ENAC
ENTE NAZIONALE PER L'AVIAZIONE CIVILE
ITALIAN CIVIL AVIATION AUTHORITY

WORKSHOP

"Sistemi, Servizi e Applicazioni spaziali a sostegno delle grandi infrastrutture nazionali "

itAlian Urban aiR mObility technologies

& distrRibuted test-fAcility

04.11.2021
FULL PROPOSAL PHASE 1 PRESENTATION
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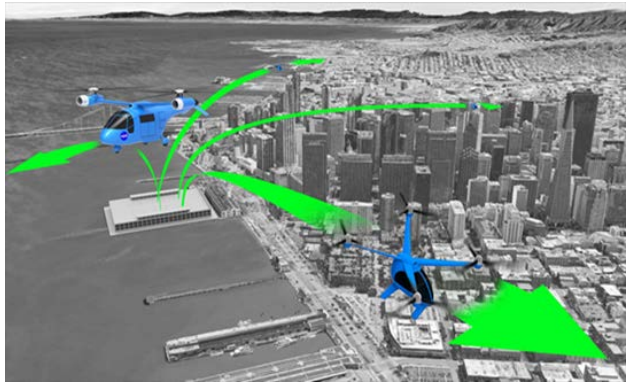
AURORA
UAM National Test Facility

TELESPAZIO a LEONARDO and THALES company
CIRA Italian Aerospace Research Centre
DTA DISTRETTO TECNOLOGICO AEROSPAZIALE
d-flight
planetek italia
exprivia
CIVITANAVI SYSTEMS

NAVISP Element 3: goal and areas of application

Element 3 aims to promote proposals in support to national navigation activities of the Participating States.
Various Satellites Navigation/PNT areas can be addressed with activities along the whole value chain with a view of fostering cooperation and national partnerships with a wide diversity of actors (agencies, industries, universities and support centers), enlarging the national space community and strengthening its relationship with authorities, organisations and institutions, industries and research centers from the non-space sector ax well.

Areas of applications:
Proposals under NAVISP Element 3 will include activities aimed at the most suitable exploitation of GNSS and more widely of PNT infrastructures. To support the design, development, verification and validation of new PNT technologies, products and services. In the domain of Urban Air Mobility, the following areas are addressed:



- Delivery of goods - Operations on logistics; monitoring technologies for UAM operations in delivery.
- Public safety – Law enforcement; Search & Rescue and safety of the public.
- Emergency services – First responders' operations and medical emergency.
- Integration into U-space / Air Traffic Management (ATM) services.
- Passenger transport - in the urban and suburban areas.

UAM background & market perspective

United Nations lasts analysis estimates that in 2050, over 60% of the world population will live in urban areas. As demand for transportation continues to increase, alternatives to ground-based transportation have emerged to enable urban travel and commuting. Skywards urban transportation is a new transport solution that requires the convergence of technologies coming from aerospace, infrastructure, communication and intelligent mobility eco-systems.

Moreover, according to Agenda 2030 for Sustainable Development Goals (SGD), this study is compliant to SDG9 (Build resilient infrastructure, promote sustainable industrialization and foster innovation) and SDG11 (Sustainable cities and communities).

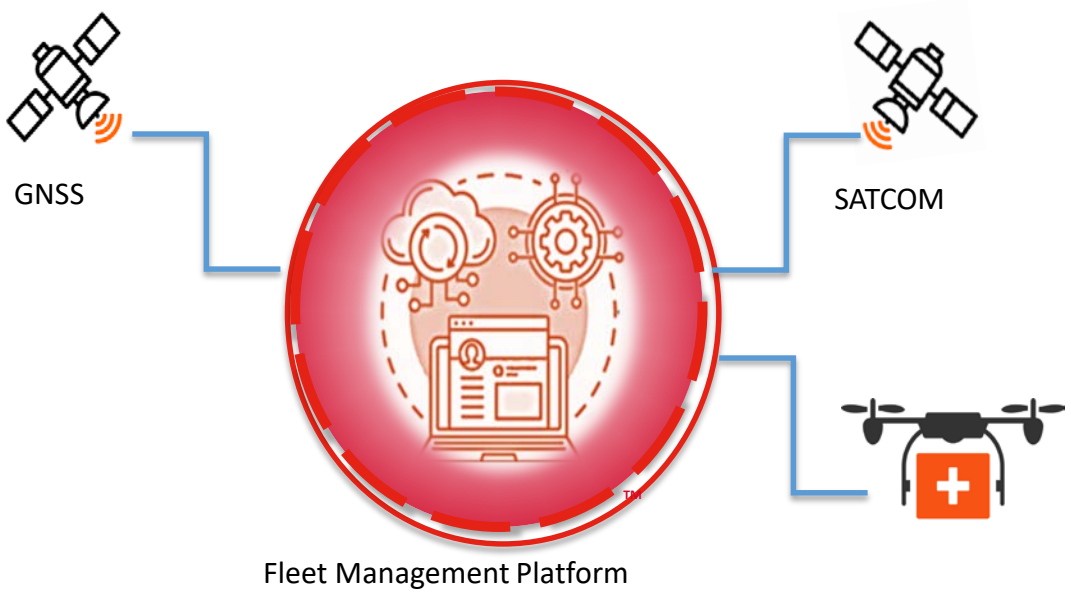
Latest market forecast by NASA & Booz Allen reports UAM (Urban Air Mobility) is currently in its infancy, with the first commercialization expected by 2023. However, its projected growth is significant: it is estimated an annual growth rate of 16.2% by 2030, with an estimated global value from 3.1bn by 2023 to 7.9bn US Dollar by 2030.

