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Flight Inspection for MTSAT

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1. ABSTRACT

MTSAT-1R was launched from TNSC (the Tanegashima Space Center) in Japan in the late afternoon of February 26th, 2005. The MTSAT-1R is located about 36,000 km above the equator and longitude 140 degrees east as one of the geostationary satellite.

MTSAT-1R is a compound type satellite purporting “Multifunctional Transport Satellite”, which is charged with Aeronautical mission and Meteorological mission. Of the two missions, JCAB takes charge of Aeronautical mission, which is divided into Aeronautical communication function and navigation function. Not only are the data and voice communications with aircraft flying over the FIR of Japan but also Air traffic control communications with overseas air traffic control center via SITA network and operational information sent to the airlines, provided by the aeronautical communication function. In addition, GPS reinforcement signal for aircraft flying over the FIR of Japan is provided by the navigation function.

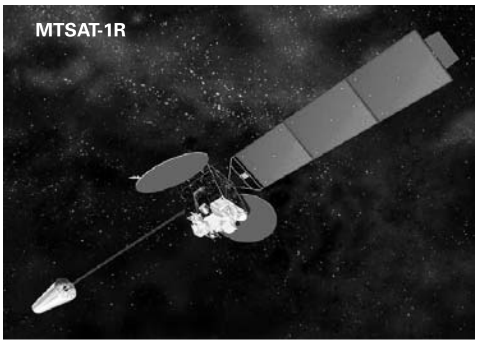
JCAB launched MTSAT project and has been promoting infrastructure developments in order to increase the airspace capacity and insuring air navigation safety in the Asia/Pacific regions, where the air traffic has been recently increasing especially in the north-pacific route.

JCAB will establish very highly-reliable system for air traffic control with MTSAT-2 in order not to have an impact on aircraft utilizing MTSAT system by transferring one satellite to another in case of system faults.

JCAB planed testing for MTSAT-1R function to maximize its abilities. After the launch of MTSAT-1R, based on the plan, basic unit testing of the satellite and connection testing of ground network were performed followed by the aeronautical communication function testing by the JCAB Flight Inspector.

Sufficient basic function and performance of MTSAT-1R were confirmed first with the Flight Inspection aircraft parked in the testing performed. After that, the data and voice communication testing were performed in the flight testing. Also, after the flight testing in FIR of Japan, flight testing area was expanded to the adjacent FIR, where flight testing for confirmation of the function was performed comprehensively.

In our presentation, we will explain about the equipments of the aircraft used in the flight testing, how to collect the data, actual data collected in the testing and original evaluation criteria prescribed by JCAB Flight Inspector.



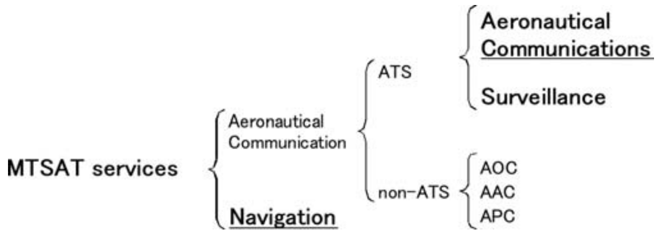
2. MTSAT SERVICES

MTSAT system provides new communication services and can push past the limits of Navigation utilizing ground radio facilities in the oceanic airspace where we cannot support its services by the existing systems and in the area where the state of radio wave is unstable.

Also, MTSAT is expected to play an important role in increasing airspace capacity and ensuring air navigation safety.

MTSAT provides aeronautical communications and navigation.

The aeronautical communications are classified roughly into Air Traffic Communication Services (hereinafter called ATS) or non-Air Traffic Communication Services (hereinafter called non-ATS), which provide Airline Operational Communications (AOC), Aeronautical Administrative Communications (AAC) and Aeronautical Passenger Communications (APC), and so on.



Of the above-mentioned services, JCAB takes charge of ATS for aeronautical communications and surveillance, and navigation.

