Advanced air traffic services

Dual Frequencies Multi Constellations GNSS service to support improved IFR rotorcraft operations in the TMA

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SESAR 2020 SHOWCASE

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Introduction

- Rotorcrafts play a key role in the society thanks to:
  - *extraordinary versatility*
  - *excellent manoeuvrability*
  - *capability to perform vertical take-off and landing.*

- However, Rotorcraft are particularly vulnerable to adverse weather conditions:
  - *Even if the majority of operations are carried out under Visual Meteorological Conditions (VMC) …*
  - *the need to complete mission-critical operations often leads to inadvertent Instrument Meteorological Conditions (IMC) at a certain point of the flight.*

Introduction

- Statistically the main causes of fatal rotorcraft accidents (particularly in the HEMS business) are:
  - *inadvertent flight into IMC*
  - *Controlled Flight Into Terrain - CFIT (mainly to avoid inclement weather or cloud ceilings)*
  - *missions in darkness*
  - *bad weather conditions*
  - *shortage of tailored helicopter IFR routes/procedures (especially in TMA and to/from a FATO located at airport)*

Why IFR – GNSS for Rotorcraft?

- Performance Based Navigation (PBN) concept as paradigm shift from "equipment" to "performance-based" navigation solutions, in order to :
  - *encourage rotorcraft airspace users in investing on the Instrument flight rules (IFR) capabilities and*
  - *allow rotorcraft operators enjoying IFR routes/procedures network, specifically tailored to rotary-wing aircraft at very low altitude:*
    - *to avoid icing conditions*
    - *to minimize issues due to reduced atmospheric pressure (no non-pressurized cabins)*
    - *to overcome any operational issues*
  - *to offer to rotorcraft operators IFR routes/procedures network specifically tailored to rotary-wing aircraft at very low altitude*
  - *EU reg. 1048/2018 mandates States to deploy a full PBN airspace based on GNSS as primary means of navigation*

CNS

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Solution Scope:

This work package targets safety, performance and technical requirements derivation for the IFR rotorcraft operations supported by enhanced satellite technologies based on **MCMF** (*Multi Constellation Multi Frequencies*) technology, with the main aim to improve the access in several rotorcraft suitable locations inside high dense/constrained TMA, including airports in proximity of dense urban areas (e.g. cities edge, hospital helipad, congested and hostile environment etc.).

Specifically, the solution will evaluate **procedural means** (e.g. **RNP0.1, Tactical Parallel Offset**) and technical capabilities of IFR rotorcraft operations, assuming that these ones are supported by **DFMC-GNSS** technologies (*Dual Frequency Multi Constellation-Global Navigation Satellite System*), combining the use of multiple satellite signals coming from (at least) two constellations in different frequency bands, that will provide technical capabilities aimed at improving performance, robustness and coverage of system (especially avoiding multipaths signal in hostile/congested low level flight environment). These developments will lead to technical performance improvements, which create the potential for enhancing pilot and ATCO's situational awareness bringing significant operational benefits to the ATM system.

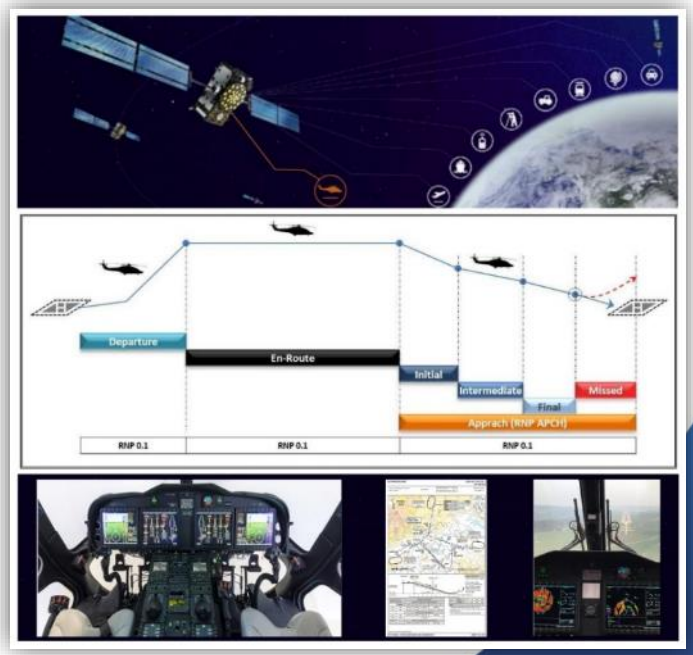
Supporting Solution Exercises and dates:

