



International Civil Aviation Organization

Communication, Navigation and Surveillance Sub-Group

**Eighth Meeting (CNS SG/8)**  
*Cairo, Egypt, 26 – 28 February 2018*

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**Agenda Item 4: CNS Planning and Implementation in the MID Region**

**ENHANCEMENTS TO MLAT SYSTEM AT CAIRO AIRPORT**

*(Presented by Egypt)*

**SUMMARY**

This paper presents Egypt’s experience with MLAT Operation at Cairo International Airport (HECA), the improvement to the performance and availability of the MLAT system and the lessons learned.

Action by the meeting is at paragraph 3.

**REFERENCES**

- ANSIG/1 WP/29
- EUROCAE ED 117
- ICAO Annex 10 Vol. 4
- ICAO APAC MLAT Concept of Use

**1. INTRODUCTION**

1.1 The First meeting of the ANSIG Implementation Group (ANSIG) held in Cairo, Egypt, 10–12 February 2015. Egypt submitted a working paper entitled ‘The Implementation of A-SMGCS at Cairo Airport’; presenting Egypt’s experience with A-SMGCS (Implementation of B0-SURF), the drawbacks, and the suggested mitigations.

**2. DISCUSSION**

2.1 Multilateration is a Surveillance System that provides accurate and reliable real time location and identification of aircrafts and vehicles equipped with operational transponders. Multi-sensor Surveillance System (MSS) is a cooperative surveillance sensor. Its operation is based on Multilateration Time Difference of Arrival (TDOA) algorithm that uses Mode A/C and Mode S target emissions on 1090 MHz according to ICAO ANNEX 10. The MSS provides accurate position and identification information on transponder-equipped aircrafts and on Mode S transponder/beacon equipped surface vehicles by “Multilaterating” the signals transmitted by the transponders. Multilateration can be categorized as air and ground surveillance system, because of its capability to detect targets in high altitudes (depending on antenna coverage) and on the ground as well. Multilateration can be used as a stand-alone system; in this case its output will connect to ATC displays directly. It can also be used as an enabler for A-SMGCS system, and in this case it will connect to a data fusion server.

2.2 Generally, Multilateration can interface with various systems using standard protocols and communication devices, such as ATC Tower Displays, A-SMGCS, TIS-B Server, Traffic Management Unit, Airline Operations, and Airport Operations.

***MLAT Functionality***

2.3 MLAT system consists of the following components:

- A receiving antenna array subsystem that receives transmissions from the target and timestamps receipt at each antenna;
- A transmitting subsystem that includes interrogation message generation and transmission functions (Active MLAT system).
- A central processor that calculates and outputs the MLAT (and ADS-B) tracks.
- Receiver synchronization method.
- Appropriate communication Links between receivers/ transmitters and the central processors.

2.4 The more receivers we add the more accuracy we get. So, sensors' antennas must be situated such that at least 4 of them simultaneously have clear line-of-sight to a given target in the operationally significant coverage area.

2.5 The system must comprise of at least one additional sensor to the minimum number of sensors required for obtaining a 2D or 3D solution throughout the required coverage area.