Here shows each service in greater detail below.

I. ATS

a. [Communications]

Aeronautical communications are realized by CPDLC and Sat Voice. Currently, HF voice is used for communication between aircraft and ATCC (Air Traffic Control Center). MTSAT provides direct controller-pilot communication in voice and data, thereby improving the quality and efficiency of communication significantly.

b. [Surveillance]

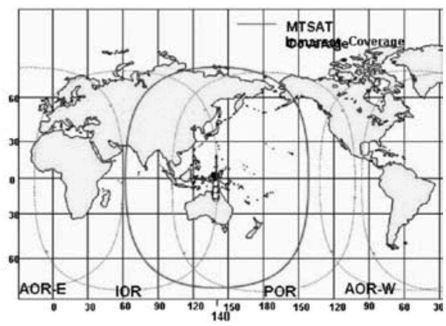
Surveillance is realized by ADS. Aircraft flying outside of radar coverage transmits its own position data automatically to ATCCs via MTSAT. The position of aircraft is displayed on screen like as Radar.

II. Navigation

Navigation is realized by receiving MSAS (MTSAT satellite based augmentation system) signals. MTSAT provides aircraft with augmentation information to improve the reliability and accuracy of GPS for aircraft navigation.

III. Effect

ATS utilizing MTSAT function provides controller with the position of aircraft fly over the ocean. In addition, the MTSAT enables controllers to communicate with pilot directly. The introduction of MTSAT achieves reduction of separation minima and enhancing the capacity in oceanic air space. Especially in North Pacific route, minimum longitudinal separation between leading aircraft and trailing aircraft on the same route and the same altitude will be reduced from current 15 minutes at most (about 120NM) to 6.5 minutes (about 50NM) in order to cope with the increasing air traffic.



MTSAT Coverage

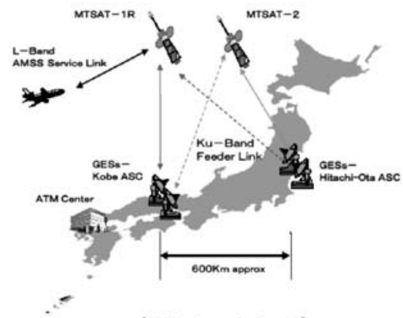
On the other hand, Navigation utilizing MTSAT function enables to set air routes flexibly while the existing air routes are fixed linearly between the ground radio facilities

IV. Non-ATS

Non-ATS function provided by MTSAT is realized by the partnership with SITA.
MTSAT system will provide ATS and non-ATS as one package.
AOC is utilized to communicate between aircraft side and ground side for airlines. With the communication services, information of airline operational control duties, airline operational duties and maintenance schedule are treated. And AAC is utilized to deal with information of crew schedule, aircraft equipments, reservations, and connection at the airport. In addition, APC is utilized as public telecommunication service in the cabin.
MTSAT system also provides those non-ATS under the cooperation with SITA.

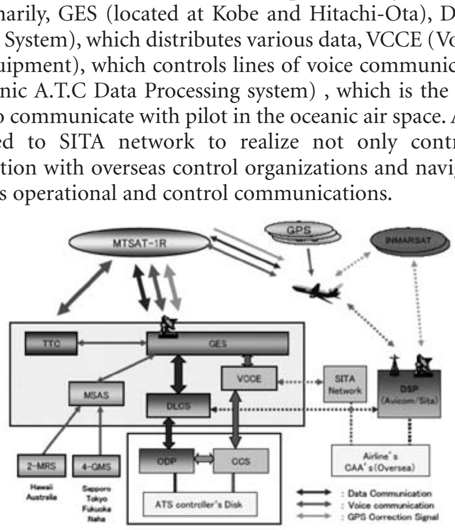
3. MTSAT SYSTEM CONFIGURATION

In order to realize air navigation high safety and reliability, GESs (Ground Earth Station) for MTSAT-1R are located at two places. One is located at North Kanto region (Hitachi-Ohta: about 120km east of Tokyo) and another is at Kansai region (Kobe: about 40km west of Osaka) in Japan and distance between them is about 600km.
Therefore, MTSAT enables to provide consistently services by transferring GES in case of the impact on the electric wave propagation by bad weather, and so on.
In addition, in case of GES trouble, it is automatically transferred in no time at all not to suspend its operation.