- PJ.01-W2-06 RT V2 RTS#1 – Milan 03/05/2021 to 07/05/2021
- PJ.01-W2-06 RT V2 RTS#2 – Rome 24/01/2022 to 28/01/2022

V1 | V2 | V3

Target Release R11/R12

30-June-21 | 30-Sept-22



Intended Benefits:

Access and equity: thanks to a better integration between rotorcraft and fixed-wing aircraft there will not be any need of penalization of rotorcraft operations to facilitate fixed wing aircraft or vice versa

Human Performance*, Safety* & Flight Efficiency *(e.g. Fuel Burnt, Flown Trajectory)*

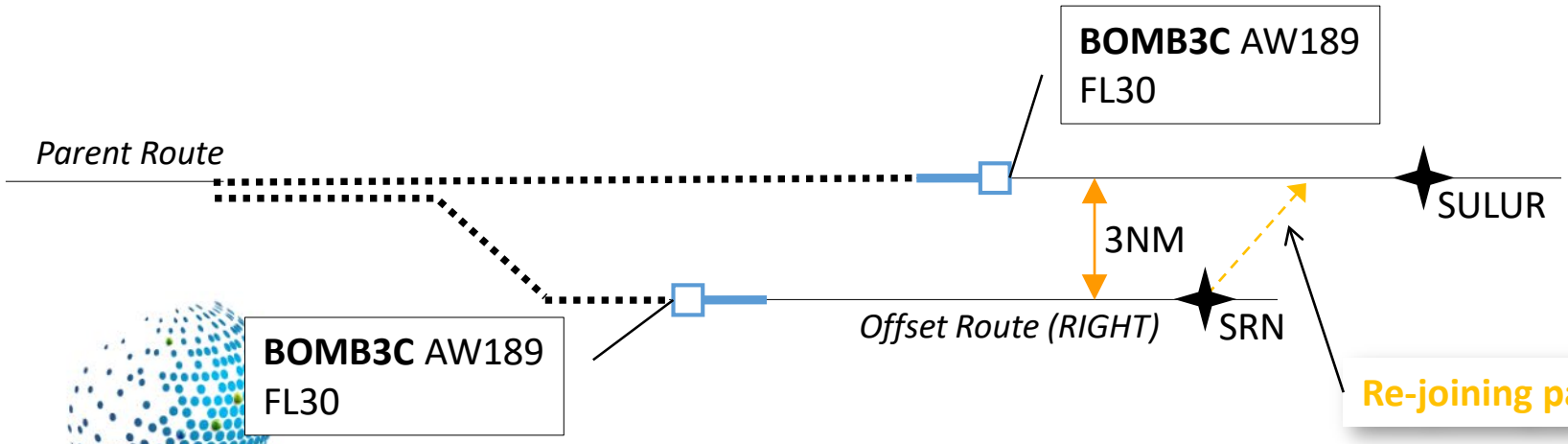
NAIS Solutions as ENAV's LTP

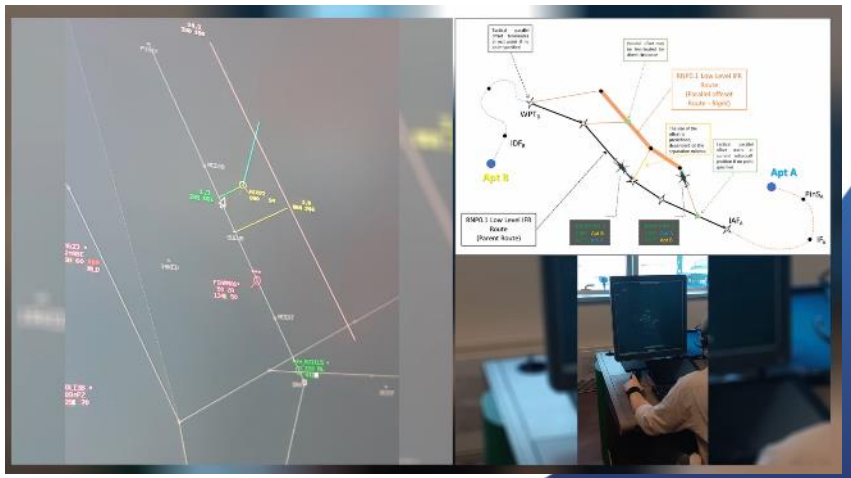
Validation Activities

ICAO Doc 4444 PANS-ATM Chapter 12 defines the following phraseology to be used in parallel offset operations:

