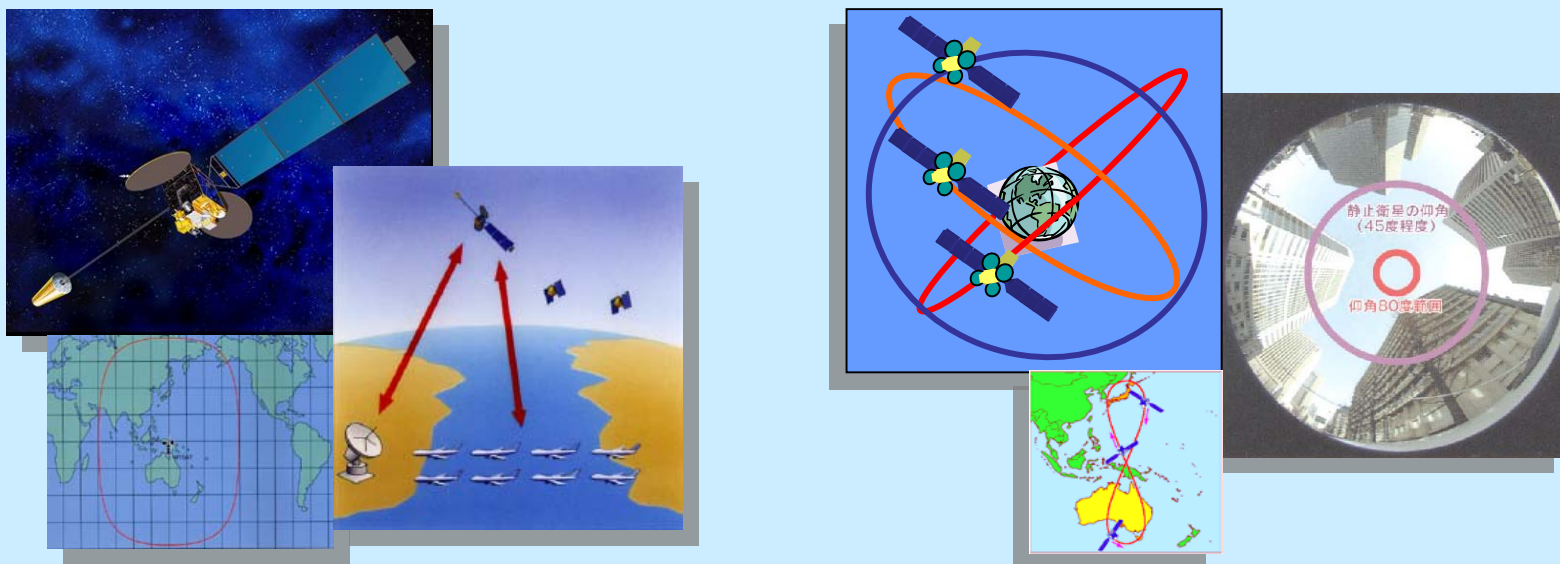


# Status of Japanese GNSS augmentations



Kota TANABE  
Permanent Mission of Japan  
to the International Organizations in Vienna

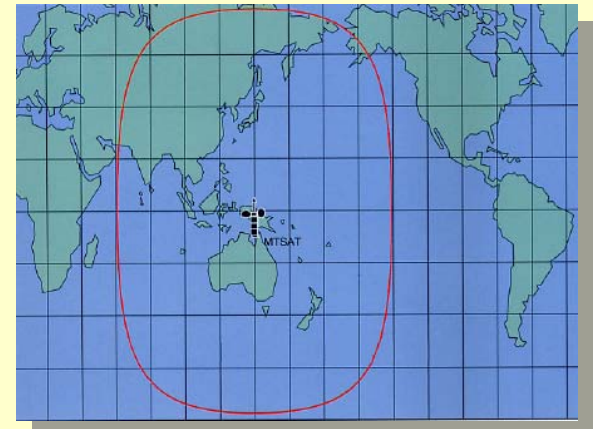
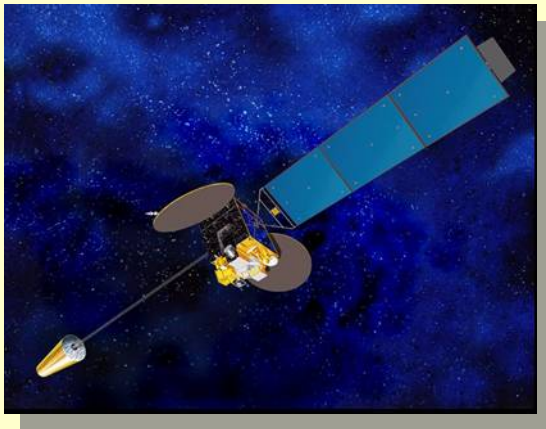
# Contents

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- **MSAS**
  - Overview
  - Effects of MSAS
  - System Configuration
  - Interoperability
  - Schedule
- **QZSS**
  - Background and Objectives
  - Overview - *Orbital Characteristics*
  - Expected Applications
  - Schedule
- **Summary**

# MSAS

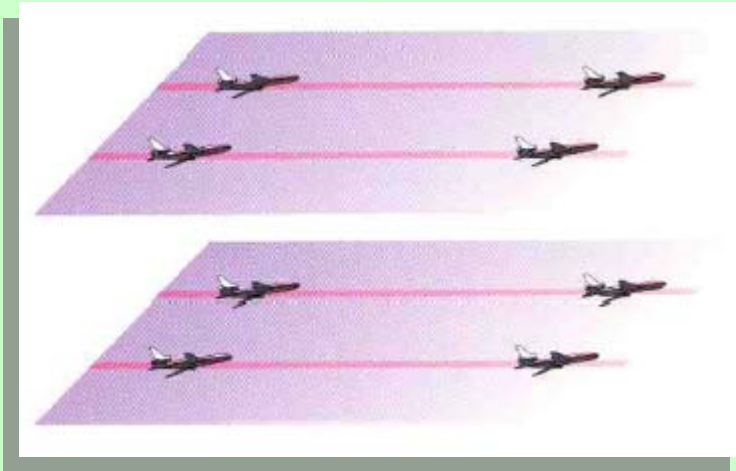
## <MTSAT Satellite-based Augmentation System>



