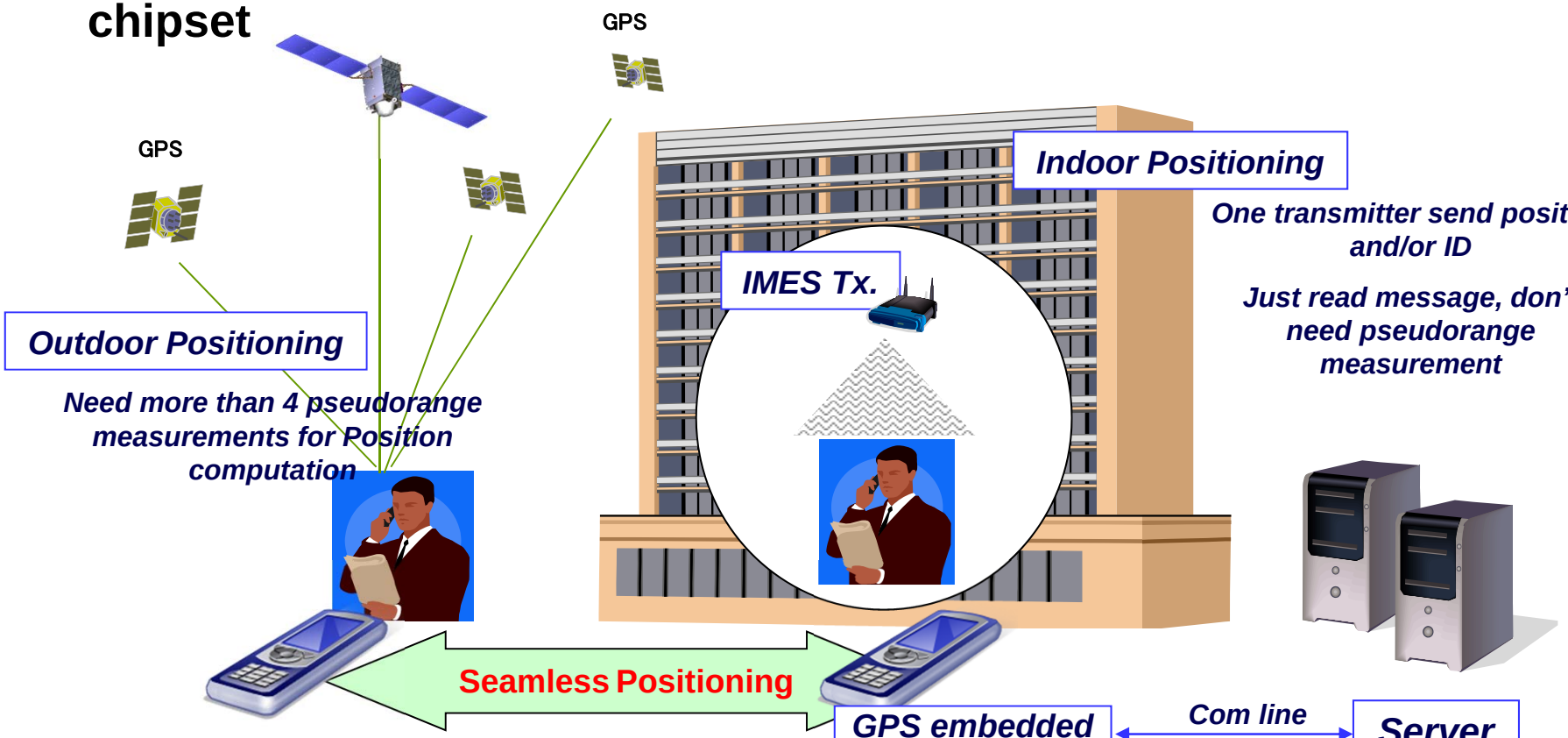
- Issue of present satellite navigation system ⇒Indoor Navigation
- “Seamless” is key future to extend application field of GNSS



“QZSS and IMES”, gContents World2007, Tokyo, 2007
JAXA, GNSS Technologies Inc.

