

# Improve HEMS service through PBN routes based on GNSS only

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## Abstract

Trentino is a small mountain area in the North of Italy, well known as touristic zone with a good offer in terms of activities that could be performed (skiing, biking, hiking, sailing, paragliding, climbing,.....), where population can varies from about half million residential people to a touristic seasonal population some times more. PAT Nucleo Elicotteri VVF is a small Air Operator Certificate, Part 145 and Part M approved helicopters company inside firefighting and civil protection service, based in LIDT Trento-Mattarello airport, entitled by local government to ensure HEMS (Helicopter Emergency Medical Service) capability in entire administrate territory. Service is performed by two AW139 and a AS365N3, two AS350B3 are for aerial work only.

Typical local areas are not so easy for HEMS purpose due to roughness of territory. More than half of surface, where take places touristic activities, are over 1500m a.m.s.l. In particular lots of mountain and tight valleys could obstacle flying, introducing an high risk level in order to guarantee HEMS capabilities through 24H, especially in nighttime, where only some hospitals have an emergency medical unit and the patients are to be centralized from the peripheral local hospital. In order to improve HEMS service, Società Aeroporto Caproni spa (local airport public company) in conjunction with PAT Nucleo Elicotteri VVF won a GSA call for the development of new PBN routes through European SBAS service EGNOS.

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## 1 INTRODUCTION

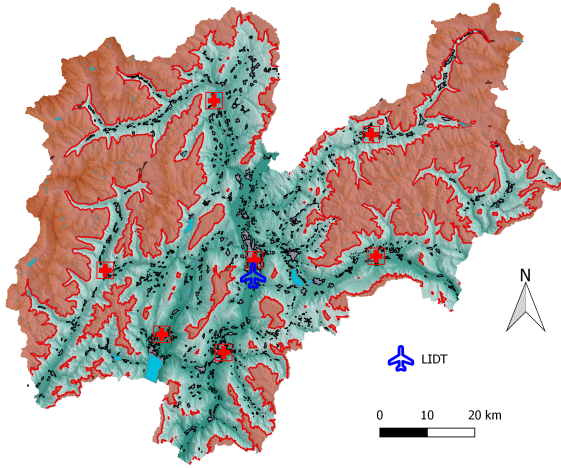
### 1.1 Provincia Autonoma di Trento

The Autonomous Province of Trento is a small autonomous territory in the Northern Italy and it can claim a truly unique historic and cultural identity, codified in the form of a special institutional autonomy granted after the Second World War (1946) in a specific agreement signed by Italy and Austria. In Trentino all the most important political decisions are taken locally, rather being referred to central Government; hence economic decisions are made rapidly, on the ba-

sis of the specific characteristics of the area and with the objective of promoting excellence. The financial resources and wealth produced remain within Trentino and are managed by the provincial government. The focus of public administration lies in providing public services and the PAT Nucleo Elicotteri VVF is responsible for land based search and rescue helicopter operations from 1959.

### 1.2 Organization

Servizio Antincendi e Protezione Civile is the service entitled by local government to perform HEMS services



Trentino region. Red highlighted zones represent the areas above 1500m asl

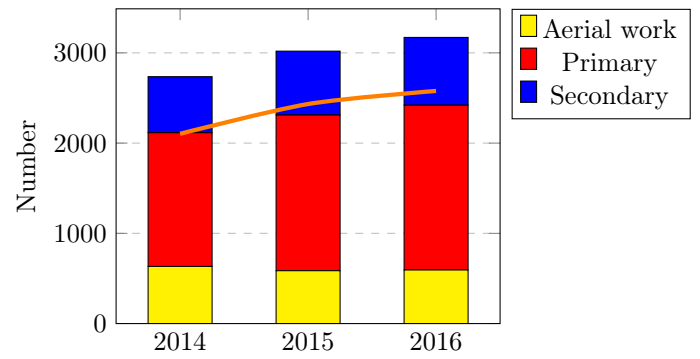
through Nucleo Elicotteri (Helicopters Group). This dedicated group is specifically built in order to provide some services to local territory like HEMS, aerial work, aerial firefighting, video coverage of show, avalanche prevention, landslide monitoring, ...

Regione Trentino-Alto Adige/Sudtirolo was one of the first public administrations in Italy to establish an Helicopters Group for public purposes. In January 1959 the first helicopter, the Agusta Bell AB47J, marks I-TREJ, landed in Trento airport. In February 1980 the Regional law stated that Nucleo Elicotteri operates under the Fire Department of Provincia Autonoma di Trento administration.

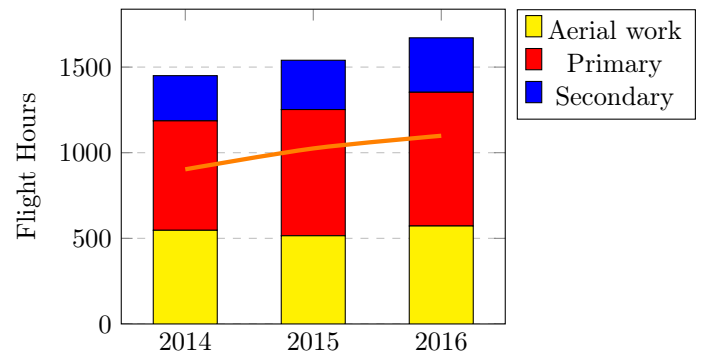
The Company operates under EASA regulation and has an Air Operator Certificate, and it is Part 145 and Part M approved with the purpose of maintain airworthiness of the entire fleet.