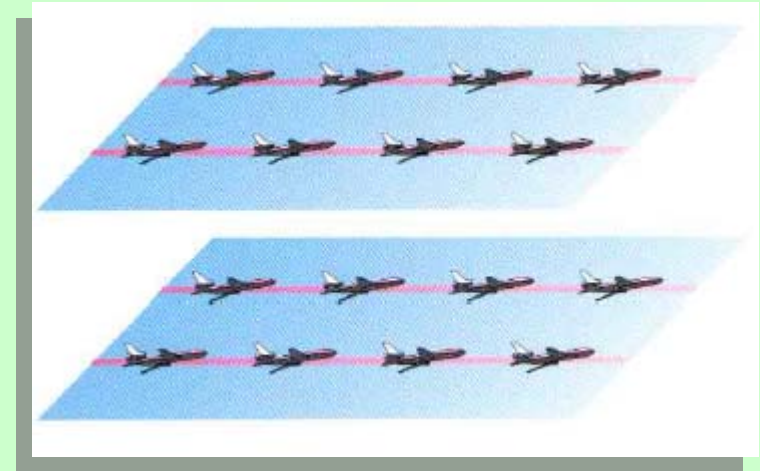
- MSAS (MTSAT Satellite-based Augmentation System) is Japanese SBAS compliant with ICAO SARPs
- Augmentation data is broadcasted by MTSAT (Multi-functional Transport Satellite)
- Dual GEO (two MTSATs) coverage will ensure high Reliability and Availability
- MSAS has a capability to provide augmentation service to other nations within MTSAT coverage if required Ground Monitor Stations are installed

## ◆ Reduction of Separation Minima

Current System

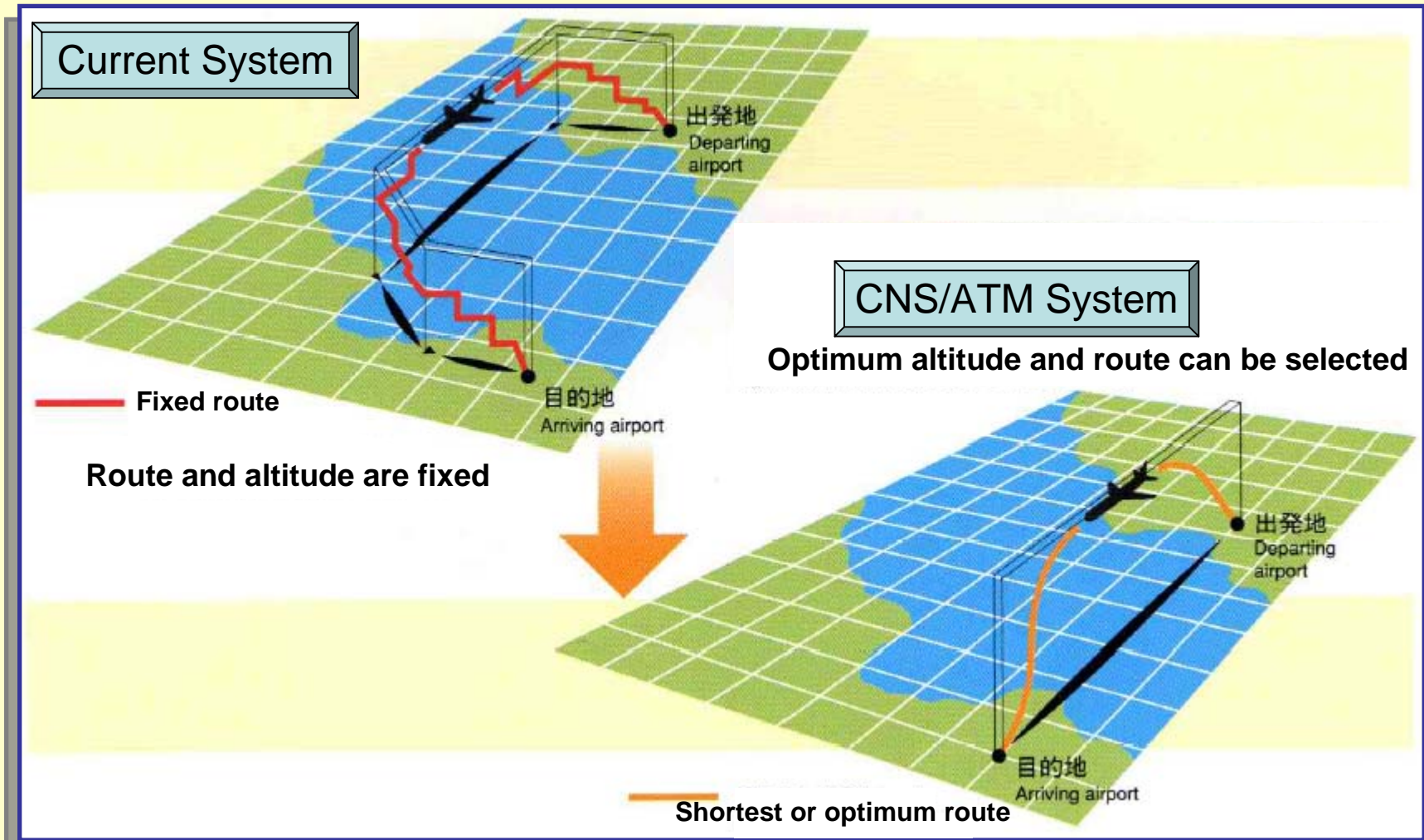


CNS/ATM System



\*CNS/ATM: Communications, Navigations, Surveillance and Air Traffic Management

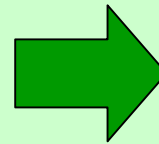
## ◆ Flexible Flight Profile Planning



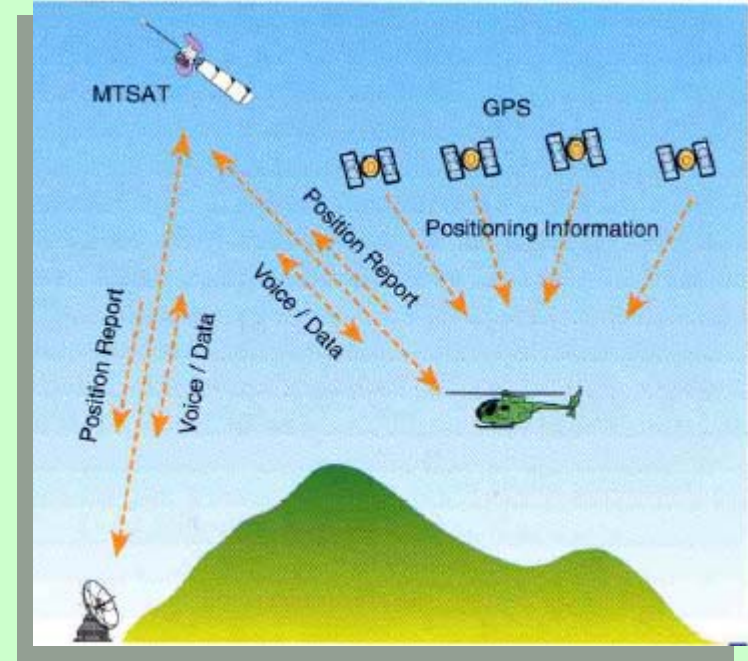
# Effects of MTSAT/MSAS

- ◆ High Quality Communications
- ◆ Safety Enhancement --especially at low altitude--