Concept of seamless positioning

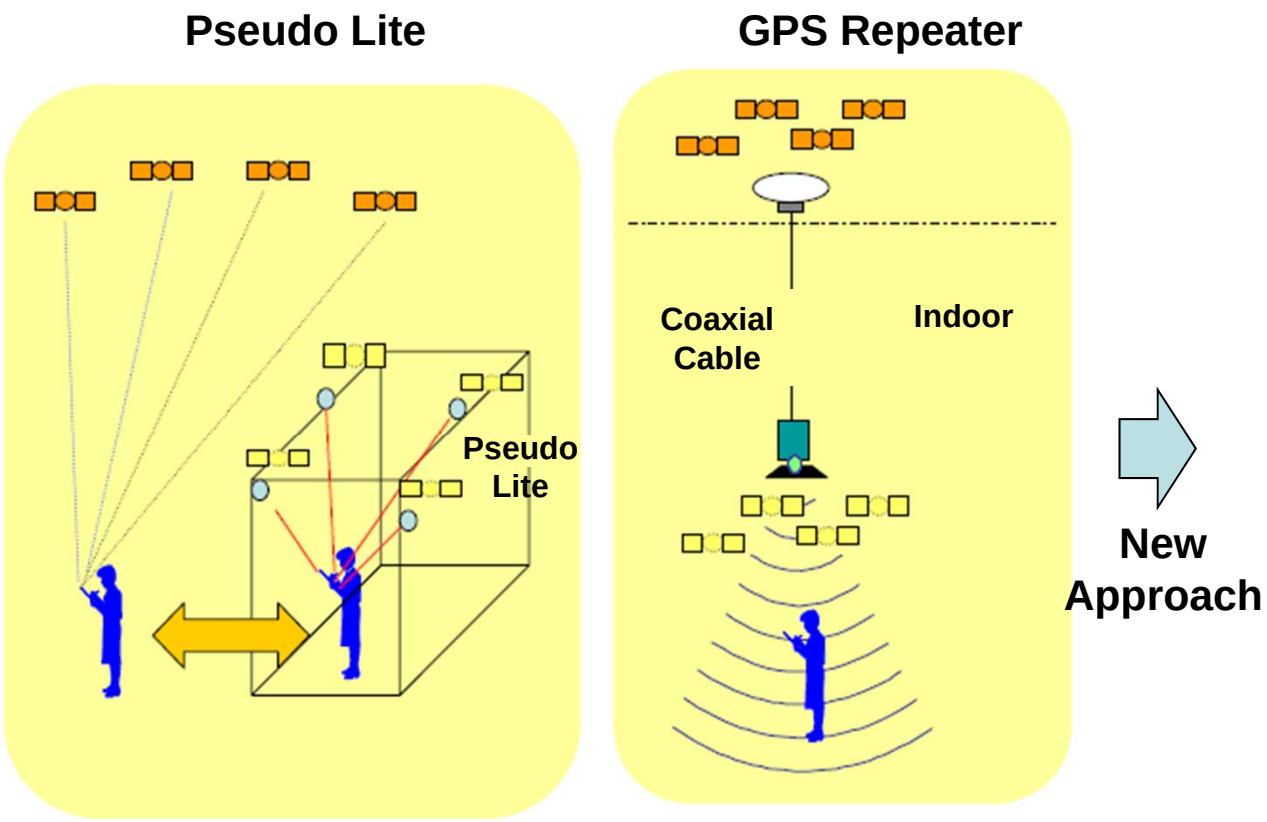
- **Seamless positioning between Indoor and outdoor with common GPS chipset**



"One solution for a seamless positioning, IMES concept and compatibility with GNSS signals", ICG-6 WG-B, Tokyo, 2011, JAXA

Concept of IMES

Overview of IMES(Indoor MEssaging System)



- Existence of near far problem of GPS signal
- Issues related to time synchronization
- Cost

"QZSS and IMES", gContents World2007, Tokyo, 2007
JAXA, GNSS Technologies Inc.

Concept of IMES

Characteristics of IMES(Indoor MEssaging System)

- Transmit 3D position directly
- Moderate accuracy(10-20m)
- Compatibility with GPS/QZSS signal
- Target : Cell-phone, smart-phone

	IMES	GPS
Center Frequency	1575.42MHz +/- 8.2kHz	1575.42MHz
PRN ID	173-182	1-32
PRN Code Chip Rate	1.023MHz	1.023MHz
PRN Code Length	1ms	1ms
Data Rate	50bps	50bps
Modulation	BPSK	BPSK
Polarization	RHCP	RHCP

