



# ATC Interfacing GNSS: A European Perspective

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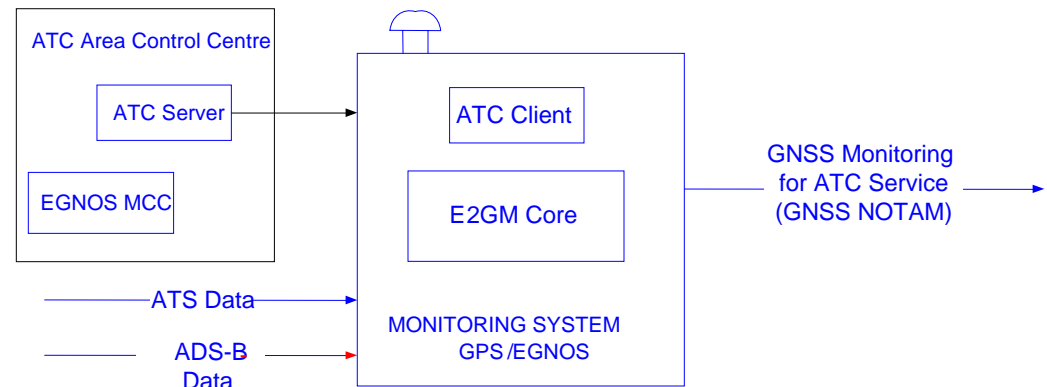
- Operative context
- Objectives
- Services and functionalities
- Operational benefits
- Economic benefits
- Conclusions

- ICAO requirement for civil aviation
- In the aeronautical field the GNSS has been chosen by the ICAO as fundamental component for the future CNS/ATM systems because of its peculiar characteristics that provide the necessary assistance during all flight phases
- However there is the needs to monitor performance and status of GNSS service (like traditional nav aids)

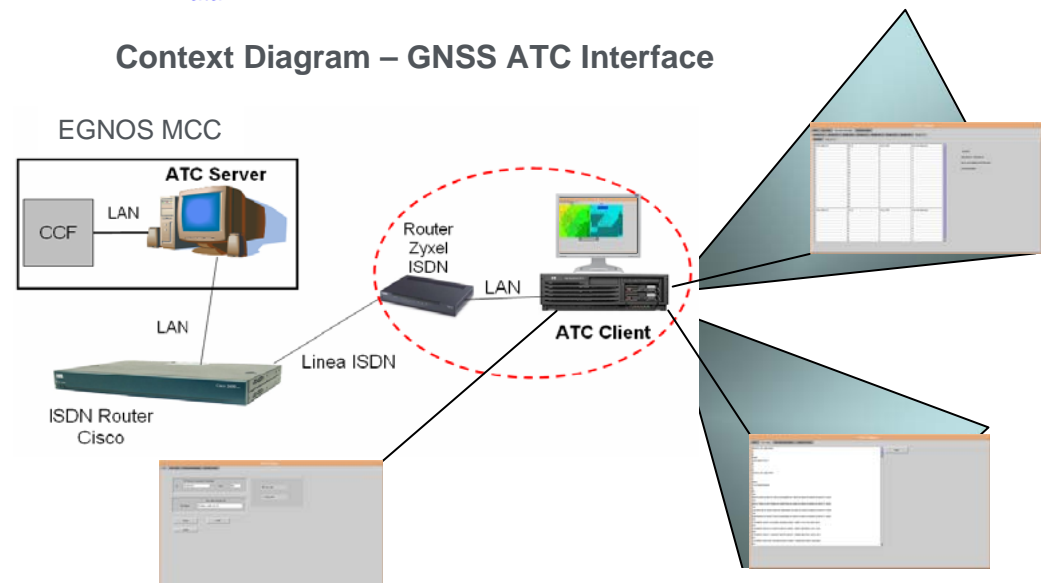
- The ATC interface developed in the frame of EtoG aims to facilitate the introduction of GNSS services in the Italian airspaces
- A new design of the ATC Interface for the monitoring of the GNSS performance of the Italian Airspace and the presentation to the ATC Controllers has been developed

# Services provided

- With the aim to provide a service to the ATC controllers, the system provides the following services, (as in RTCA DO 229D):
  - A real time evaluation of the GNSS availability for any virtual user who flies over the Italian airspace for all phases of flight (from En-route to Precision approach)
  - A prediction of the GNSS availability for any virtual user who flies over the Italian airspace for all flight phases (from En-route to Precision approach)
  - To display over a particular geographical area or over a specific airways the GNSS availability



Context Diagram – GNSS ATC Interface



- Moreover the system will provide:
  - Evaluation of the User Differential Range Error (UDRE) and Grid Ionospheric Vertical Error (GIVE) parameter included within the SBAS augmentation messages provided by the EGNOS ATC Server
  - NOTAM GNSS