Typical rescue missions are about 25 minutes long and are performed by two helicopters during daytime (from 8.00AM till 8.00PM) and one helicopter during nighttime. Aerial work is performed only with the single engine AS350B3 during daylight. Today, primary purposes are rescue missions and aerial work and the flight hours are increasing over the years, as shown below [3]:

Missions flown (over last three years)



Flight hours (over last three years)



Rescue missions are divided between primary rescue and secondary missions, where the flight takes place from one hospital, or helipad, to another hospital (typically Trento Central Hospital or the most appropriate hospital in the nearby Regions).

### 1.3 Fleet

The fleet of Nucleo Elicotteri are composed by 4 helicopters:

- HEMS:
  - I-TNBB → Airbus Helicopters AS365N3



\* DOM: 2001

\* configuration:

- Goodrich (90m) Rescue Hoist
- Bucher HEMS installation

- I-TNDD → Leonardo Helicopters AW139



- \* DOM: 2011
- \* configuration:
  - Breeze-Eastern (90m) Rescue Hoist
  - Aerolite HEMS installation
  - Primus EPIC Phase 7
  - Incubator ATOM 808
  - TETRA radio with GPS location

- Aerial Work:

- I-TNAA → Airbus Helicopters AS350B3
- I-TNLD → Airbus Helicopters AS350B3



- \* DOM: 2003 and 2001
- \* configuration:
  - LISI cargo sling installation

## 2 PROJECT

The project aims to demonstrate the power of PBN navigation with SBAS for improvement of reliability and availability of HEMS service through mountain areas with GSA procurement funding mechanism.

Main goals are:

- upgrade AW139 Primus Epic avionics to Phase 7 in order to reach RNP 0.3 capability. This capability could lead our fleet to a step forward to achieving a better situational awareness with difficult meteorological conditions;
- develop and validate a new PBN route between LIDT Trento Airport and Cles hospital helipad. Validation of a new route in a real environment is a key for building a dedicated network of routes and procedures which permit low altitude flying in a very demanding scenario like mountains during poor meteorological conditions.

To date, in Trentino, every valley has at least one night HEMS helipad, managed by Società Aeroporto Caproni spa flyable only with VFR rules due to lack of navigational aid. This situation often leads to a reduced availability of this important service, particularly during night, where a typical task is the centralization policy of patients towards Trento Central Hospital. Numbers about helipads in Trentino are:

- night helipad in Trento Central Hospital
- 6 night helipads in each of peripheral hospital
- 11 strategical night helipads

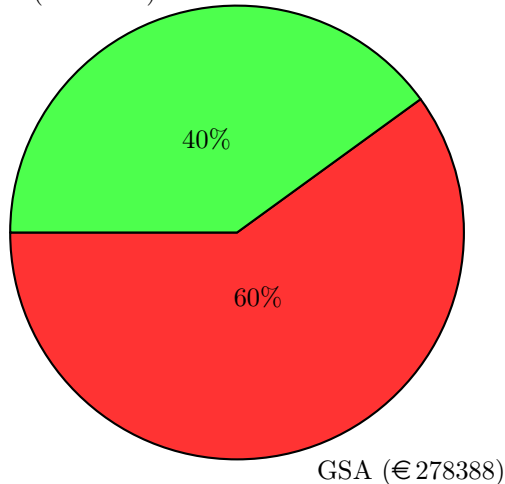
A well developed network of PBN routes could lead to a new safe connection between center hospital and local helipad. This connection will improve the availability of HEMS service on entire territory, and could enhance level of safety during normal operations. For example, during a normal HEMS mission, the weather could change in few minutes, this aspect could lead to an increased risk level in order to transfer patient to the hospital or medical staff to the patient. With a network of routes, pilots could use PinS, in order to reach, with minimal risk exposure, the nearest route to the hospital or to the HEMS site. Allowing new way of HEMS navigation, will lead to improve flight safety of entire operation minimizing time of exposure on flight in harsh environment without instrumental flight procedure aid.

### 2.1 GSA Grants



On 24 June 2015 a Call for Proposal about EGNOS adoption in Aviation was published by the European Global Navigation Satellite System Agency. The objective of this call was to award a number of grants to foster EGNOS operational implementation for regional aviation, commercial aviation, business (corporate) aviation, general aviation (training, emergency services) and rotorcraft with a final aim to maximize public benefits, increase and foster a network effect on current and future development of EGNOS enabled operations. The project was submitted to the GSA and after an evaluation, on June 2016 was signed the formal agreement [1]. On 5 March 2017, an accident on AW139 I-TNCC was happened with consequences of minor injuries only. In order to comply with objective stated in the agreement and according to GSA, a new amendment [2] was edited and subsequently signed. Main tasks remain the same, the major improvement was cancellation of funding on damaged helicopter and a new deadline (28 November 2017) due to planning trouble consequently aircraft accident. Updated cost of the project are hereafter reported:

Provincia (€185593)



This type of funding procurement is easier to manage than others, but for our public administration is a strong challenge to comply with requirements on time.