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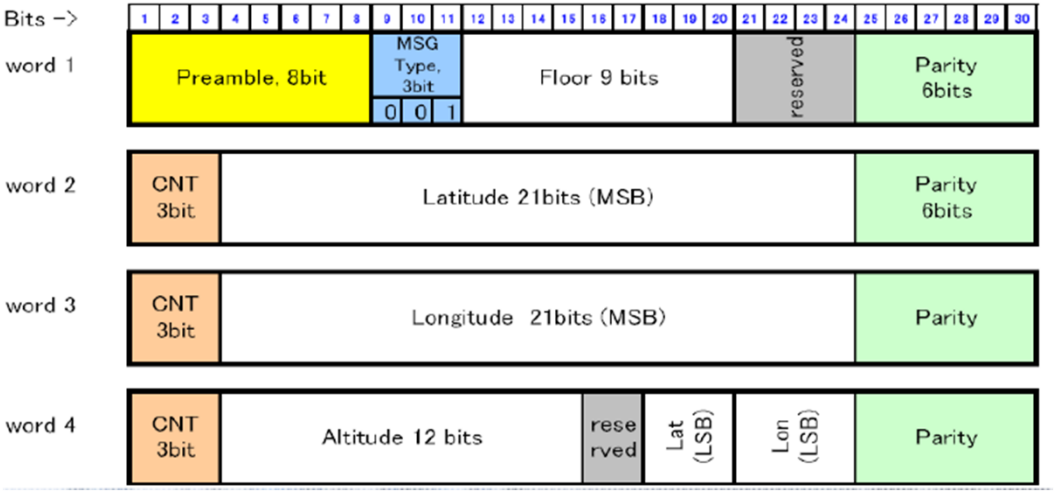
Concept of IMES

IMES message structure

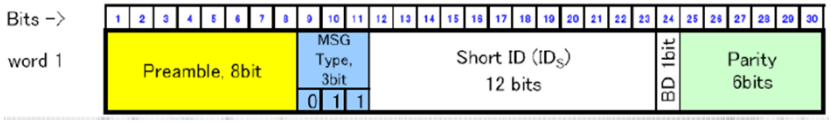
- Type #0 : Longitude, Latitude, Floor Id : 90bit, 1.8 sec
- Type #1 : Longitude, latitude, Height, Floor : 120bit, 2.4 sec
- Type #3 : Short ID : 30bit, 0.6 sec
- Type #4 : Medium ID : 60bit, 1.2 sec
- Message structure is similar to QZSS and GPS L1C/A

Example of IMES Message

Type #1



Type #3



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Concept of IMES

IMES installation

IMES Transmitter

"IMES A proposal for new indoor positioning system", ICG-3, 2008, USA
GNSS Technologies Inc.

IMES Demonstration

- **Okhotsk Michibiki Project (by SoftBank mobile Corp.)**

Configuration for Demonstration

"QZSS/IMES seamless navigation demonstration", SPAC Syposium, Tokyo, 2011, Softbank mobile corp.

IMES Demonstration

- **Okhotsk Michibiki Project(Cont.)**
  - **Application for Smart-phone**

- **Application for iPhone, Android**
- **Area information for**
  - **leisure**
  - **play**
  - **sightseeing and etc.**
- **Stamp Rally**