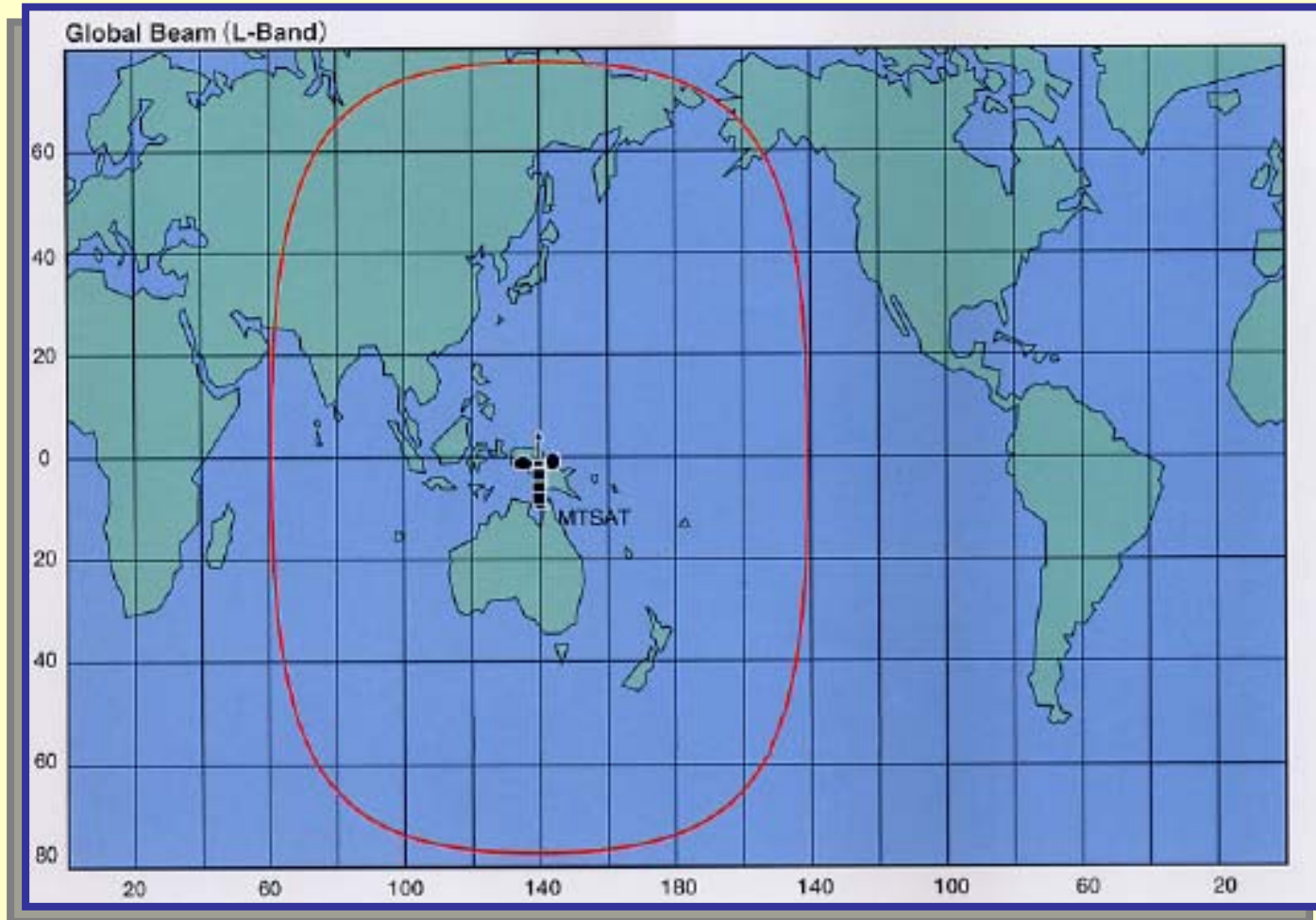
Current System



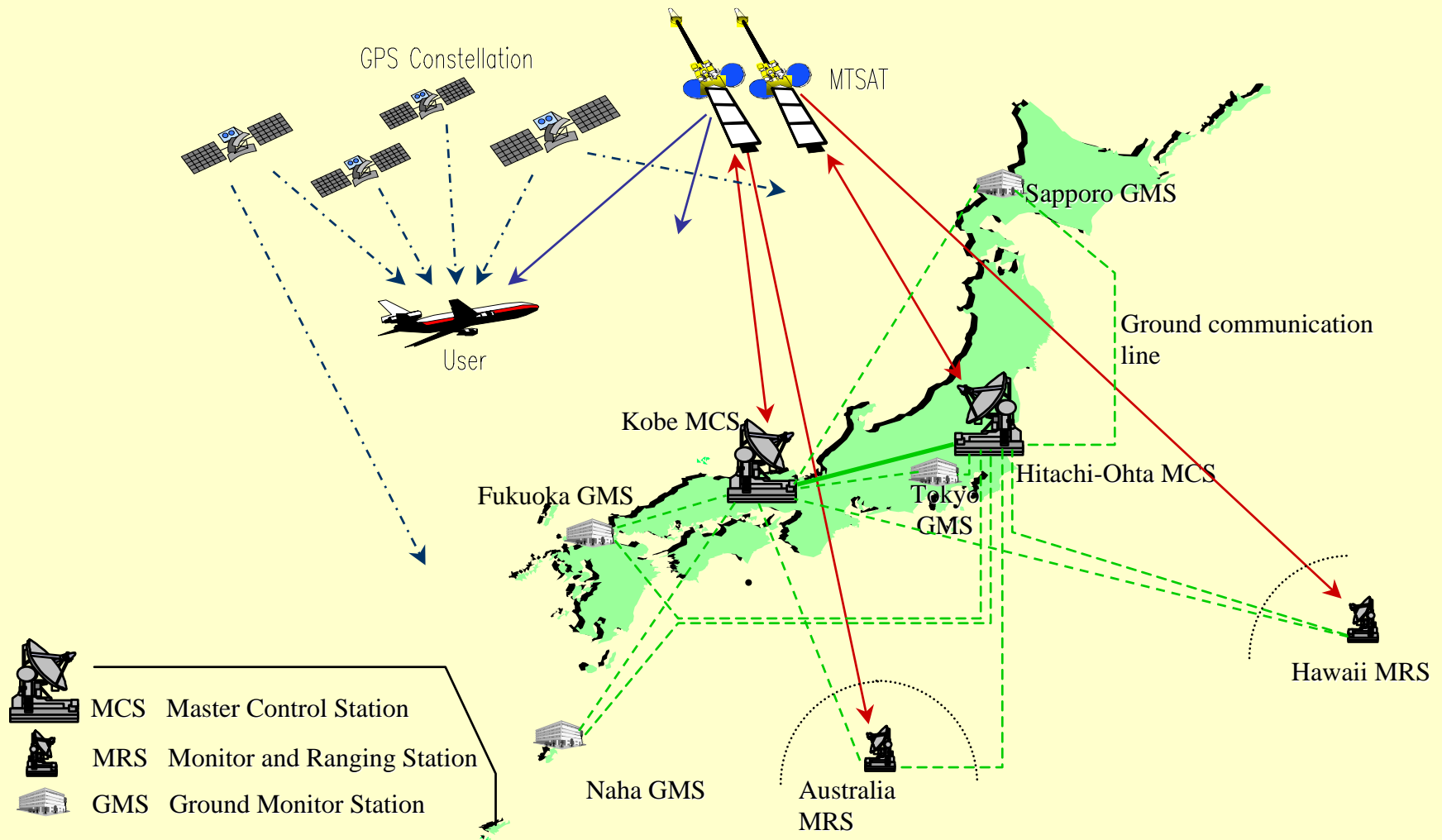
CNS/ATM System



## ◆ Global beam covers most of Asia/Pacific airspace



# MSAS System Configuration

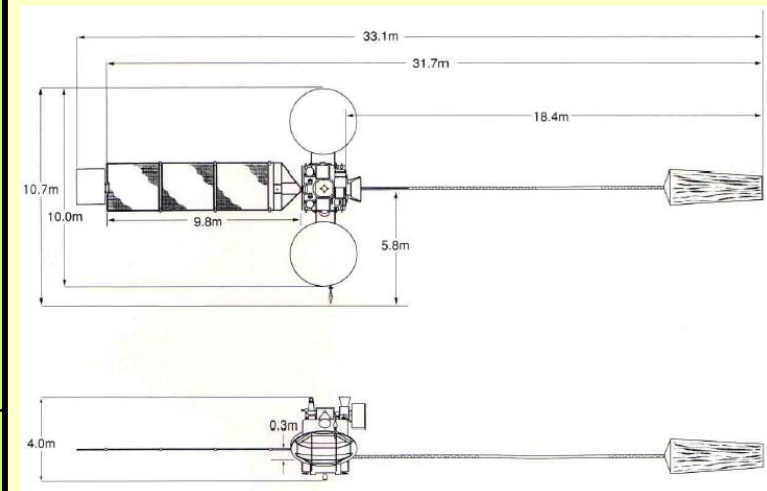
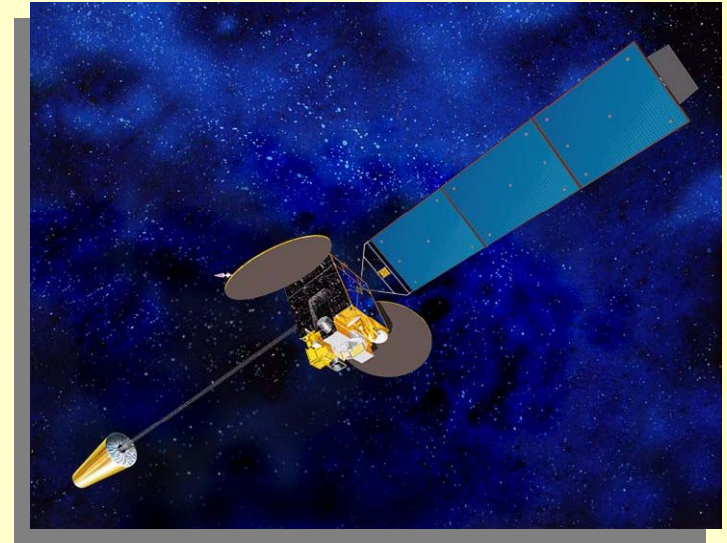


# MSAS System Components



## MTSAT Specification Summary

Type	3 Axis Attitude Control Geostationary Satellite
Life	More than 10 years –Aeronautical: 10 years –Meteorological: 5 years
Orbit Position	Longitude 140 degrees East
Frequency bands	<u>Aeronautical Mission</u> <i>Ku(4 spot beams), Ka(3 spot beams) and L(1 global &amp; 6 spot beams)</i> <u>Meteorological Mission</u> <i>S and UHF</i> <u>TT&amp;C</u> <i>Ku, S and Unified S(USB)</i>
Weight	3,300 kg (@launch), 1,400 kg (dry)



# MSAS System Components



## Master Control Station (MCS) (Aeronautical Satellite Center)



Kobe Aeronautical Satellite Center