【MTSAT System Configuration】

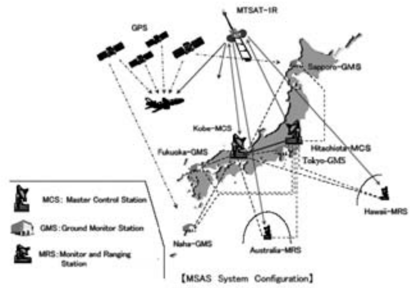
Aeronautical communication services are provided by the MTSAT-1R system primarily, GES (located at Kobe and Hitachi-Ota), DLCS (Data Link Center System), which distributes various data, VCCE (Voice Circuit Control Equipment), which controls lines of voice communications and ODP (Oceanic A.T.C Data Processing system) , which is the display for controller to communicate with pilot in the oceanic air space. Also, DLCS is connected to SITA network to realize not only controller-pilot communication with overseas control organizations and navigation, but also Airline's operational and control communications.



MTSAT Total System

On the other hand, Navigation function is achieved by several earth stations (4 GMSs located at Sapporo,Tokyo, Fukuoka and Naha in Japan and 2 MRSs located at Hawaii and Australia in the other countries), which survey consistently the signals from GPS and MTSAT-1R and by 2 MCSs (located at Kobe and Hitachi-Ota), which deal with data obtained from the earth station to generate GPS reinforcement signals. And this system is named as MSAS.

GMS: Ground Monitor Station
MRS: Monitor and Ranging Station
MCS: Master Control Station



【MSAS System Configuration】

4. MTSAT-1R TEST IMPLEMENTATION SCHEDULE

MTSAT system is connected with a lot of systems.
Therefore, its performance was tested through the following phases to maximize its abilities.

Interface testing

Basic function testing such as the communication protocol testing that is necessary for information exchanges were performed.

Ground network testing

By connecting all systems constituting a ground network, AMSS (Aeronautical Mobile Satellite Service) basic function and the data and voice communications by using test-AES (Aircraft Earth Station) were tested.

In-geostationary orbit testing

Various testing such as confirmation of the basic function that MTSAT-1R is equipped with and setting of each parameter for the operation were performed after MTSAT-1R was injected into a predetermined geostationary orbit.

Satellite testing

Confirmation of AMSS basic function between MTSAT-1R and GES, and End-to-End testing of data and voice communications via MTSAT-1R by using test-AES were performed after In-geostationary orbit testing.

Aircraft testing on the ground

End-to-End testing of Data and Voice communication function via MTSAT-1R were performed by Flight Inspection aircraft on the ground.

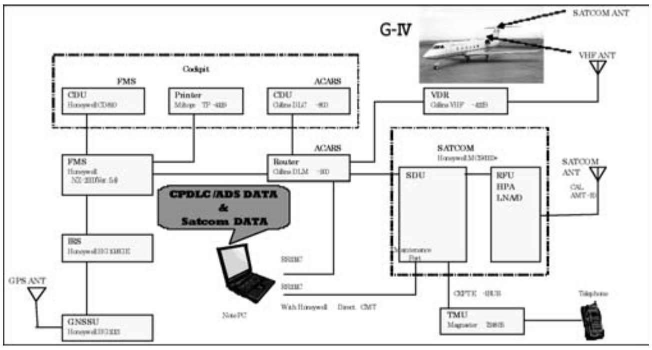
Aircraft testing in flight

Flying in over Japan and the other countries by Flight Inspection aircraft, global and spot beam functions of MTSAT-1R were confirmed. Also handover testing, and End-to-End testing of Data and Voice communication function via MTSAT-1R were performed.
Those above testing made a progress smoothly as scheduled. The test results shows high reliability and safety, which MTSAT system aimed for. Then the test phase shifted to the final stage toward the operation commencement.