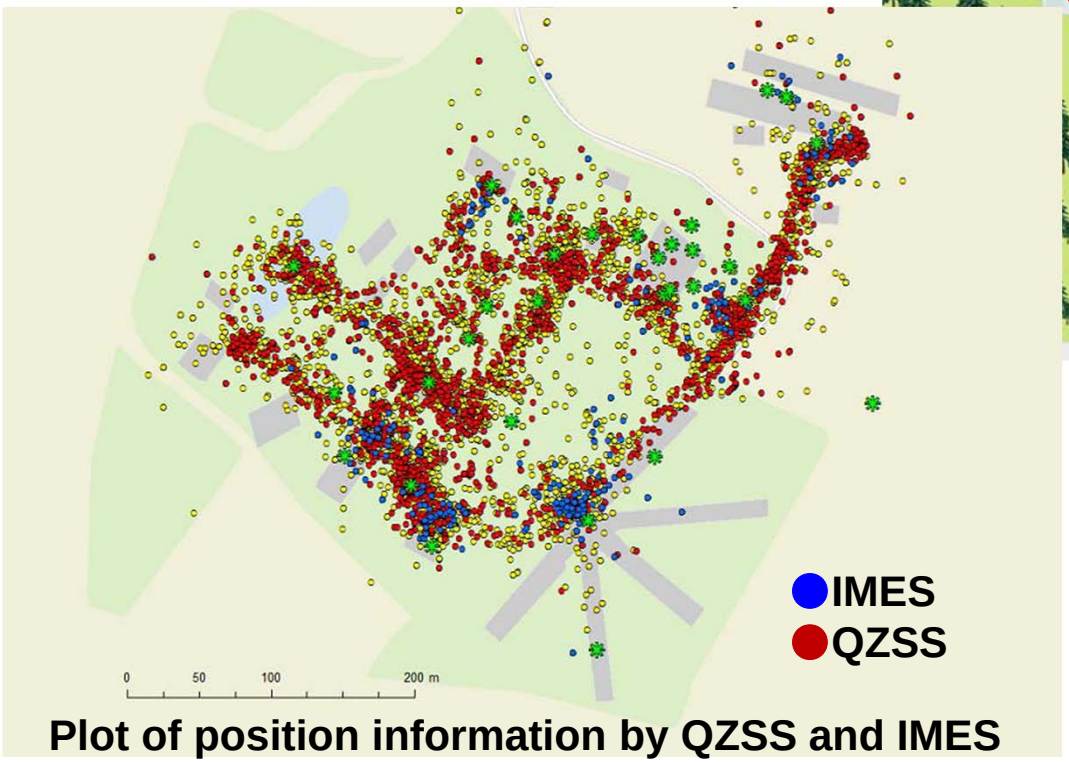
“QZSS/IMES seamless navigation demonstration“, SPAC Syposium, Tokyo, 2011, Softbank mobile corp.

IMES Demonstration

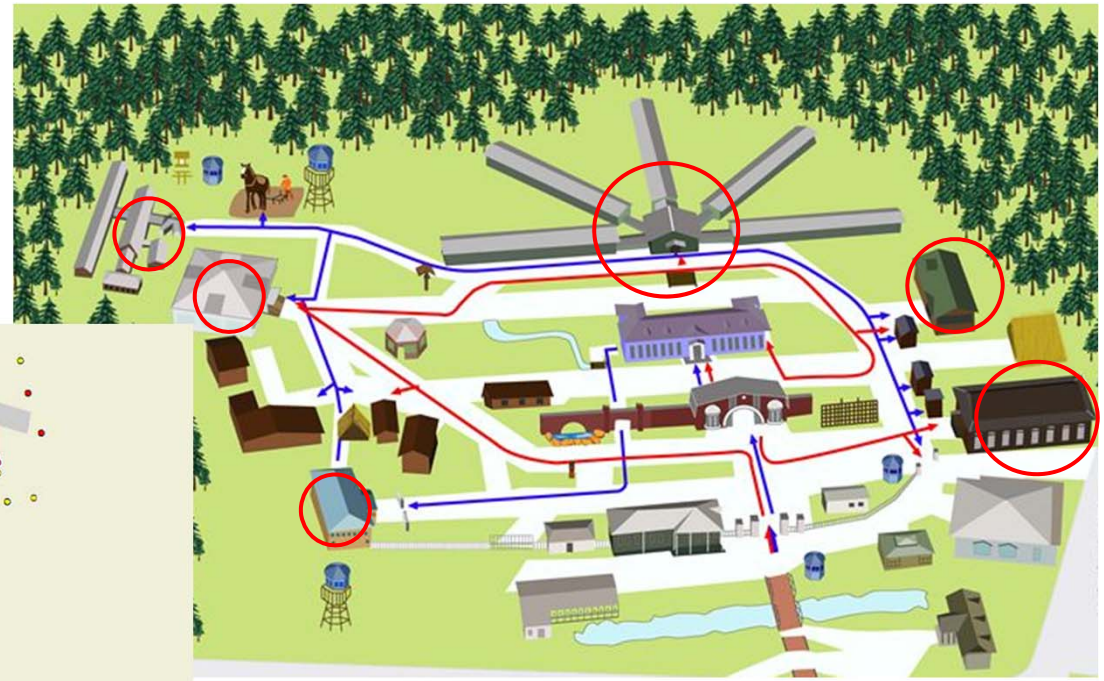
Okhotsk Michibiki Project(Cont.)