Hitachi-Ohta Aeronautical Satellite Center



Operation room

# MSAS System Components



## Monitor & Ranging Station (MRS) & Ground Monitor Station (GMS)



Hawaii MRS



Australia MRS



GPS Antenna

### GMSs in Japan

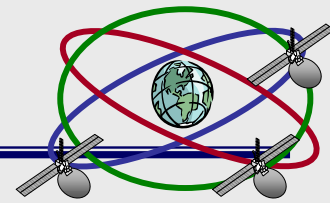
- Sapporo GMS
- Tokyo GMS
- Fukuoka GMS
- Naha GMS



# MTSAT/MSAS Program History

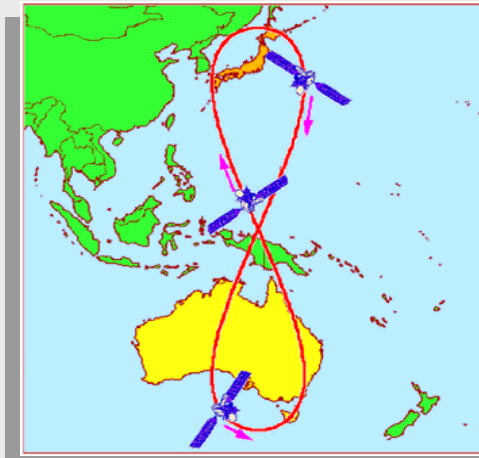
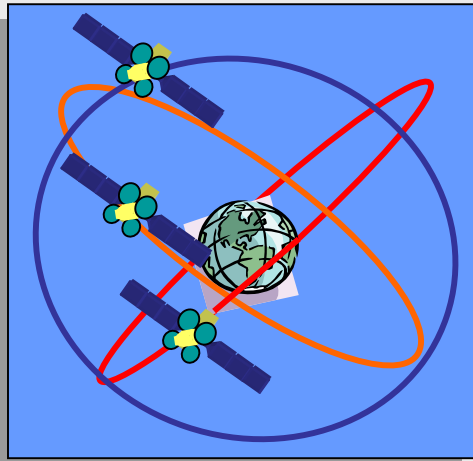


- 1991 ICAO approved FANS Plan
- 1993 Electric Navigation Research Institute (ENRI) started the research on GNSS Integrity Channel
- 1994 MTSAT Program started
- 1995 MSAS development started
- 1999 Launch of MTSAT-1 failed
- 2001 GPS data collection using ground system started
- 2004 MTSAT-1R will be launched
- 2005 MTSAT-2 will be launched (MSAS Initial Operation)