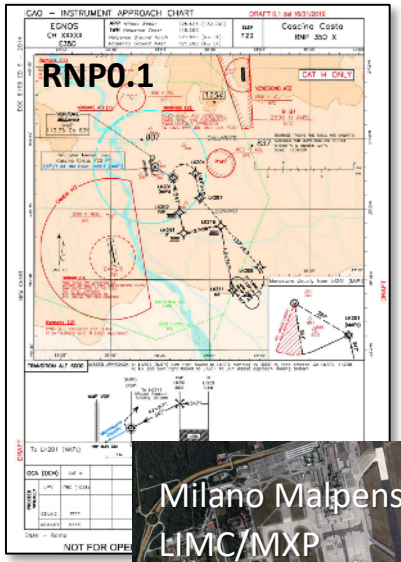
- ***ADVISE IF ABLE TO PROCEED PARALLEL OFFSET*** - used by the controller to determine whether such a manoeuvre is feasible.
- ***PROCEED OFFSET (distance) RIGHT/LEFT OF (route) (track) [CENTRE LINE] [AT (significant point or time)] [UNTIL (significant point or time)]*** - the instruction format for starting a parallel offset.
  - Example: *…**BOMB3C** proceed offset 3 NM RIGHT of track until abeam **SRN**…*
- ***CANCEL OFFSET*** - instructions to re-join *Parent* flight route
  - Example: *…**BOMB3C** cancel offset re-join the Parent route and proceed direct to **SULUR**…*
- ***REQUEST OFFSET (distance) RIGHT/LEFT OF (route) (track) [CENTRE LINE] [DUE TO WAKE TURBULENCE/TO AVOID WEATHER]*** - a pilot request to perform a parallel offset.

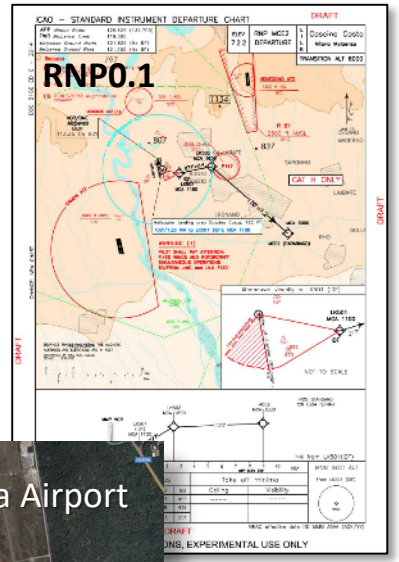
  Example: *…BOMB3C request 3 NM RIGHT of track due to wake turbulence…*