Demonstration Results

- QZSS⇔IMES exchange can be observed at the IMES install point



Plot of position information by QZSS and IMES



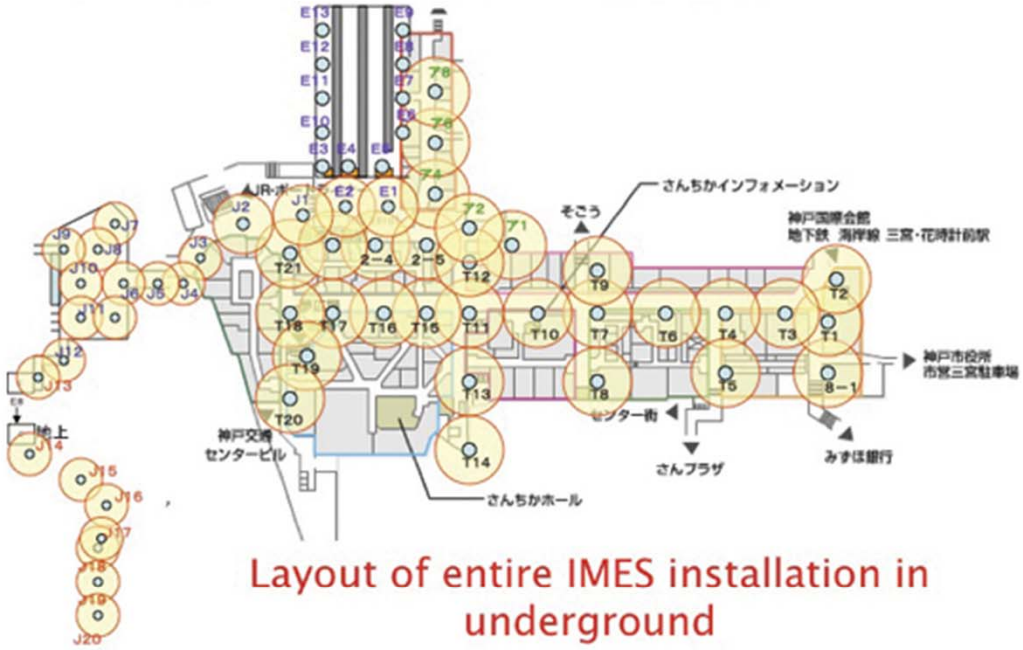
Site map of Demonstration Area

IMES install point

"QZSS/IMES seamless navigation demonstration", SPAC Syposium, Tokyo, 2011, Softbank mobile corp.

IMES Demonstration

- **Free mobility project in Kobe(by Kobe prefecture)**
  - **The project was conducted in an underground shopping mall of Kobe railway station.**
  - **Most visitors could follow the route they had chosen or find the destination point using the IMES set-up.**



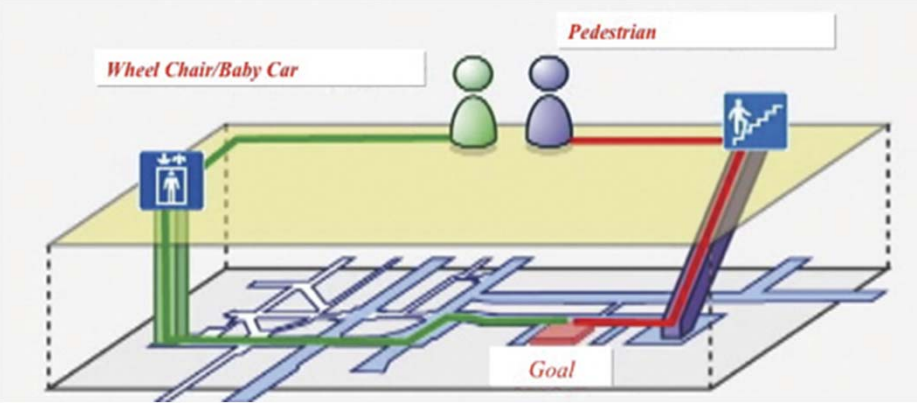
Layout of entire IMES installation in underground

"Opening Up Indoors",GPS World, May, 2011

IMES Demonstration

Free mobility project in Kobe(cont.)

- Intelligent 3D route guidance can be performed based on user preference.
- For example, a user in a wheelchair must be guided by a route that has no staircases, shown by green route in the figure, to reach the destination.
- A pedestrian can be guided by red route, which is the most direct route to the destination.



