Overview of MSAS
MTSAT Satellite-based Augmentation System
For ICG-4

Office of Aeronautical Satellite Systems
ATS Engineering Division
Japan Civil Aviation Bureau
1. Configuration of MSAS

GPS constellation

MTSATs on Geosynchronous Earth Orbit

User

MCS Kobe

GMS

MCS Hitachiota

MCS Kobe

GMS

MCS Kobe

GMS

MCS Kobe

GMS

MCS: Master Control Station
GMS: Ground Monitor Station
MRS: Monitor and Ranging Station
1. A. Space Segment (1/2)
MTSAT-1R @140E

Multi-functional Transport SATellite
1.A. Space Segment(2/2)
MTSAT-2 @145E
1.B. Ground Segments(1/2)
1.B. Ground Segments (2/2)

- MRS Canberra
- MCS Kobe
- MCS Hitachiota
- MRS Hawaii
- MTSAT Slot position 140E & 145E
1.C. Signals – PRN code

MTSAT-1R

Uplink#1

PRN129

MCS Kobe

Uplink#2

MTSAT-2

Uplink#1

PRN129 & PRN137

Uplink#2

PRN137

MCS Hitachiota

Ku

L1
1.C. Signals - specifications

- Signal characteristics are compliant with ICAO SARPs (See paragraph 3.7.3.4.4.)
  - Frequency; L1 1575.42MHz
  - Band width; 2.2MHz
  - 500 BPS FEC
  - Signal strength on the earth surface >-161dBw

- Planned signals
  - Band width expansion for L1
  - L5 signal
1.D. System time and geodetic reference frame

- MNT (MSAS Network Time)
  - Difference from GPS time is always kept less than 50ns (nano-second).

- WGS-84 is used.
1.E. Performance
-Required & observed-

For Non-precision approach

• Horizontal Accuracy (95%)
  – Required: Less than 220m (with SA on)
  – Observed value is less than 2.2m

• Integrity (Probability of HMI)
  – Required: Less than 1x10^{-7}/hour
  – Fault Tree Analysis leads 0.903x10^{-7}/hour

• Availability
  – Required: More than 99.9%
  – Observed: 99.926%
2. Service provision

• Service for air navigation
  – 24 hours a day, 7 days a week
  – Operational Information is provided as NOTAM
    • Service Interruption, degradation of service
  – Use for En-route through Non Precision Approach phase of flight
    • Performance improvement plan is now under consideration
2. Service Provision

- System is operated and maintained by certified specialists
  - MSAS and MTSATs
  - JCAB has a direct responsibility for entire operation of MSAS and MTSATs
3. Compatibility & Interoperability

• Compatibility and interoperability are achieved by those activities;
  – Participating and discussing on the ICAO Navigation System Panel meeting (NSP).
4. GNSS Spectrum Protection Activities

• A. National-level spectrum regulation is achieved by other ministry.
• B. Interference detection and mitigation work also.