Many city administrators have put Smart City policies at the centre of their plans, with UAM a core component. While the timescale for full deployment is uncertain and many obstacles still lie ahead, UAM and VTOLs undoubtedly have a part to play in the future development of urban environments.

In order for this game-changing technology to truly emerge, it is important that all industry stakeholders, lobby governments and regulators provide a legal and regulatory framework that will allow the technology to develop in a safe and open AAM (advanced Air Mobility) environment.

UAM & AAM (Urban & Advanced Air Mobility) – technological environment

The are many technologies, as well as service infrastructures that contribute to the development of future UTM services.



From Vertiports, to service center for traffic management and the design of flight corridors in the U-Space / ATM area; communication infrastructures, both terrestrial (5G / LTE) and satellite; navigation infrastructures, such as GNSS (GALILEO and EGNOS); the terrestrial surveillance and control networks of eVTOLs.

AURORA: UAM/AAM Italian strategy according to European strategy

AURORA intend create un technological ecosystem to respond of following UAM initiatives :

1. In the “Digital European Sky - Blueprint” , SESAR Joint Undertaking addresses the concept of Urban Air Mobility related to U-space and its services. SESAR JU states that one of the most challenging use cases from U-space will be to enable urban air mobility, which is expected to advance autonomous technologies in a number of areas.

2. At national level, in 2019, ENAC signed an agreement of understanding with the Minister of Innovation (MID) for the launch of a national Urban Air Mobility (UAM) project: so-called "Innovation e-Mobility” with the purpose of foster a sustainable mobility model and CONOPS with a low environment impact.

3. National working group of public and private Stakeholders, coordinated by ENAC, which aims to create an Italian ecosystem for Advanced Air Mobility (AAM).