For Outdoor environment, cellular phone tracks GPS signal for positioning

For Indoor environment, cellular phone tracks IMES signal for positioning

"Opening Up Indoors",GPS World, May, 2011

IMES application field

IMES Service Development Campaign (by IMES consortium office)

- IMES demonstration site is under construction in shopping center of Futagotamagawa.
- This demonstration site provides seamless navigation environment to LBS system developers to promote unique and powerful application software.

IMES Application Fields

"IMES Service Development Campaign Guideline",IMES consortium office, 2011

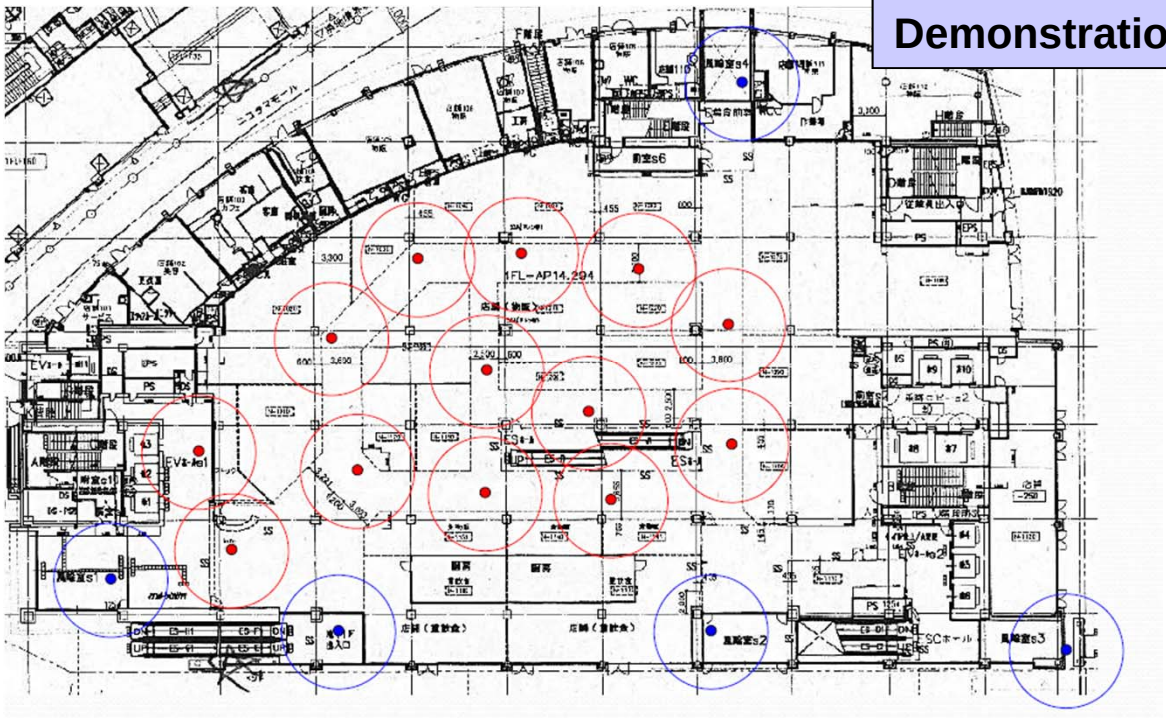
IMES application field

IMES Service Development Campaign(cont.)

- Campaign : Call IMES service applications that cause a stir in the market

2011.12-2012.2	Call for applications
2012.2	First selection
2012.3-5	Application development
2012.6	Location Business Japan 2012/Geospatial EXPO 2012 Awards ceremony