***MLAT Benefits and Advantages***

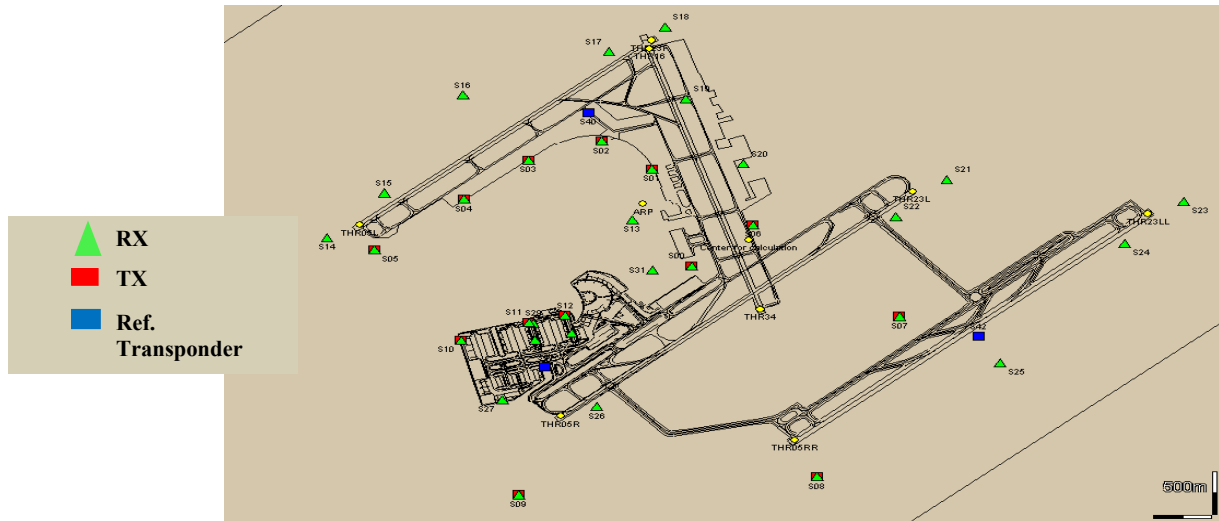
2.6 MSS has the following benefits and advantages:

- Improved situational awareness in all weather conditions
- Reduced runway incursions
- Improved airport efficiency
- Improved accuracy
- Increased capacity
- Provision of independent measuring of the aircraft's altitude
- Minimal Installation Requirements
- Low maintenance cost
- Low power consumption for remote sites
- High interrogation capability and advanced target processing
- No cone of silence (as opposed to radar)
- Resistance to FRUIT
- No Additional Avionics required; an important feature of MSS is that it works with any aircraft already equipped with either Mode A/C or Mode S transponders without additional avionics. In addition, MSS supports simultaneous reception of Automatic Dependent Surveillance Broadcast (ADS-B) long squitter messages with no need for any equipment modification.

**MLAT Implementation in Egypt**

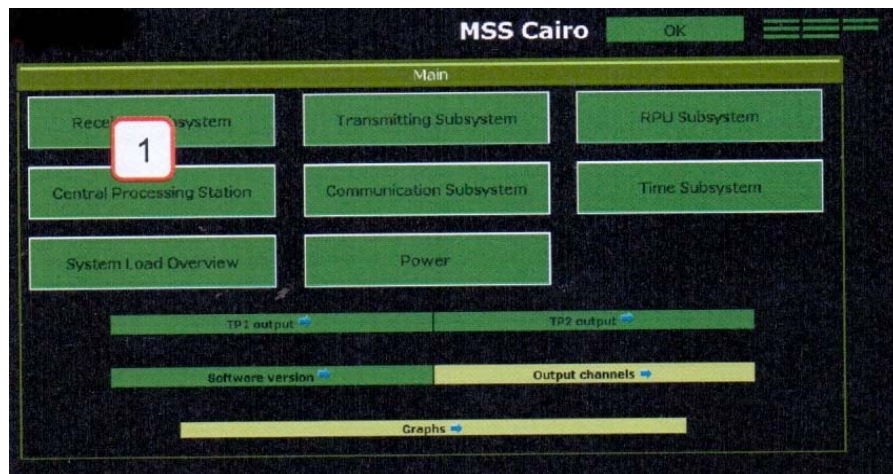
2.7 The implementation of MLAT system started in 2012 as the primary surveillance input to the ASMGCS system, which covers Cairo airport runways and maneuvering areas.

2.8 In the beginning of the project, MLAT system consisted of 31 receivers, 13 transmitters and central processing units, all parts are linked with microwave network. The system covered the three runways, the taxiways, terminal 1 and terminal 3. At that time, terminal 2 was under reconstruction so no sensor was installed there.