AURORA distributed test facility: main objectives

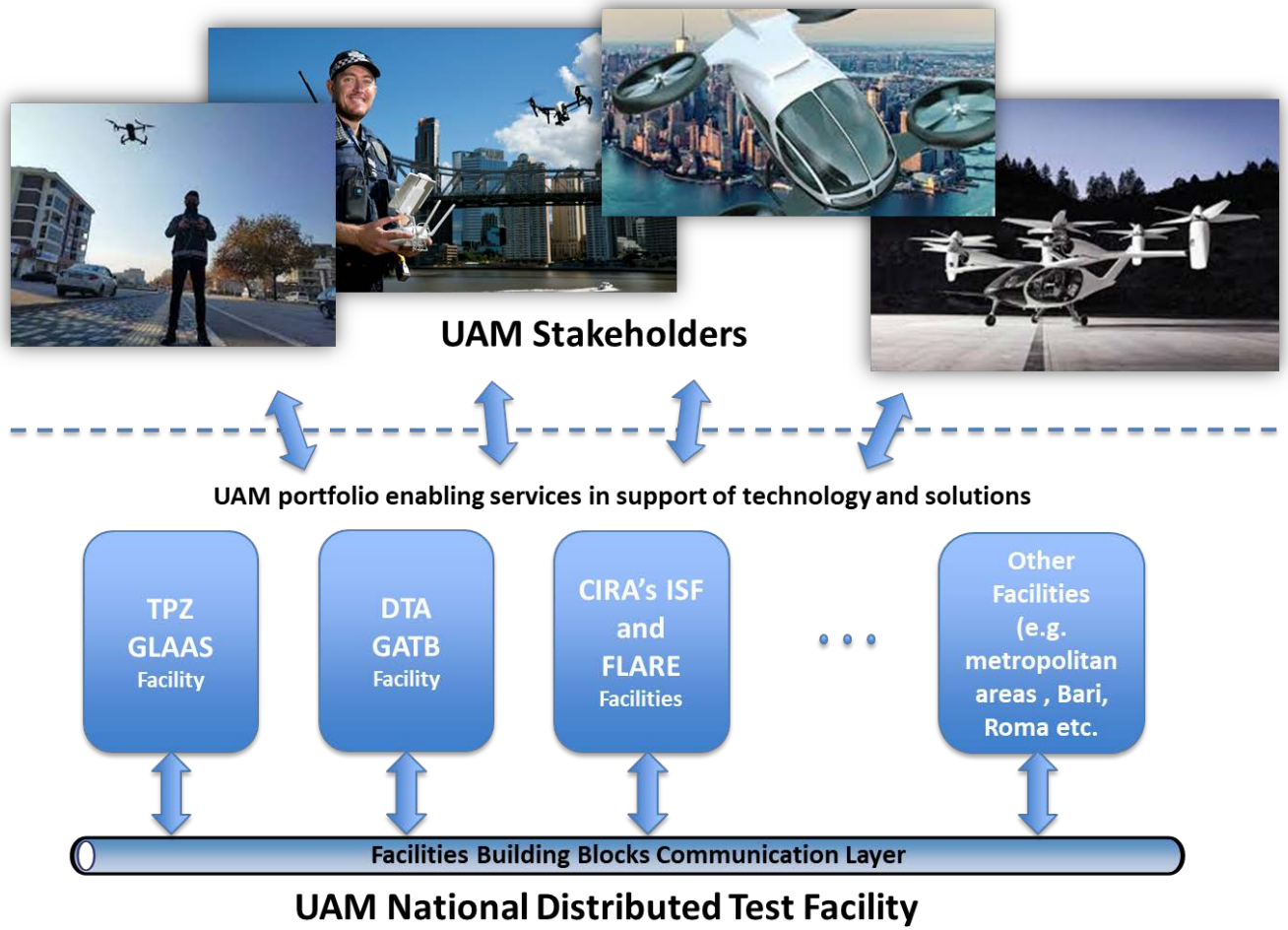
AURORA project has two main objectives:

1. Define the PNT Requirements and ~~to~~ Design a GNSS Based Architecture for Urban & Advanced Air Mobility (UAM/AAM).
2. Design a GNSS based PNT distributed testing infrastructure focus on ~~for~~ UAM/AAM needs.

AURORA will combine the analysis of the peculiar needs of the territories (City and metropolitan areas) and study the new technologies trends of Satellite GNSS/PNT and alternative PNT technologies; integrating space, ground networks and systems in the context of the UAM/AAM in order to:

- Define a PNT Operational and Performance Requirements Document for UAM/AAM.
- Propose a GNSS scalable architecture that can be implemented within the national UAM mission scenarios for at least the class of vehicles related to the EASA Specific and Certified Category of unmanned vehicles, which will include mid/big size manned systems for human transportation (VTOL) and goods delivery.
- Design and develop a UAM National Research & Development and Certification Distributed Facility.
- Investigate new PNT technologies for UAM applications, performing laboratory and in-flight demonstrations of their effectiveness.

AURORA distributed test facility: overview



Distributed test facility on e sites:

- GLASS - GNSS-PNT test labs at Rome from Telespazio.
- GATB - Airport of Grottaglie – Taranto Test Bed of DTA.
- Aeronautical technology labs at Capua and experimental vehicle FLARE from CIRA.