## 2.2 Upgrade Fleet

The project is still active on AW139 helicopter (s/n 31374, marks I-TNDD) only, where it requires improvement of the avionic suite Honeywell Primus Epic to the standard Phase 7. Upgrade works were performed in Spring 2017 by Leonardo Helicopters Part 145 in Cascina Costa facilities. This enhancement consist in: reaching RNAV (GNSS) RNP=0.3 capability during approach phase and RNP=1.0 during missed approach phase, new AFCS, EDS and FMS functions related to RNAV navigation. First three pilots are already trained to perform this type of operations, and as soon as the route will be approved the operator will ask PBN operations approval to the NAA.

## 2.3 Design Route

The project covers design and validation of approach and departure procedures serving LIDT Trento airport and the helipad in Cles hospital and the specific point-to-point link (STAR) to connect this IFP through valleys. Accuracy of 0.3NM (due to RNP 0.3), as indicated in ICAO PBN Manual DOC9613, and its associated obstacles protection criteria represents a valuable and real improvement to the current VFR operations, due to the highly demanding terrain, along the entire path. All this characteristics permit to maintain correct obstacles clearance margins and to fly at the lowest possible altitude, a very critical medical consideration in certain cases. Development of routes was assigned to ENAV, the italian air service provider but also a flight procedure design organization. Draft of 2 departure and 2 approach procedure was developed and, through the support of Leonardo Helicopters division, trans-

lated into a database uploadable on helicopter avionics.

## 2.4 Flight Validation

Flight validation phase will be the last but not the least objective of our project. Validation process imply a lot of necessary actions to be performed in order to ensure that the instrumental flight procedure could be flown without any risk. Particularly, validation regards a series of flight with the new instrumental flight procedures with a dedicated equipment that record a lot of parameters like pseudo-ranges, DOP, ... After these flights the actual tracks of helicopter will be compared with the pre-planned track of the instrumental flight procedure. With deviations from planned routes within certain value specified on regulation the instrumental flight procedure will be validated and approved for publication. Flight validation activity, with necessary authorization from the NAA, are already planned during September 2017, some month before the deadline of the project.

# 3 OUTCOME

We think that this project could be a cornerstone to develop a safe way of low altitude flying through the building of a network of PBN routes. We know that this new procedures will be only the first step of a new approach to low altitude navigation in demanding environment. A lot of troubles will be arise, like ownership of procedures or strategical plan of new routes or connections between different HEMS area and so on, but we trust that this approach could lead to safer flights.

## 3.1 First Step

This project are only a small first step in a larger strategical vision of HEMS activities. The route that will be validated will have some limitations, like higher altitude due to larger obstacle clearance subsequently RNP capability of AW139 (0.3 only on approach phase), but will be the necessary input to a bigger process that aim to a change in HEMS helicopter flights. The first instrumental connection between Trento and Cles will be the test case in order to evaluate net steps that aim to build a network of routes.

## 3.2 Strategical Scenario

These new procedures are some first small bricks of a new edifice built in order to enhance HEMS service.

Scenario in few years will be a network of routes that could connect center helipad and airport to valleys (directly to helipads or, with VFR rules, from PinS to HEMS site). This aspect imply a change of mind from the traditional way ( VFR flights, direct to the



target, weather-dependent) to a new way (IFR flights, following dedicated route, all-weather).

A very important next step would be connect territory administrated by different entity by routes aiming to take advantage of specialization of hospitals, so patient will receive better treatment from specialized medical staff.

Another important aspect to consider for the near future will be the integration between manned and unmanned aviation. Using of planned route could lead to a realistic integration and cooperation in HEMS operations, especially for Search and Rescue operations and disaster relief.

## References

- [1] GSA. Grant Agreement GSA/EEEX.0030/2015/11.
- [2] GSA. Grant Agreement GSA/EEEX.0030/2015/11 - amendment 2.
- [3] PAT Nucleo Elicotteri VVF internal data.

## Glossary

AFCS Automatic Flight Control System. 4

DOP Dilution of Precision. 4

EDS Electronic Display System. 4

EGNOS European Geostationary Navigation Overlay System. 1, 3

FMS Flight Management System. 4

GNSS Global Navigation Satellite System. 1, 4

GSA European Global Navigation Satellite System Agency. 1, 3

HEMS Helicopter Emergency Medical Service. 1–3, 5

IFP Instrumental Flight Procedure. 4

IFR Instrumental Flight Rules. 5

NAA National Aviation Authority. 4

PBN Performance Based Navigation. 1, 3, 4

PinS Point in Space. 3, 4

RNAV aRea NAVigation. 4

RNP Required Navigation Performance. 3, 4

SBAS Satellite Based Augmentation System. 1, 3

STAR STandard instrument ARrival. 4

VFR Visual Flight Rules. 3, 4