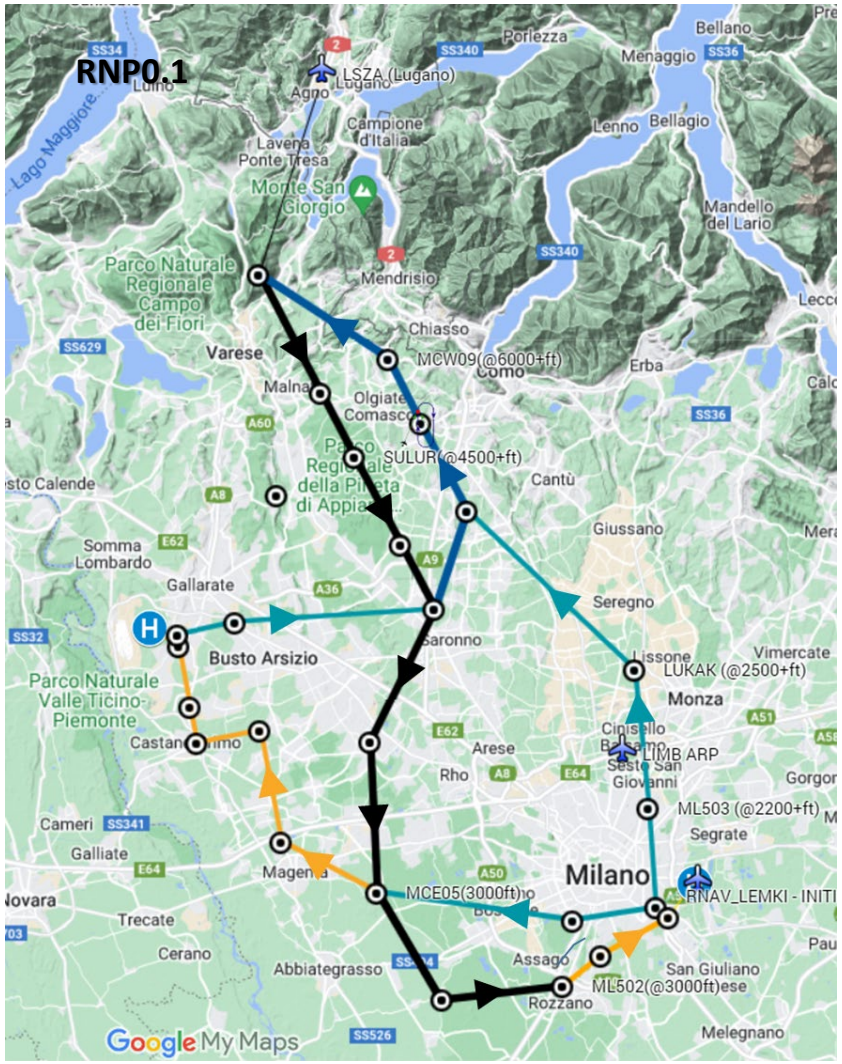


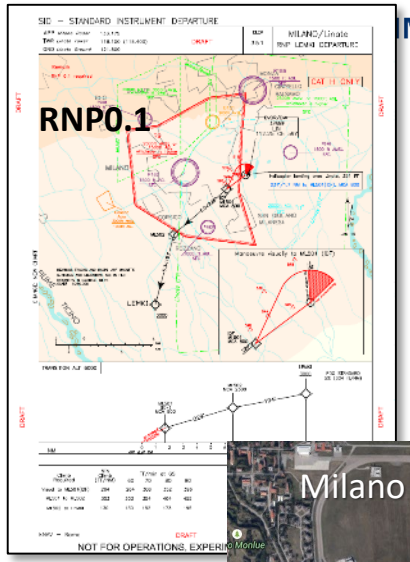


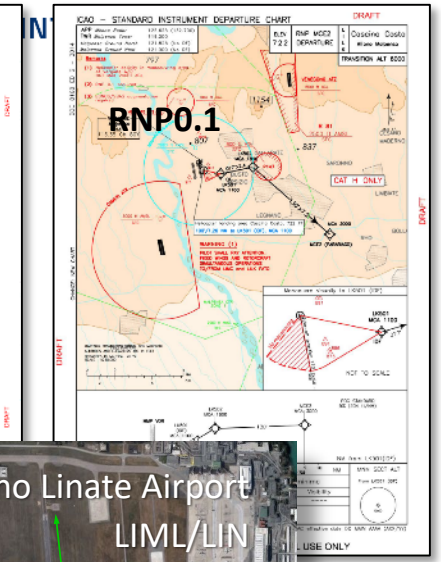
Validation Activities







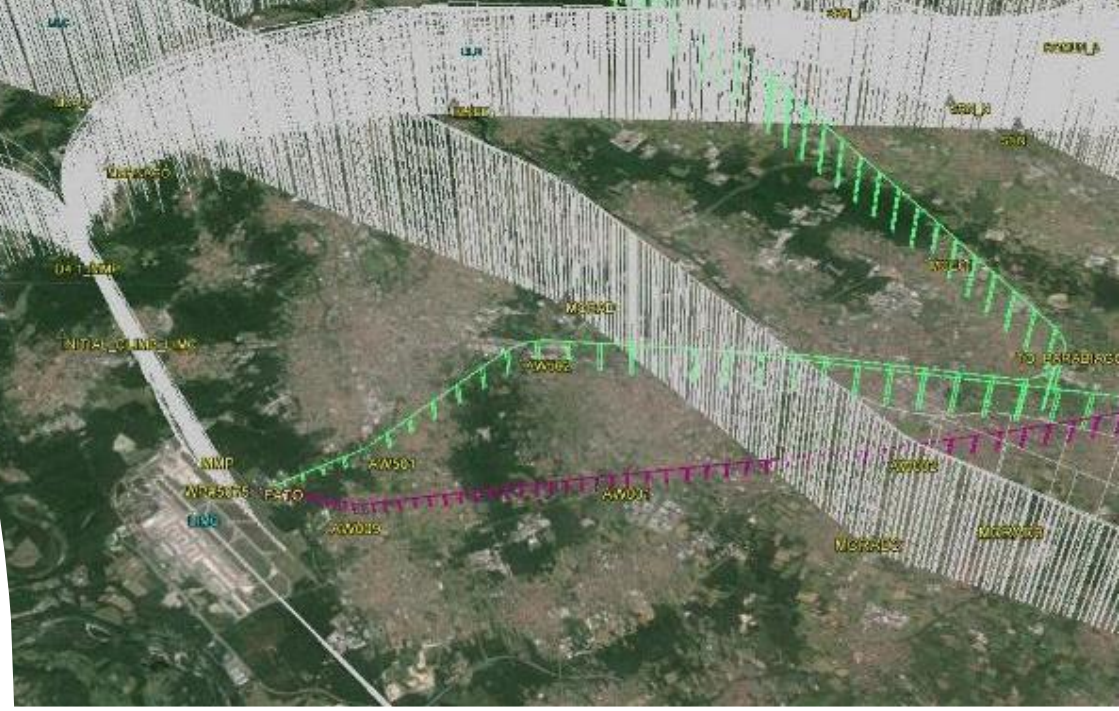




Impact on Performance

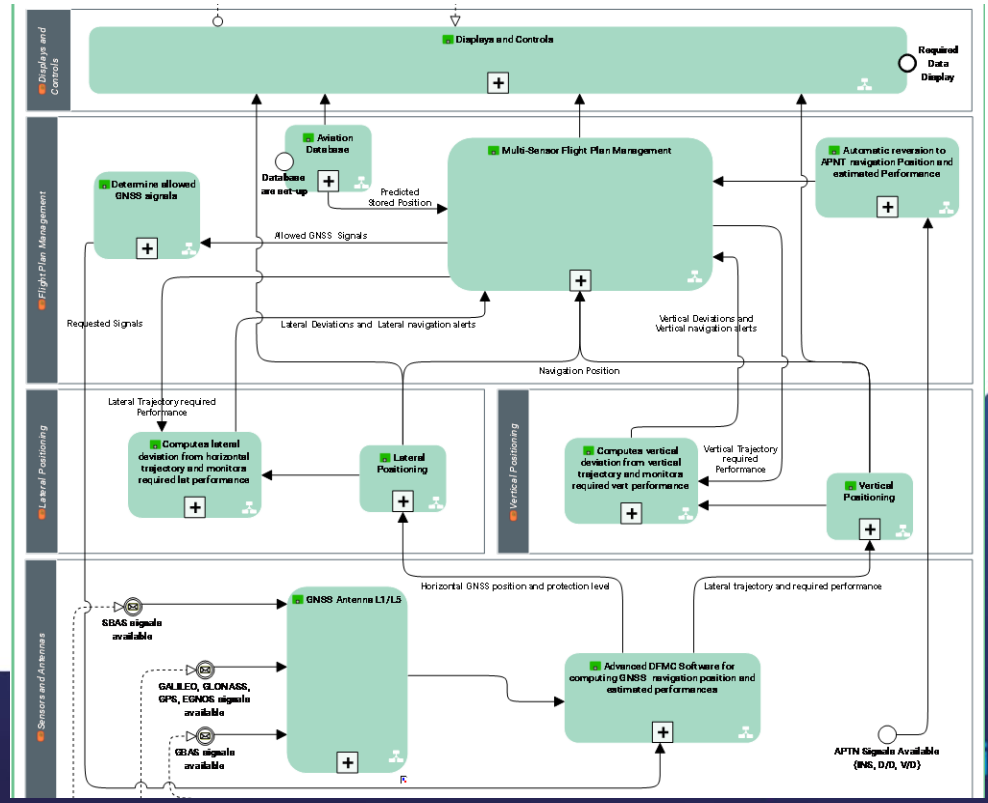
The main findings from the validation exercises can be summarised as follows:

- Rotorcraft access to busy airports
  - *Reduced/unaltered workload for ATCO; (the concept removes slow traffic from runway operations and allows easier AC\RC separation).*
  - *Reduced pilot workload;*
  - *Better rotorcraft access to busy airports;*
- Integration of rotorcraft operations in dense/constrained airspace
  - *Reduced/unaltered workload for ATCO;*
  - *Reduced pilot workload;*
  - *Better transition from ow Level IFR route to PinS rotorcraft approaches/departures to/from heliports.*
  - *(FATOs) and from en-route to terminal route (and vice versa);*
  - *More direct routing in dense terminal airspace;*
  - *Improved management of opposite traffics along the same uni-directional Low Level IFR route*