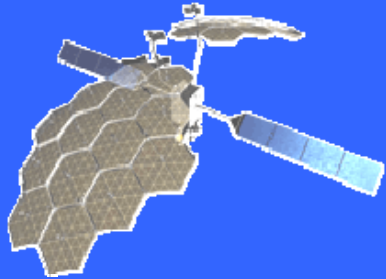


# QZSS

## <Quasi-Zenith Satellite System>

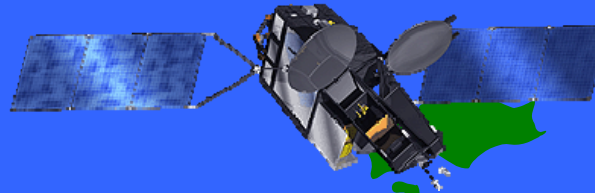


# Background **i-Space** *Space information infrastructure*



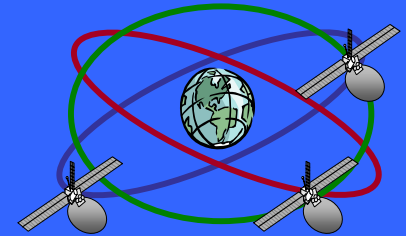
**ETS-VIII (2004)**

Engineering Test Satellite-VIII



**WINDS (2005)**

Wideband InterNetworking  
Engineering Test and Demonstration  
Satellite



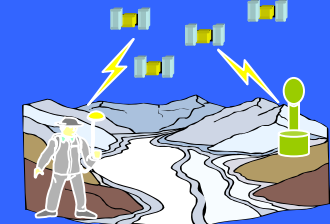
**QZSS (2008)**

Quasi-zenith Satellite System

**Overcoming  
Digital Divide**



**High Accuracy  
Positioning**



**Tele-Medicine**



**Tele-  
Education**



**Disaster  
Management**



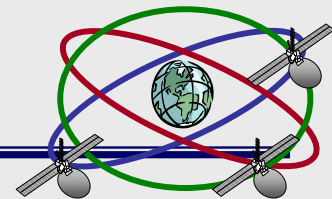
**Satellite Mobile  
Communications**



**Satellite  
IP Multicasting**

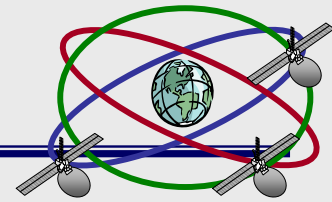


# Background



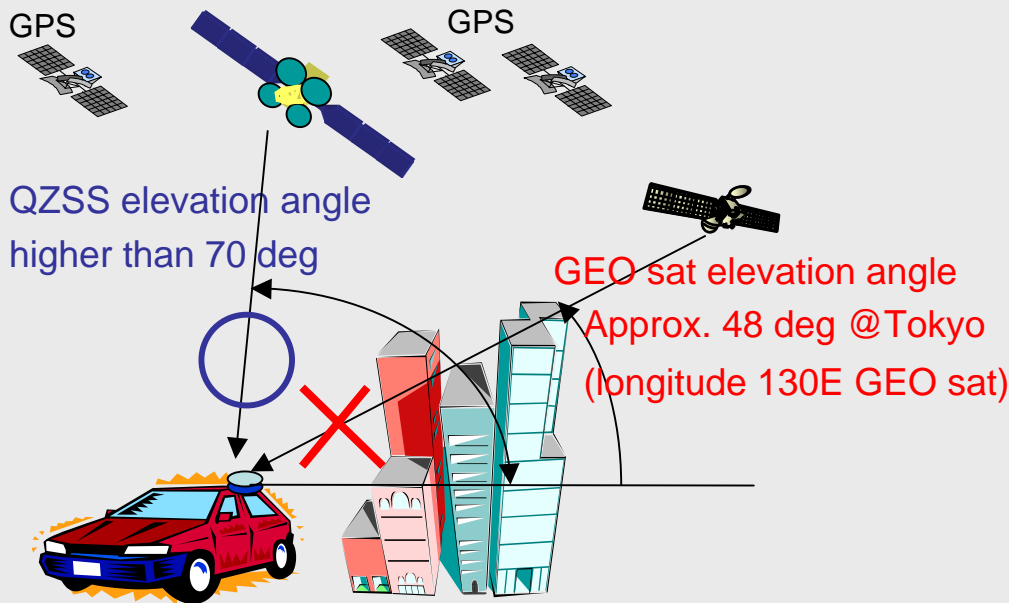
	<b>Current Conditions</b>	Future Condition with QZSS
<b>Communications</b>	<ul style="list-style-type: none"><li>◆ Due to shadowing by buildings and mountainous features, GSO satellite systems can only service urban and mountainous areas with 30% coverage.</li><li>◆ The private sector predicts a huge growth in the broadband mobile communications market.</li></ul>	<ul style="list-style-type: none"><li>◆ High speed broadband mobile communications services will be able to provide coverage everywhere, including urban canyon and mountainous areas.</li></ul>
<b>Positioning</b>	<ul style="list-style-type: none"><li>◆ Japan's geographic features can reduce the number of visible GPS satellites and cause user positioning error. Availability can also be compromised.</li><li>◆ R&amp;D in GPS augmentation is needed for applications which require high accuracy positioning such as ITS, precise agriculture, machine control for construction.</li></ul>	<ul style="list-style-type: none"><li>◆ Continuous, stable and highly accurate positioning services will be provided.</li><li>◆ Marked improvement in continuity, integrity, availability and accuracy for GPS users.</li></ul>

# Objectives



## Research & Development for

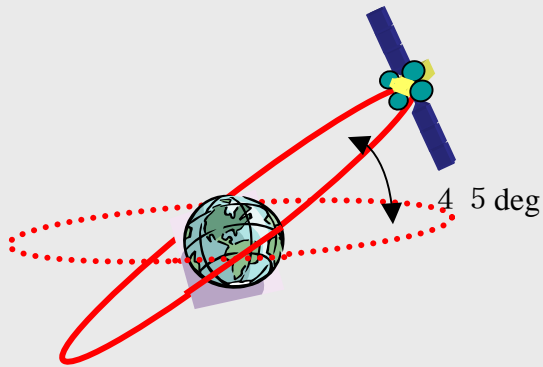
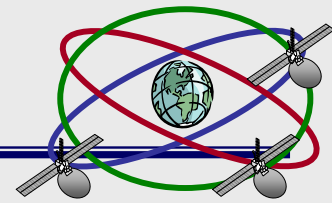
- **Satellite Positioning** --- *High accuracy navigation service by complement and augmentation of the GPS*
- **Mobile Communications** --- *High speed communication service*



### **Advantages of the high elevation angle**

- **Easier to provide broadband mobile communication services with**
  - ✓ Simplification of antenna tracking mechanism
  - ✓ Utilization of the antenna with higher gain at the zenith
- **Less shadowing by buildings or mountains**
- **Less multi-path interference**