GLAAS - GNSS LAboratory As a Service

Independent GNSS Reference Laboratory

The GNSS-PNT Reference Laboratory supports the following main HW & SW capabilities:

- RFCS Spirent GSS 9000 capable to simulate till 12 Galileo (E1, E5, E6) and 12 GPS (L1, L5) satellites in view;
- AWG Agilent N5172B (frequency range from 100 KHz to 3 GHz);
- Record and Play-back system (RPS) Spirent 6425 (BW 50 MHz, 2 bit-depth I&Q);
- Real Time Spectrum Analyzer Tektronix 5100A;
- Septentrio receivers (PolaRx 4 TR PRO, PolaRx S PRO and PolaRx 3eG);
- Active GNSS Antennas (supported frequency bands E1/E5/E6);
- Spirent SimGEN SW for the generation and monitoring of the simulation environment;
- Spirent SimSENSOR SW for simulating the output of INS systems;
- GNSS Assistance Data Dispatcher SW;
- NovAtel GrafNav Post-Processing SW (RKT and PPP);
- In house developed post-processing tool for GNSS navigation data specific analysis (eg. KPI and metrics generation)

Highlights

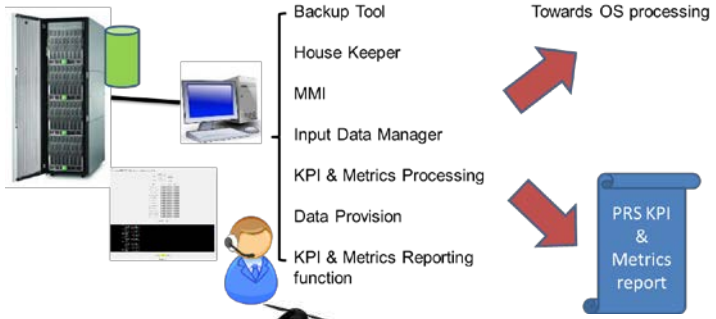
GNSS Performance Monitoring and Prediction

Near Real-time Monitoring Tool (NRT) — Highlights

- Proper and **accurate prediction** of the **Galileo OS service provision degradation**.
  - Support the decision making and the definition of deadlines for decision triggering.
  - Improve the timeliness of the Galileo OS monitoring capabilities, by sending alert messages (e.g.: SMS and/or email) to selected operators in case of performance degradation and/or system failures.
  - Support the incident management process.
  - Up to 24/7 Service delivery and provisioning.
- Service scalability and modularity allows to **extend the monitoring and performance** assessment to additional Galileo services, such as: **CAS, HAS, PRS**.

Navigation KPI's Monitoring Tool (NKT) — Highlights

- **Key Performance Indicators and Metrics monitoring of GNSS Systems**
  - Perform daily analysis, with the capability to provide monthly reports of the performances of the GNSS
  - Results provisioning in form of reports and synthetic indexes
- The monitored KPIs are:
  - Availability and Accuracy of Ranging Service to Single and Dual Frequency Users
  - UTC Time and Frequency dissemination Availability and Accuracy
  - GGTO (Gal2Gal Time Offset) Determination Availability and Accuracy
  - Positioning Availability and Accuracy for Single and Dual Frequency Users



GNSS Augmentation and Integrity provisioning

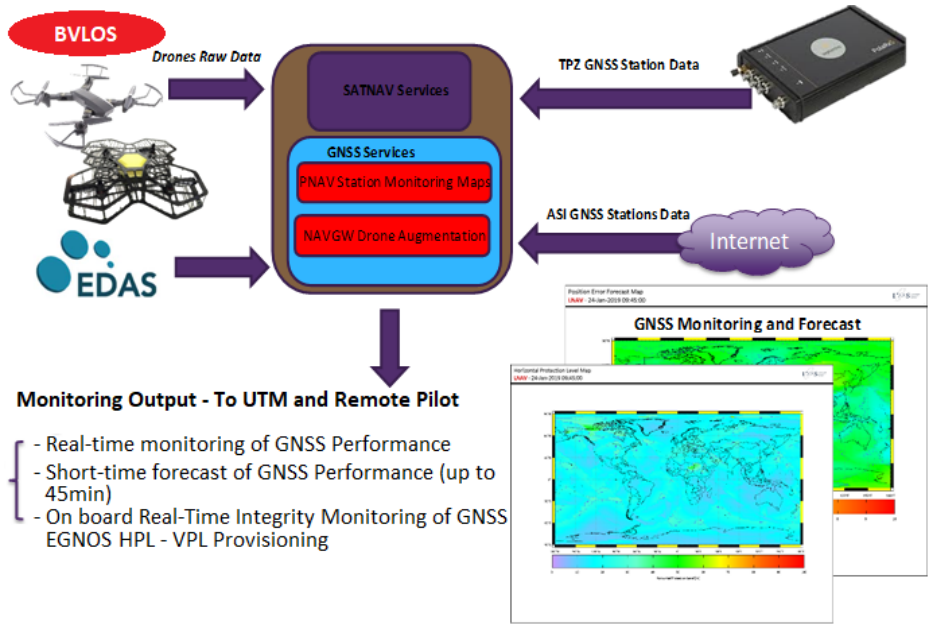
RPAS Augmentation and Monitoring Service (RMS) Highligs

- Solution to improve the safety of drone-based flights providing to UTM and Drone Pilots the Real-time status of GNSS
- Use of a network of fixed stations and elaboration of GNSS raw data coming from the on-board GNSS receiver

- For Large & Medium RPAS (25kg to 150kg) the service is mainly devoted to the matching of the ICAO recommendation in case of the integration of the RPAS in the civil aviation (GNSS performance monitoring).