*Fig 1: MLAT Distribution Sensors on the Three Runways*

2.9 The accuracy of MLAT was almost 3 meters. To keep it that accurate, we applied  $N - 1$  redundancy criterion, i.e. if two sensors fail out of 31 sensors, all the MLAT system stops introducing output to save the accuracy of the system. Unfortunately applying the  $N - 1$  redundancy criterion on the whole system was affecting the availability of the system.



*Fig 2: the Main Panel of Management System before Dividing the Airport Layout to Clusters.*

2.10 Later, in 2017, the construction of Terminal Building Two (TB2) was completed, five (5) receivers and two (2) transmitters were added, to cover its maneuvering area. Also, the redundancy criterion has been revised in order to improve the availability—the whole airport area was divided into six clusters and applied the  $N - 1$  redundancy criterion on each cluster individually. This mitigation measure increased the availability of the MLAT system by 30%.

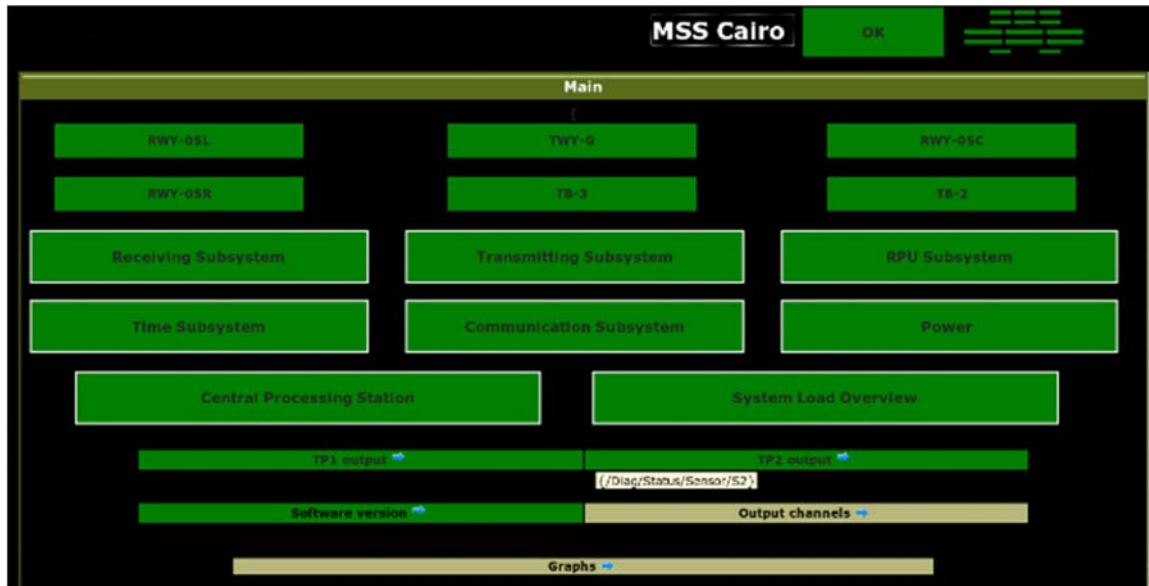


Fig 3: The Main Panel of Management System after Dividing the Airport Layout to Clusters.

2.11 The probability of detection reached 99.99 % and the rate of false target dropped to less than  $10^{-6}$  over any 5 seconds period.

### ***Lessons Learned***

2.12 The lessons learned during implementation phases of MLAT system at Cairo Airport are:

- a. Multiple clusters should be implemented with big Airport or complex airport layout. ( $N - 1$ ) redundancy criterion should have be applied to each cluster individually in order to increase the availability while maintaining the accuracy.
- b. Probability of detection should be at least 97% for the MLAT system.
- c. Rate of false targets during any update should be less than1%.
- d. Active MLAT systems shall not use Mode S All-Call interrogations.

**3. ACTION BY THE MEETING**

3.1 The meeting is invited to:

- a) take into consideration the lessons learned during the MLAT Implementation to enhance the performance, availability and redundancy; and
- b) update the MID Surveillance plan with Egypt's Experience on MLAT.

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