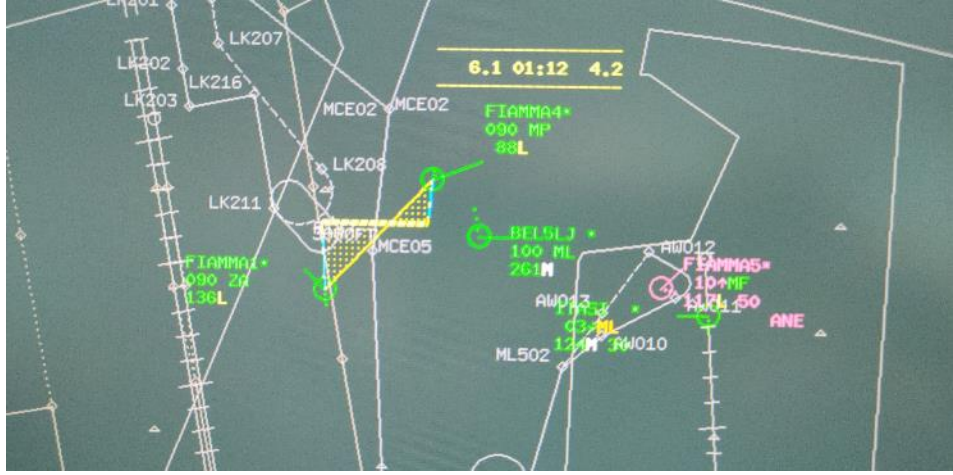
Impact on Aircraft System

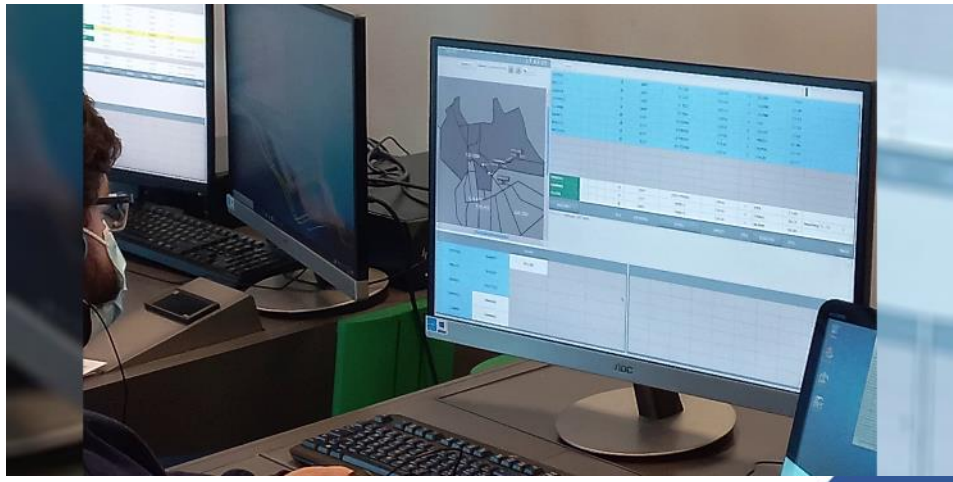
- *Validation tests with real flight data related to a standard SBAS receiver showed a good accuracy of the simulator with possible improvements to be performed on the multi-path and in the Radio-Frequency modelling. In the same flight conditions **DFMC GNSS** receiver exhibits a performance improvement also when multi-paths are present.*
- *Overall the experience acquired during the validations led to some considerations regarding the impact on the following avionics systems :*
  - *Displays & Controls*
  - *Flight Management System*
  - *Impact on Vertical/Lateral Position guidance.*
  - *Sensors and Antennas*



Conclusions

- DFMC GNSS is a valid enabler for enhanced IFR rotorcraft operations in TMA.
- RNP0.1 routes/procedure specifically dedicated to the rotorcraft AUs represent one of the best means to open the ATM systems to new airspace users.
- DFMC GNSS enhanced receiver performance capabilities (e.g. RNP0.1) may optimize the designing criteria of IFR rotorcraft routes/procedures in the ATM environment, facilitating the mixed traffic management.
- The TPO technique -*opportunely adapted to the TMA context and to IFR rotorcraft operations*- resulted as very useful technique to easily manage opposite traffics along the same uni-directional low level IFR route.





Thank you!

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