# QZSS Overview -Orbital Characteristics-

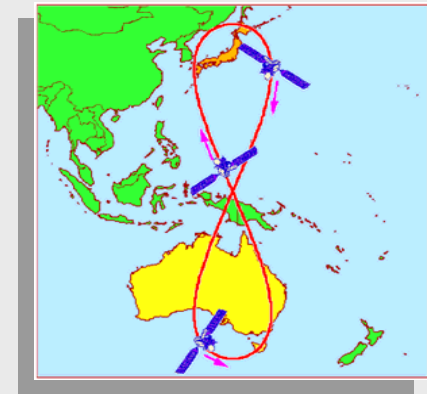
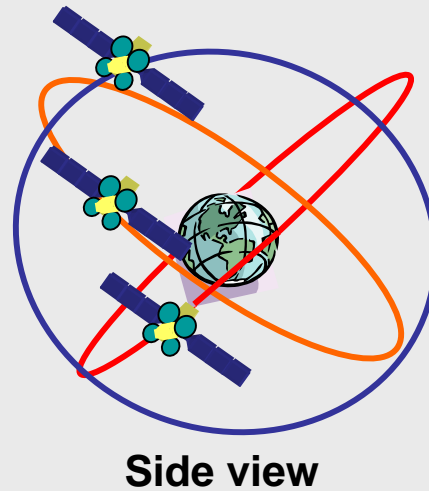
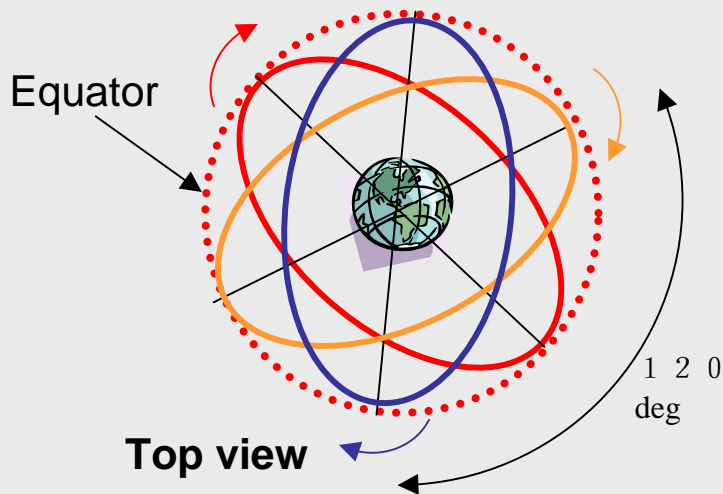


(1) Inclined orbital plane at approximately 45 deg from GSO

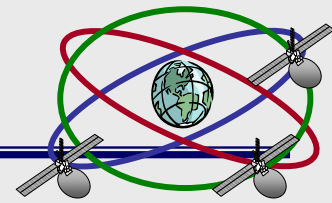
→ Ground track draws a figure “8” centered on the equator

(2) 3 satellites on the 3 orbit planes operate so that the right ascension of the nodes are each 120 degrees apart

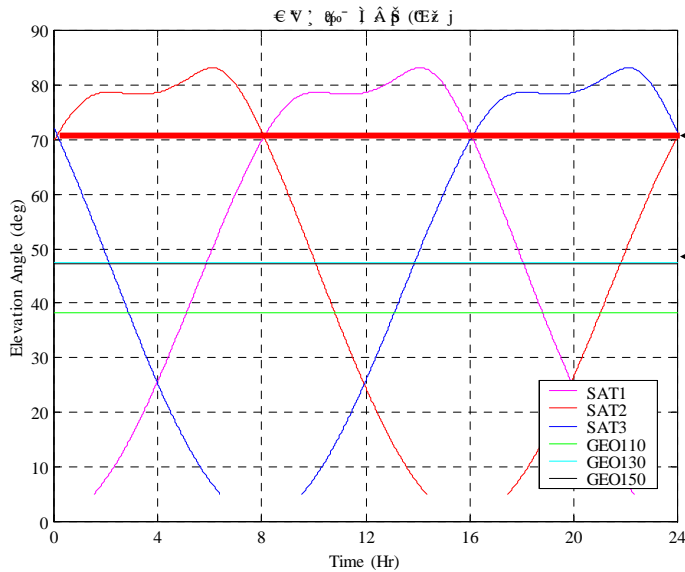
→ Every 8 hours each of the 3 satellites passes over the same point on the figure “8” ground track



# QZSS Overview -Orbital Characteristics-



Satellite visibility ensured with high elevation angle of **more than 70 degrees.**

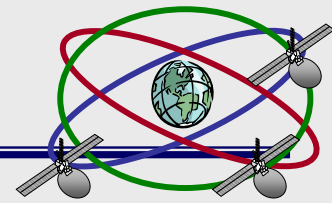


Elevation angle at Tokyo (24hour)

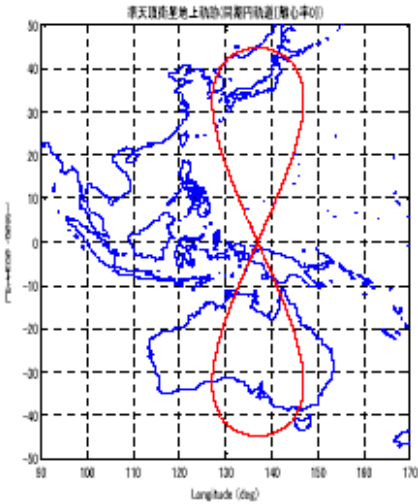


The urban canyon picture (Shinjuku area)

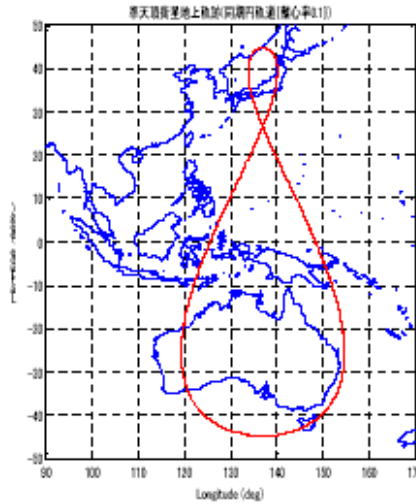
# QZSS Overview -Orbital Characteristics-



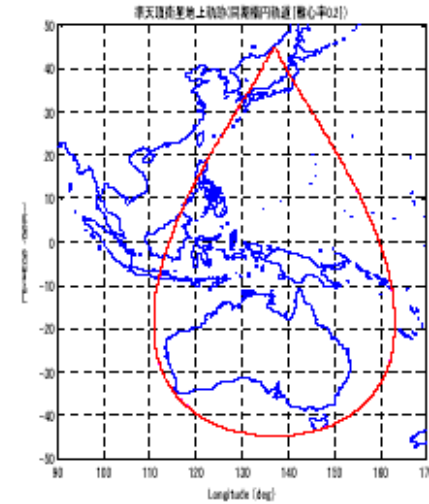
## The Possible Orbital Variations of QZSS