5. TEST SYSTEM

AMSS function test of MTSAT by Flight Inspection aircraft was carried out mainly with Gulfstream-IV Flight Inspection aircraft equipped with MCS-6000+ SATCOM system manufactured by Honeywell, also SAAB2000 Flight Inspection aircraft, which was equipped with SAT-906

SATCOM system manufactured by Collins was used secondarily. ATC data communication function of these Flight Inspection aircraft is equivalent to the FANS-1 function of Boeing B747-400 aircraft. However the function is not applicable for actual operation because its system is certified only for test purpose.



Schematic diagram of onboard SATCOM test system on G-IV aircraft

Following is explanation about onboard SATCOM test system of G-IV aircraft.
The core component of the SATCOM system is SDU (Satellite Data Unit), which is connected to other major components related to the SATCOM system. It manages input and output of data or control of transmission frequency, etc.
The SATCOM data was collected by using a notebook PC at a SATCOM port wired from a maintenance port of SDU to an AFIS (Automated Flight Inspection System) console in RS232C protocol.
A kind of the data acquired here is as follows.

- Periodic Data: Some pre-specified parameters (e.g. Bit Error Rate(BER), Carrier Strength, Signal Quality Index) are collected at pre-specified time intervals (e.g. 20sec)
- Trace Data: Pre-specified parameter is acquired when some event happened (e.g. Log_On to satellite, Log_Off from satellite). With these Trace Data, we can easily recognize which Satellite/GES is logged on to or logged off from.

Above 2 data can be acquired by using D-CMT (Direct-Commissioning & Maintenance Terminal) function of SDU in real time.

- Call Event Log: The phone number, start/stop time of call and GES ID etc that performed Sat Voice are recorded.
- Data Event Log: Quantity of packet data during Log_On to one Satellite is recorded.
- System Management Event Log: Places (latitude/longitude) and time (UTC) are recorded when some events (satellite / GES Handover, Log_ON/OFF, taking off/landing etc) occurred in a SATCOM system.