- For small RPAS (< 25kg) the service is mainly devoted to estimate the bounds on the GNSS positioning errors providing EGNOS/EDAS protection Levels

- BVLOS/BRLOS enabler: it improves the overall RPAS operation safety



AURORA Assets: CIRA's Integrated Simulation and Flight Test Facility

- CIRA's facility optimally mixes simulators with real vehicles and equipment to perform experimental validation of new technologies up to TRL6 in complex, multi-agents scenarios
- Currently used in several national and international projects (PRORA, SESAR, EDA, HE, CS2, etc.)

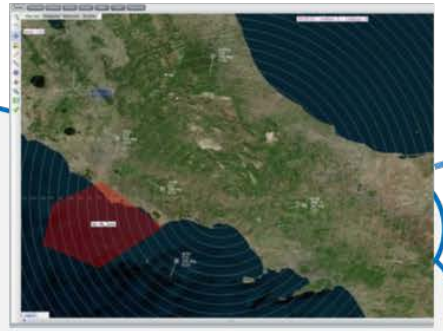
Optionally Piloted Vehicle

FLARE

ADS-B

Controller Working Position
U-Space Management Workstation

Scenario Simulators
Manned/Unmanned Traffic Generation,
GNSS Const., Terrain, Obstacles, Weather



4/5G Net
Sec. Radar

Real Traffic

CAPUA Airfield

Network Infrastructure & Voice Comms

Pilot-In-the-Loop Simulators
Manned/Unmanned

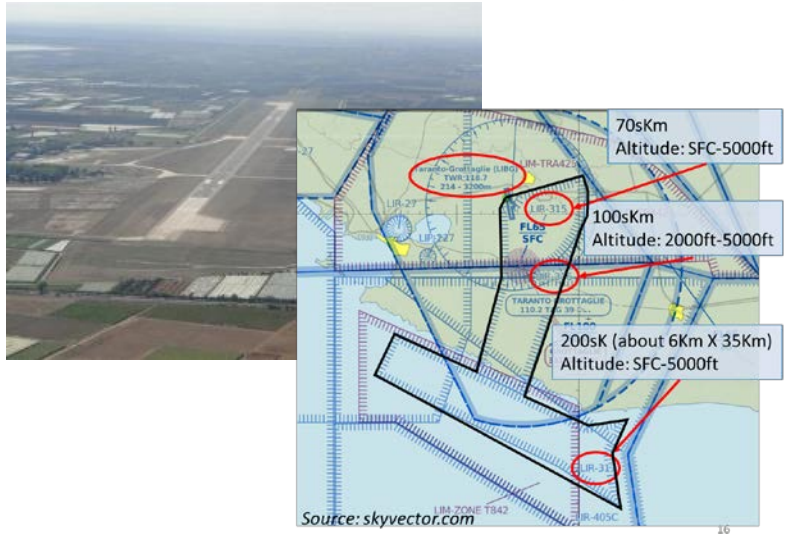
HLA
Proprietary

Location#1
Location#2
Location#3

External Facilities

AURORA Asset: Grottaglie – Taranto Airport TestBed led by DTA

- **Technological facility (UAS in ATM simulation), airport and segregable airspaces**
- **Services:** flight tests design, set-up, authorization, realization
- **UAS flight tests (done and planned):** EDA, EUSPA, ESA, SESAR, MUR, MISE, ASI, Regione Puglia
- **Drone Living Lab** (DTA, ENAC and Municipality of Bari) to experiment and demonstrate innovative UAM (and EO) services for the city of Bari
- **Drone Beyond – 2021 session**: large demonstration in conjunction with Mediterranean Aerospace Matching event



GNSS Interference monitoring system

ECARO flight trials

Bari seaside surveillance

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MANY THANKS

FOR YOUR ATTENTION!

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