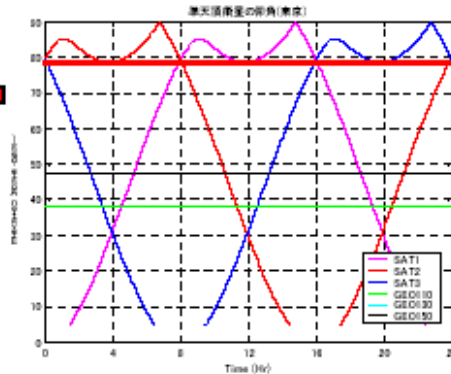
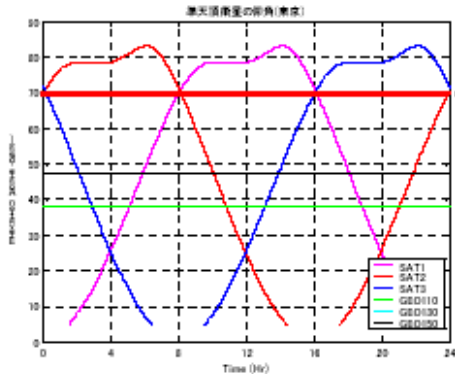
(a)  $e=0$



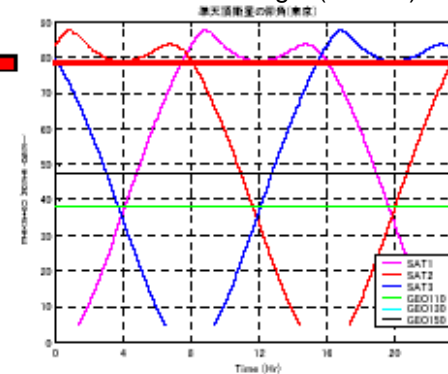
(b)  $e=0.1$



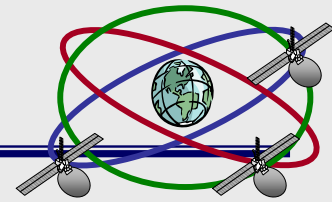
(c)  $e=0.2$



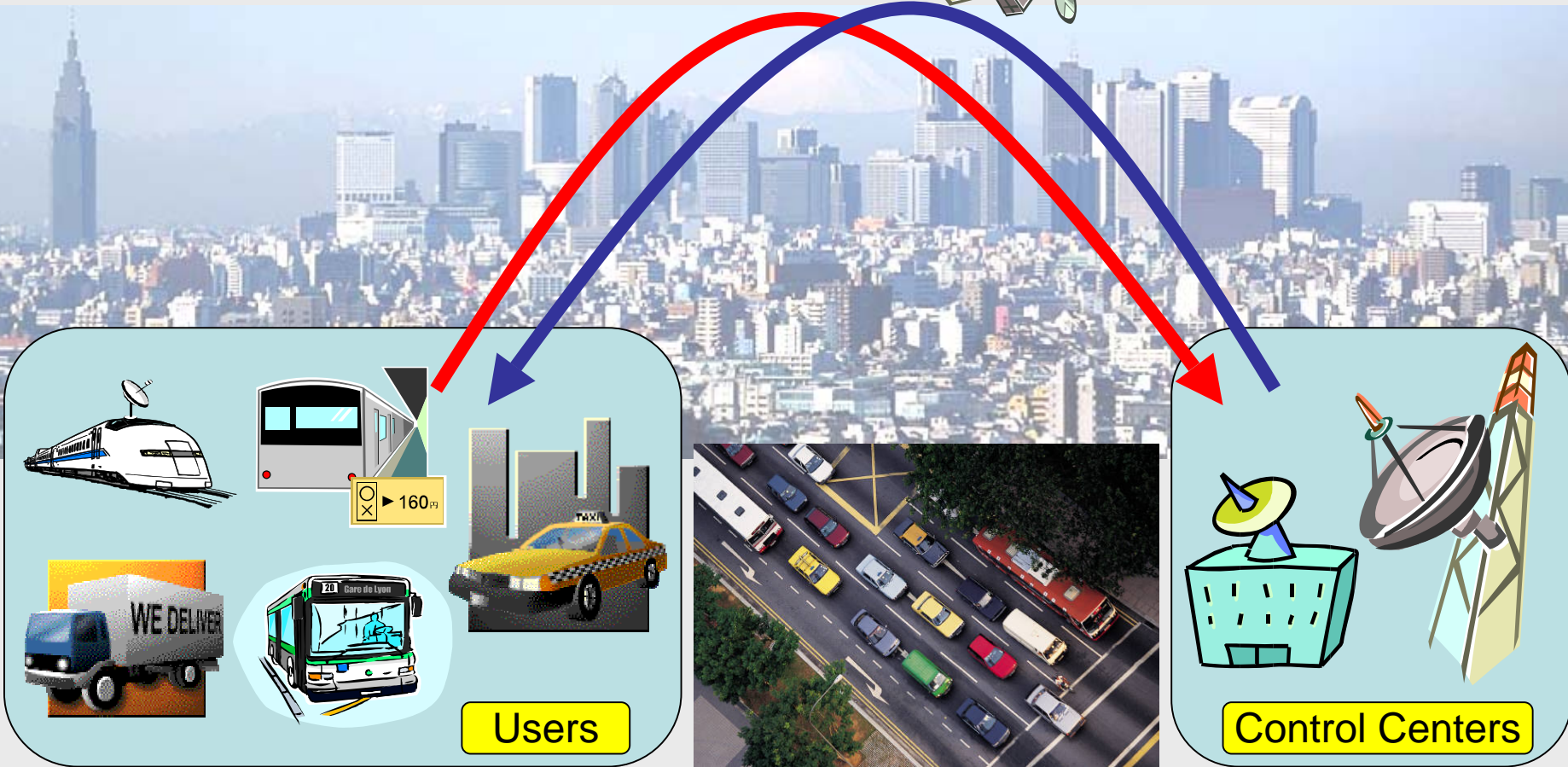
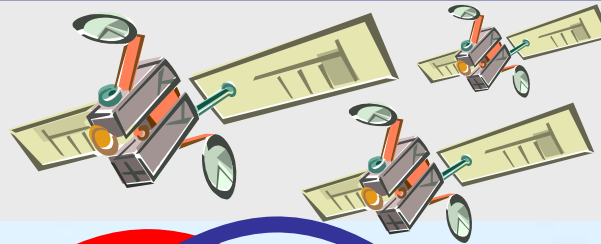
← Minimum Elevation Angle (24hour)