IMES location in Demonstration area



"IMES Service Development Campaign Guideline",IMES consortium office, 2011

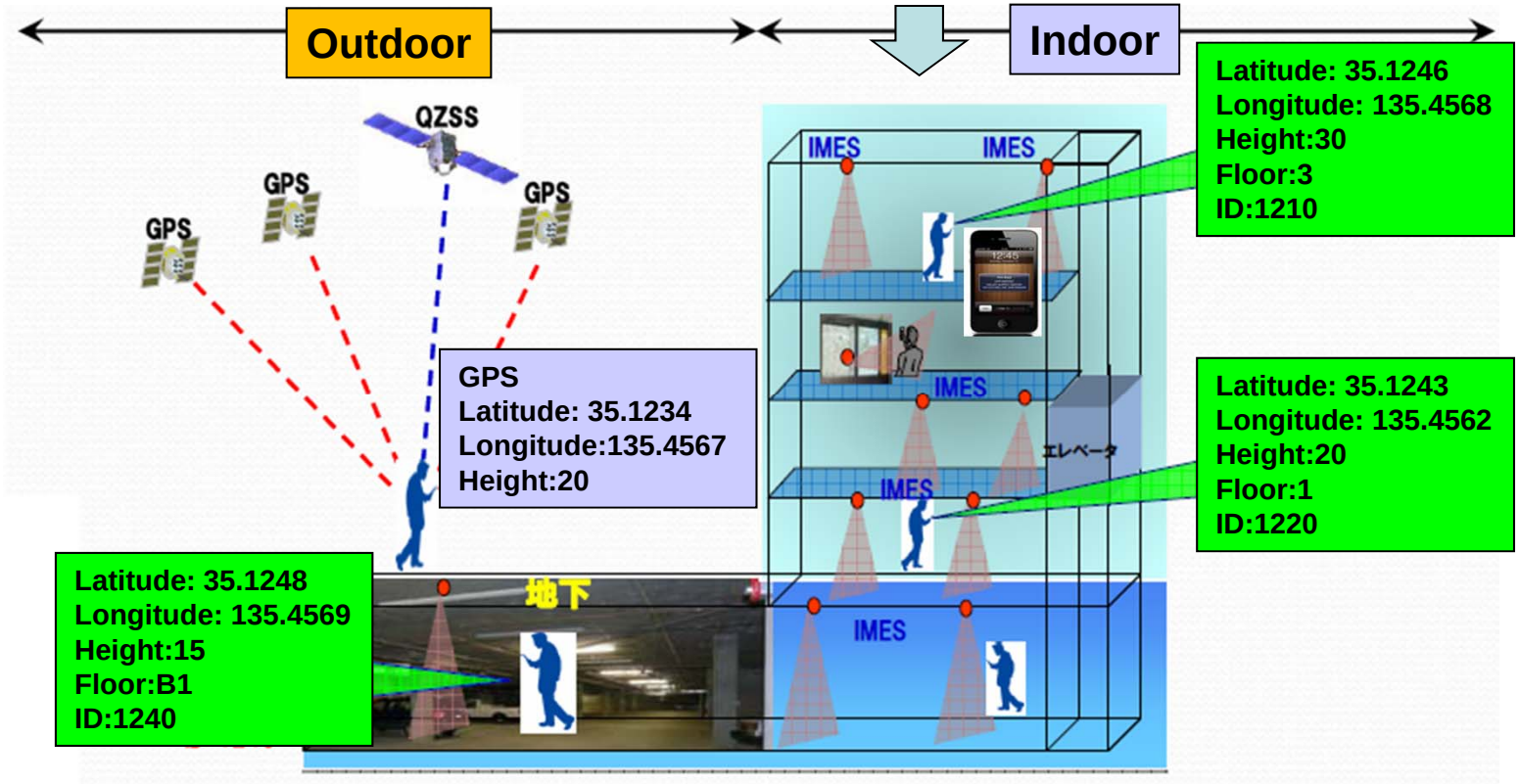
IMES application field

IMES Service Development Campaign(cont.)

Tenant Companies

- Contents
- IMES DB
- Indoor Map
- Advertisement

Navigation, AR(Augmented Reality), Coupon, Signage, Security, SNS and etc.