Above 3 data can be acquired by downloading log stored in SDU after a flight.
In addition, we collected the communication log data that was actually exchanged between a ground terminal (ATC work station, DLCS etc) and an onboard terminal (FMS, ACARS etc). The data was picked up by using a notebook PC at an AFIS console via RS232C cable wired from a maintenance port of an ACARS router (DLM-900 Router) in real time.
The application software that we used for all of data acquisition and saving is the Hyper Terminal that is general communication software.

```
03:47:38        SD<soh>2.JA001G<nak>H19<stx>F00AYE0000
#M2B/B0             RJTG.AFN/FMHJA001G,.JA001G,,034730/F
PON18222E144138,1/FCOADS,01/FCOATC,01FF3C<etx>
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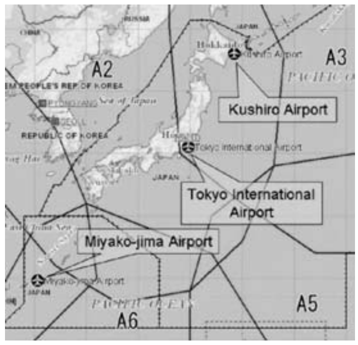
[Sample of collected data (The AFN_LOGON data example which picked up at DLM-900 Router]

6. AIRCRAFT TESTING ON THE GROUND

The reason of the ground test which is required before a flight test is as follows.

- Almost all of test items to be carried out during ground parking test phase are the first experience for us, and we concerned about occurrence of some malfunction what neither Flight Inspector nor the ground engineer can imagine.
- Even if some malfunction occurred, we can easily take communication with some staff of ground facility such as GES by mobile telephones directly in real time.
- At the worst, it is easy to interrupt anytime during the test.
- It is necessary for personnel who execute the test to take a rest, because there were too many confirmation items and the test took a lot of time.

In order to confirm the global beam and the spot beam which we can confirm at domestic airport on the ground, the test was carried out as Flight Inspection aircraft parking at 3 airports in Japan. The first one is Tokyo International Airport that is a base airport of JCAB Flight Inspection. The second one is Miyako-jima Airport that is an airport of the southern end in Japan. And the last one is Kushiro Airport that is an airport of the northern end in Japan.



Location of Ground Parking Test

The final purpose of the test with Flight Inspection aircraft is to confirm End-to-End communication. However, the total system of satellite communication which enables reliable End-to-End communication is intricately-intertwined with various systems including both space segment and ground segment, which is out of Flight Inspector's scope. So that many prior consultations with many ground engineer about test item and its method were conducted again and again. Furthermore, the exchange of information between Flight Inspector and the ground engineer was very important. Because Flight Inspector has no expertise in satellite communications, also the ground engineer has no expertise in aircraft system (including onboard SATCOM system). The ground test for AMSS with Flight Inspection aircraft for was started on July 19th, 2005. In this test period, most test items except the items in the air were carried out.
First of all, it was necessary for the onboard SATCOM system to logon to MTSAT at the beginning of the test. Basic performance of MTSAT has complete compatibility with existing INMARSAT satellite. As for the SATCOM system, information (a satellite number / satellite longitude / Psid frequency) of an individual satellite is to be written automatically in the System Table recorded in the onboard SDU by receiving a broadcasted Psid (the information related to Satellite Identification broadcasted by P-ch) signal from a satellite. A SATCOM system is to try to logon to desired satellite/GES on the basis of this information of the System Table recorded in onboard SDU. However, MTSAT information was not included in Psid signal broadcasted by INMARSAT at the first stage of the test. So that SDU could not know even Psid frequency to logon to MTSAT. Therefore we directly accessed to SDU with a notebook PC and wrote MTSAT information at SDU which MTSAT planned to broadcast in Psid. Afterwards, it was necessary to set MTSAT information correctly into ORT (Owner's Requirement Table) file where priority of satellite / GES etc. is registered, and to load the ORT file into SDU. The tools to change configuration of ORT, for Honeywell system is called as "ORT tool", for Collins system is called as "SATCOM tool". We added MTSAT as satellite number "04" and Kobe GES as GES number "161 (octet)" by these software, and we set this priority in GES list as the highest preference (set