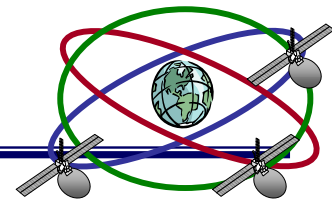
# Expected Applications



## Traffic Management & Control System



# Expected Applications



## Medical Services

### Mobile Hospital



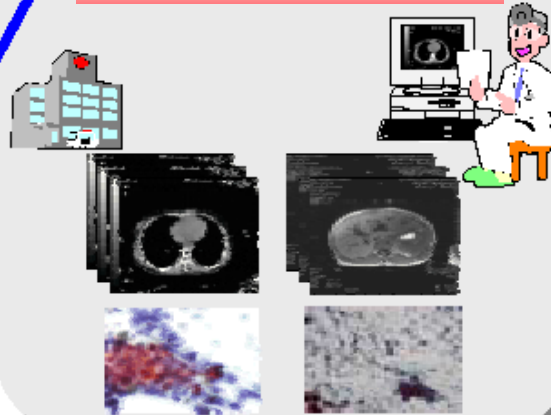
### Disaster



### Emergency/Rescue



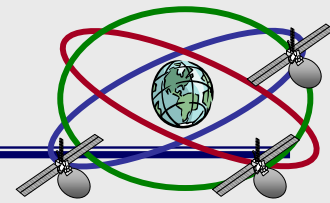
### Local Hospital



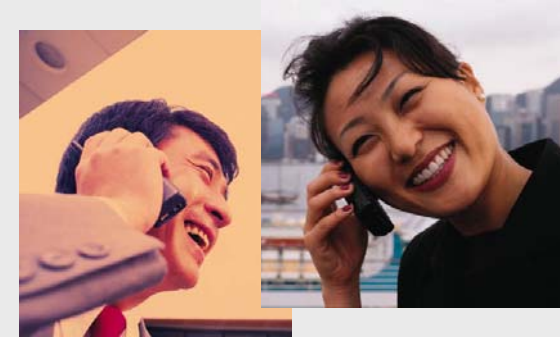
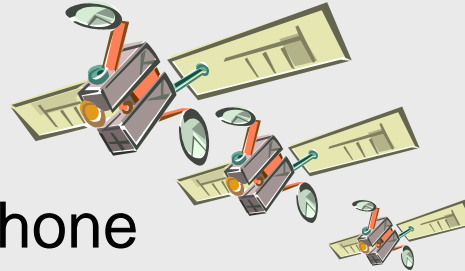
### City Hospital



# Expected Applications



- Broadcasting
  - ✓ TV, Car-TV, Mobile Phone
  - ✓ Traffic Information
  - ✓ Emergency/Disaster Information



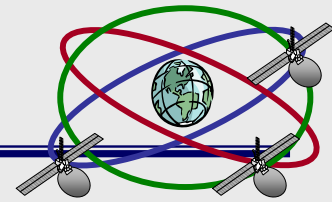
- Search and Rescue
- Field Education



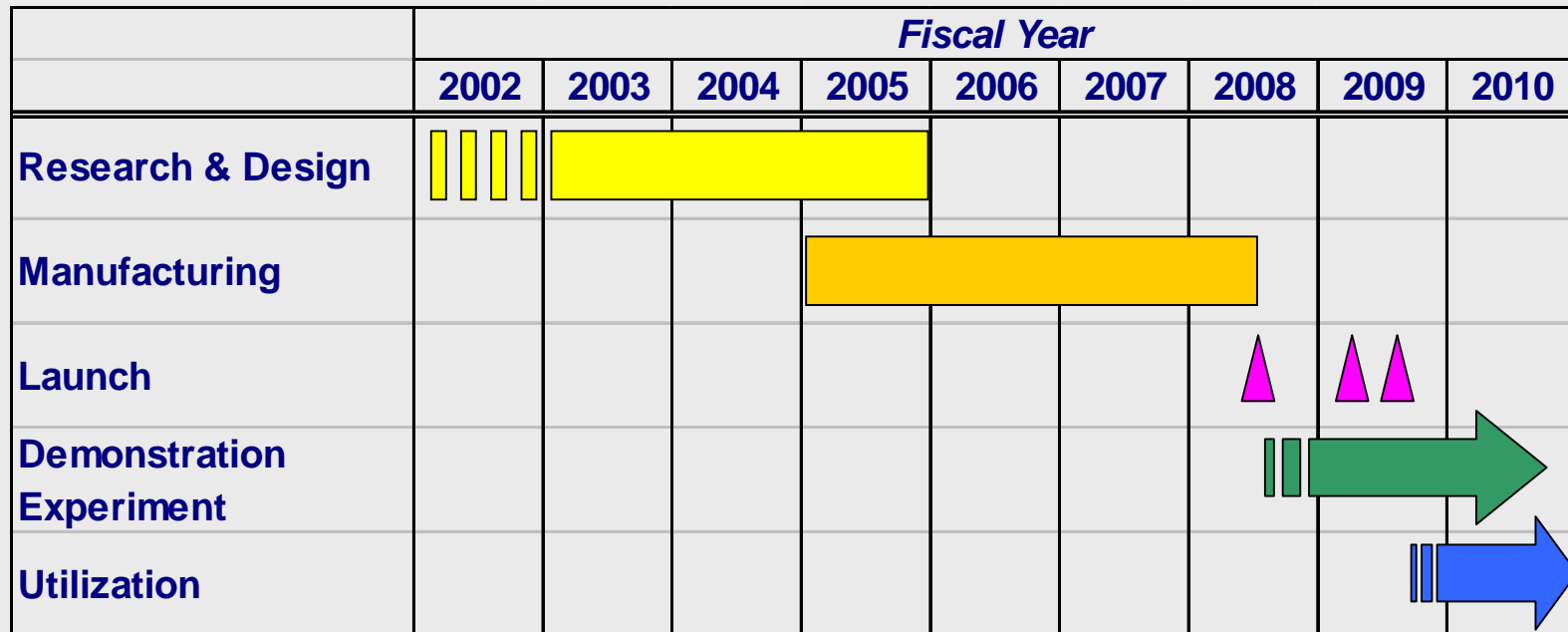
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# Development Schedule (Tentative)



QZSS Development Schedule (tentative)



Note: The Japanese fiscal year starts in April and ends in March of the next year.

# Summary

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Japanese GNSS augmentations could make useful contributions to the world's space infrastructure.

## ◆ MSAS

- Japan is focused on developing the MSAS system. In future, it should aid in the realization of safe and high quality aviation services for the Asia Pacific region.
- Based on ICAO standards, the system is interoperable with the other SBASs.

## ◆ QZSS

- A brand-new and unique system under development in Japan which could provide a variety of utilizations and applications.



**Thank you ...**

**Kota TANABE**

Special Adviser

Permanent Mission of Japan  
to the International Organizations in Vienna

E-mail: [ktanabe@v003.vaio.ne.jp](mailto:ktanabe@v003.vaio.ne.jp)