"IMES Service Development Campaign Guideline",IMES consortium office, 2011

IMES application field

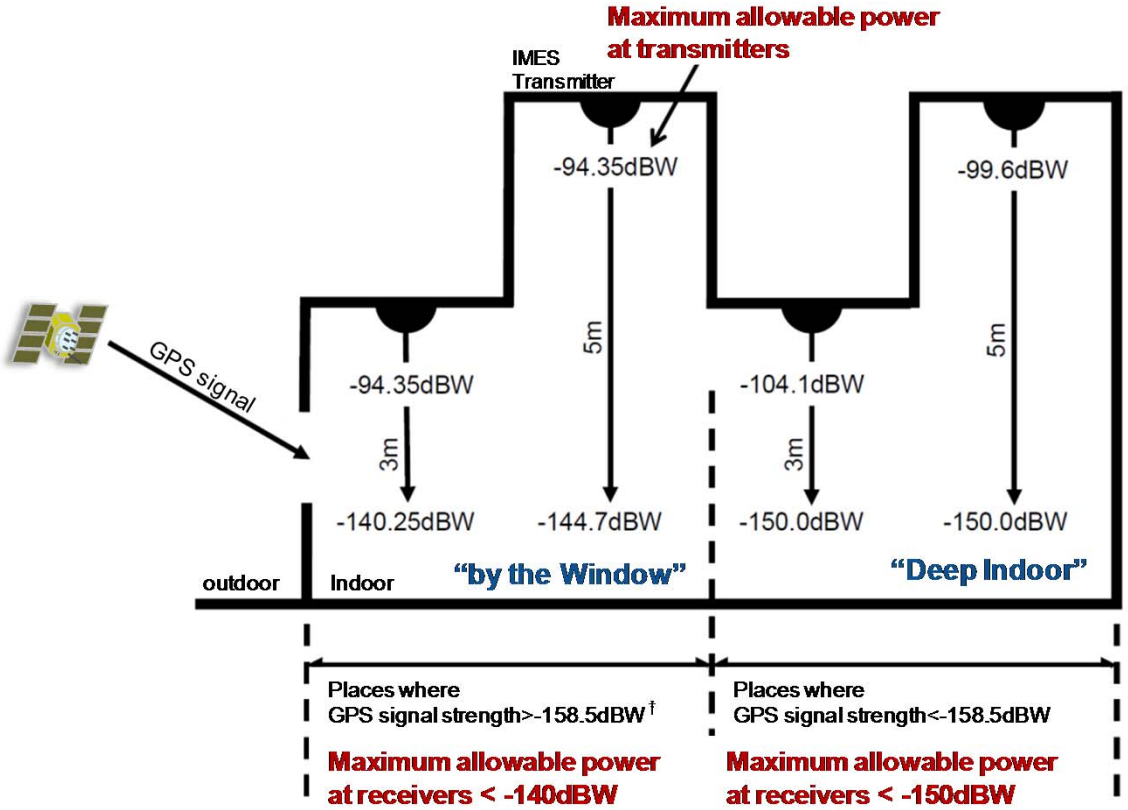
- IMES can be used wherever indoor position data is required.

- Followings are examples of places where IMES might be used

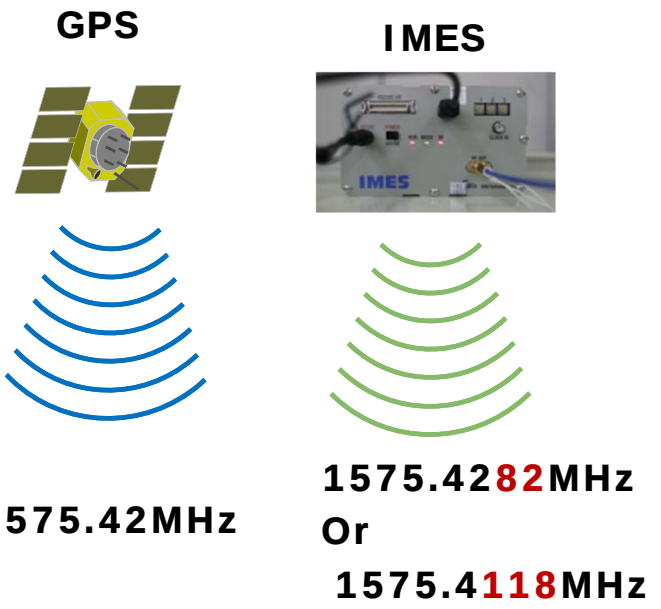
  - Every room of a building, to provide exact room location
  - At entrances, exits, elevators, escalators, staircases, public facilities, and corridors for indoor navigation
  - At every emergency exit for guidance
  - Along hallways and lobbies at set intervals to guide the user
  - In front of shops for advertising and information
  - Complement other positioning systems like Wi-Fi, RF Tag and so on
  - With security cameras to provide accurate position data
  - In factory production lines for automated control of moving objects and etc.

Avoidance of interference to GNSS signals

- Two step measures are taken to avoid interference to GNSS signals
  - Specifying allowable maximum signal strength
  - Shifting the center frequency of IMES



† -158.5dBW : "Received Minimum RF Signal Strength" specified in IS-GPS.



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