to “9” in the case of Honeywell, set to “1” in the case of Collins), then prepared an ORT file. Log_On to MTSAT was enabled by loading the ORT file that had been prepared here into SDU.
Furthermore, there seemed to be some difference in a control protocol of SDU by difference of a SATCOM system manufacturer, therefore we confirmed that a required function was satisfied for both SATCOM systems made by Honeywell and made by Collins which are two major companies of SATCOM system manufacturer. Also both of them have been equipped in our Flight Inspection aircraft.

SATELLITE INFORMATION:

SAT	SAT NAME
00	AOR-W
01	AOR-E
02	POR
03	IOR
04	**MTSAT**

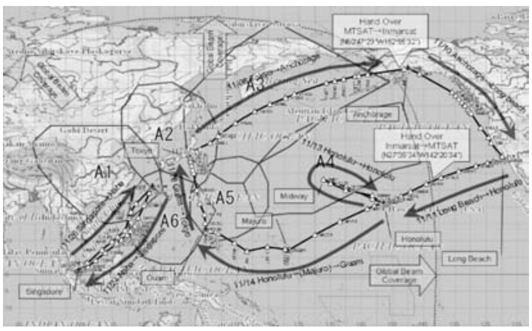
GES INFORMATION:

SAT	GES	PREF	GES NAME
00	001	3	GOONHILLY-AW
00	002	5	SOUTHBURY-AW
00	004	3	EIK-AW
00	005	3	AUSSAGUEL-AW
01	101	3	GOONHILLY-AE
01	103	3	AUSSAGUEL-AE
01	104	3	EIK-AE
01	105	5	FUCINO-AE
02	201	3	SENTOSA-P
02	202	5	SANTA PAULA-P
02	203	6	YAMAGUCHI-P
02	205	3	PERTH-P
03	301	3	EIK-I
03	302	3	NUNTHABURI-I
03	305	3	PERTH-I
03	306	7	YAMAGUCHI-I
03	310	3	SENTOSA-I
03	312	5	FUCINO-I
04	**161**	**9**	**KOBE**

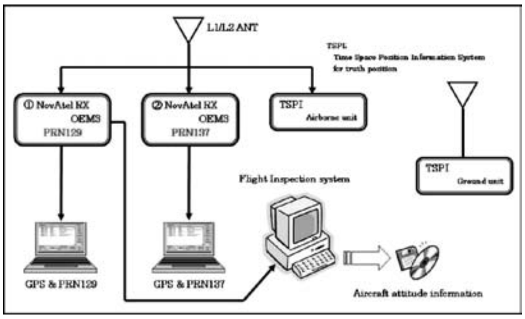
Sample of satellite / GES setting in ORT

7. AIRCRAFT TESTING IN FLIGHT

The test by an actual flight with a Flight Inspection aircraft was carried out from August 8th to November 27th, 2005 with confirmation in domestic FIR. During this period, we examined items that we could confirm only in flight-condition. Also it was confirmed that items which had been confirmed during ground test period was the same result as flight-condition.
To give an actual example, it is the confirmation of the Handover between each Spot beam, and between Global beam and Spot beam. Also it is the confirmation as to whether the Handover occurred at the position that we assumed, and as to whether there are no difference of quality in data and voice communication before and after the Handover. At that moment, Periodic and Trace data etc were useful for confirmation of Handover. In these data, it was recorded where, when and why the Handover occurred. Furthermore, Periodic Data was very effective data for various technical considerations by ground engineer, because various parameters (BER / Career Strength / Vertical Elevation) about satellite communications were recorded in it.
After the flight test in domestic FIR, around the Pacific and to/from Southeast Asia flight had been commenced from November 8th, to November 27th, 2005. Its main purpose was to confirm communication function in the spot beam that we could not confirm in Japanese FIR, to confirm coverage of a global beam, to confirm Handover with the other satellite (INMARSAT) and to establish ATC communication with foreign ATC Units.



During this flight, we also collected the basic MSAS signal broadcasted from MTSAT-1R with GPS signals. For collecting those data, NovAtel Millennium Rx was fixed on the shelf in AFIS Equipment Rack, and then output data from the Rx were recorded into two notebook PCs. The reason why we got same data with the two notebook PCs separately was that we wanted to make sure whether lack of data happened depending on the different performances of PCs. After the flight, we found there was no lack of data or malfunction on both of PCs. These recorded raw data were passed to JCAB ATS Engineering Division in charge of MSAS implementation and maintenance, and used only for the purpose of verification on what kind of data JCAB should collect during formal flight test which will be planned in autumn, 2006. At the formal flight test conducted within Japanese FIR in 2006, we are going to collect MSAS PRN-129 & 137 messages broadcasted from MTSAT-1R & MTSAT-2 with GPS signals, truth position data and aircraft attitude information.



Schematic diagram to collect MSAS signal

The JCAB Flight Inspection established Flight Inspection criteria for AMSS function of MTSAT originally. The reason why we established it is that MTSAT has a function (Sat Voice / CPDLC / ADS) similar to existing ATC voice communication or a Radar, as a communication device used for ATC purpose. Also we thought that at least JCAB has a responsibility to have to confirm the basic function of MTSAT as a service provider of AMSS. A basic way of thinking on establishing Flight Inspection criteria for AMSS function of MTSAT is whether a user can establish reliable End-to-End communication (between ATC controllers and Pilots) and whether MTSAT is able to be used for ATC purpose in actual operations. The following JCAB Flight Inspection criteria for MTSAT show the evaluation item and its tolerance.
• Sat Voice:
Sensitivity / articulation should be satisfactory for aircraft operation. There should not be significant time delay in transmitting and receiving.
• Data Communication:
It should be reliable two-way communication without garbled characters in both up-link and down-link message. It should not require overload to a pilot in ADS / CPDLC operation in normal condition.

Scenery of in-flight test

• Beam Transfer:
The communication (voice / data) quality should not have a difference between before and after beam transfer.
• Coverage:
When MTSAT was set as the highest priority onto ORT satellite (GES) preference list, AES should surely logon to MTSAT in the range required for ATC purpose within planned coverage of MTSAT.

8. RESULT OF FLIGHT TEST

On this flight trial, we could solve many things that were unknown to JCAB Flight Inspectors and ground engineer. For example, a certain

number of differences in its protocol behavior by each SATCOM airborne equipment, the way to set parameter in airborne AES equipment in the case of exchanging data communication through MTSAT, the mechanism of how and where Handover function happens in actual AES, etc.
Concerning coverage of each spot beam, we confirmed that Handover functions were done properly from a spot beam to another one or to global beam at the boundary line of Spot Beam Map broadcasted from MTSAT. Also, concerning coverage of global beam, Handover function between MTSAT and INMARSAT POR was done at N60?47'29" W152?55'32" (20 minutes before landing to Anchorage Airport) in the flight from Tokyo to Anchorage and at N27?35'34" W142?20'34" (between DIALO and DEROK) in the flight from Long Beach to Honolulu. Those Handover points were as supposed in advance, and we did not recognize any differences of the quality of data and voice communication between before and after Handover.
And, MTSAT functions were satisfied with Flight Inspection criteria established by JCAB. Therefore AMSS communication through MTSAT was confirmed its normal function under actual operation.

Flight Inspection Report－AMSS

Date of Inspection: 7/19~11/27/05

Name of Facility: MTSAT-1R

Type of Inspection					
×	Commissioning (MR:第115号,第91号)	×	Special (航空局第115号,国空無第91号)		Others
	Periodic ( )		Surveillance ( )		Incomplete()

COVERAGE

	Set	Unset	Route (from/To)	Remarks
Satcom Log_On	×		N35°33' E139°47' / N60°47' W152°56'	N36°47' E140°48'~N38°25' E144°57' の間不安定
	×		N27°36' W142°21' / N21°19' W157°58'	KLGB→PHNL
	×		N21°19' W157°56' / N21°19' W157°56'	PHNL→(PMDY)→PHNL (Local FLT)
	×		N21°18' W157°56' / N07°04' E171°16'	PHNL→PKMJ
	×		N07°04' E151°16' / N13°29' E144°48'	PKMJ→PGUM
	×		N13°29' E144°48' / N35°33' E139°47'	PGUM→RJTT
	×		N26°12' E127°39' / N01°22' E103°59'	ROAH→WSSS

Sat_Voice Communication

Other Party	Sensitivity・Clarity		Time of Delay		Name of Fix or Lat/Lon	通話日時(UTC)	Remarks
	Set	Unset	Set	Unset			
Fukuoka ATMC	×		×		N47°03' E158°16'	11/08/05 13:51:00	
Kobe GES	×		×		N51°10' E167°27'	11/08/05 17:24:00	
Anchorage ARTCC	×		×		PLADO	11/08/05 17:36:00	
Hitachi-Ota GES	×		×		N21°15' W158°16'	11/10/05 22:11:00	
Oakland ARTCC	×		×		N26°04' W169°16'	11/10/05 23:47:00	
Tokyo ACC	×		×		N18°07' E144°21'	11/16/05 03:45:00	
Singapore ATCC	×		×		N10°09' E117°59'	11/26/05 05:42:00	

Data Communication

ATC Center	AFN Log_On		ADS		CPDLC		Remarks
	Set	Unset	Set	Unset	Set	Unset	
RJTG	×		×		×		with ATMC
PAZA	×		N/A	N/A	×		ADS is not in service
KZAK	×		×		×		
RJTG	×		×		×		with Tokyo ACC
WSJC	※	※	–	–	–	–	

Beam Transfer

Beam Transfer(Before/After)	Sat_Voice		Data		Location of Transfer	Remarks
	Set	Unset	Set	Unset		
A3 / GLOBAL1	×		×		N60°16' / W153°18'	
GLOBAL / A4	×		×		N24°42' / W166°41'	
A4 / GLOBAL1	×		×		N24°28' / W166°34'	
GLOBAL / A6	×		×		N13°37' / E144°49'	
A6 / GLOBAL1	×		×		N28°45' / E141°48'	
GLOBAL / A3	×		×		N34°41' / E140°04'	
A6 / GLOBAL1	×		×		N12°22' / E129°18'	
GLOBAL / A1	×		×		N15°40' / E129°00'	

Remarks

1. MR : Commissioning & Special inspection for biginning of MTSAT.
2. ※ : Down link Data was received at Singapore ATCC, nevertheless AFN LOG_ON was not established because of mismatch of data processing protocol.
3. JA001C aircraft did not continue AFN_LOGON at the time of beam transfer. It seems to be software problem specific on flight inspection aircraft. For that reason, it must be reconfirmed by other aircraft equipped with FANS-1/A function.
4. During voice communication by JA001G, the tendency for quality of a satellite signal to deteriorate, but there was some malfunction in aircraft SATCOM Antenna System on JA001G as a result of farther investigation.
5. Interference investigation with MSV(Mobile Satellite Ventures Corp) was conducted.

Adjustment: yes / no — ×

Facility Status	×	Unrestricted		Restricted		Unusable

Due date for the next	Aircraft No	Mission specialist's signature	Flight inspector's signature
–	JA001G/3G/4G		

9. CONCLUSION

Regarding protocol behavior of SATCOM system, there seems to be a little difference by each manufacturer's equipment. Of course, it is the only manufacturer to know its detail, so there are many things on what each user never knows its mechanism. Also, it is impossible to make sure about its technical behavior for all aircraft, because there are various configurations on SATCOM systems equipped in each aircraft. However, once the order of priority of Satellites and GES which would be entered in ORT was set to MTSAT properly according as configuration of your aircraft, you can exchange data and voice communication through MTSAT system, with safe, comfortable and definite quality.
To use MTSAT system, user needs to register his or her aircraft information in MTSAT-GES. And, since the transferring behavior between satellites would be carried out seamlessly with interoperability between MTSAT and INMARSAT, all users must be promised very comfortable utilization in coverage. Let JCAB know users who make use of MTSAT system. In the case of other utilization except ATC communication with Japanese ATC Center (ATM Center*), user would need to contract with SITA who is partnered with JCAB.
JCAB's final goal is to establish operational structure with dual MTSAT system. The second MTSAT called as MTSAT-2 was also launched by H-2A rocket successfully from TNSC in the evening of February 18th, 2006. From now on, similar test to MTSAT-1R is planned by JCAB Flight Inspection aircraft. Please look forward to the promising MTSAT system. Finally, users can always apply to JCAB MTSAT support center at Kobe aeronautical satellite center for technical support or inconvenience of MTSAT system.

*ATM Center : JCAB's ATM Center is located at Fukuoka in Japan. It has ASM (Air Space Management) function, ATFM (Air Traffic Flow Management) function and ATS (Air Traffic Service for Oceanic Control area) function. These 3 functions are collaborated with each other.