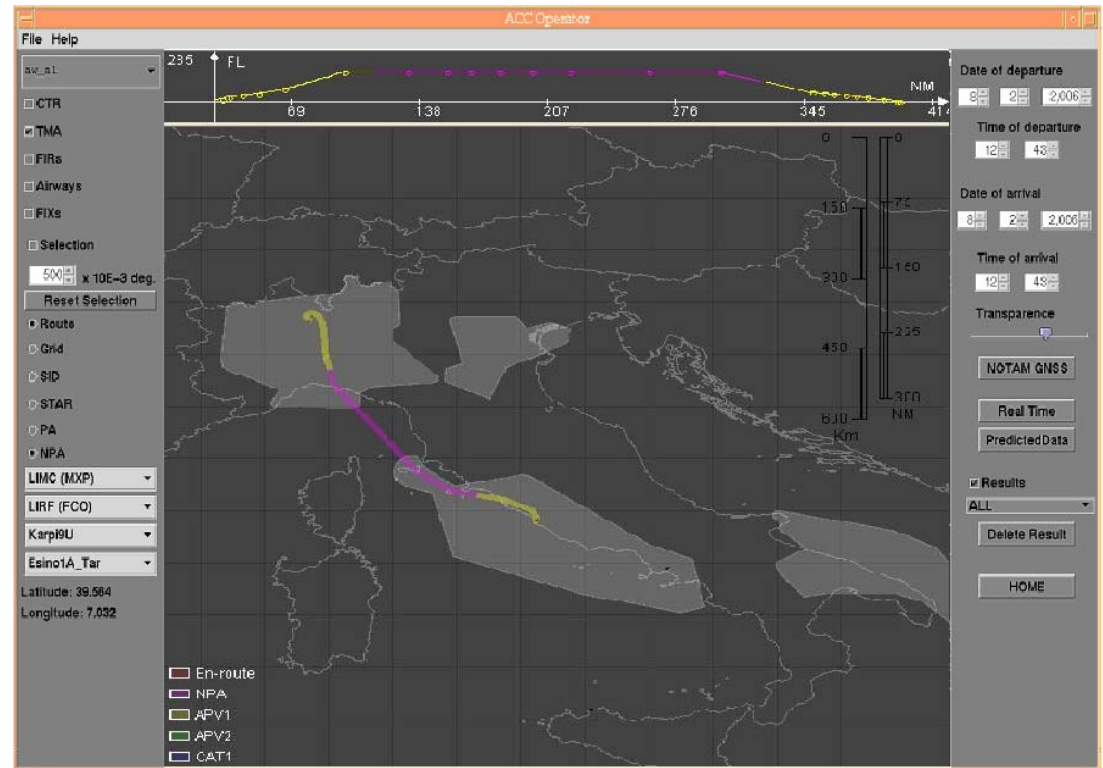
- The GNSS ATC interface can offer advantages to three main figures:
  - Planner operator (the person that manages and plans the flight within his region of interest)
  - Executive operator (the person who directly provide to the airman the guideline to execute the operative procedure)
  - Supervisor operator (the person that monitors the GNSS system performances)
- For each ATC operator the system has been designed to give an appropriate support based on the peculiarities of the different User profiles
- Three main scenarios have been identified and characterized in order to provide a better service directed to the operator that shall exploit it

# GNSS SIS Performance Requirements

Typical operation	Accuracy horizontal 95% (Notes 1 and 3)	Accuracy vertical 95% (Notes 1 and 3)	Integrity (Note 2)	Time-to-alert (Note 3)	Continuity (Note 4)	Availability (Note 5)
En route	3.7 km (2.0 NM) (Note 6)	N/A	$1 - 1 \times 10^{-7}/h$	5 min	$1 - 1 \times 10^{-4}/h$ to $1 - 1 \times 10^{-8}/h$	0.99 to 0.99999
En route, Terminal	0.74 km (0.4 NM)	N/A	$1 - 1 \times 10^{-7}/h$	15 s	$1 - 1 \times 10^{-4}/h$ to $1 - 1 \times 10^{-8}/h$	0.99 to 0.99999
Initial approach, Intermediate approach, Nonprecision approach (NPA), Departure	220 m (720 ft)	N/A	$1 - 1 \times 10^{-7}/h$	10 s	$1 - 1 \times 10^{-4}/h$ to $1 - 1 \times 10^{-8}/h$	0.99 to 0.99999
Approach operations with vertical guidance (APV-I)	16.0 m (52 ft)	20 m (66 ft)	$1 - 2 \times 10^{-7}$ per approach	10 s	$1 - 8 \times 10^{-6}$ in any 15 s	0.99 to 0.99999
Approach operations with vertical guidance (APV-II)	16.0 m (52 ft)	8.0 m (26 ft)	$1 - 2 \times 10^{-7}$ per approach	6 s	$1 - 8 \times 10^{-6}$ in any 15 s	0.99 to 0.99999
Category I precision approach (Note 8)	16.0 m (52 ft)	6.0 m to 4.0 m (20 ft to 13 ft) (Note 7)	$1 - 2 \times 10^{-7}$ per approach	6 s	$1 - 8 \times 10^{-6}$ in any 15 s	0.99 to 0.99999

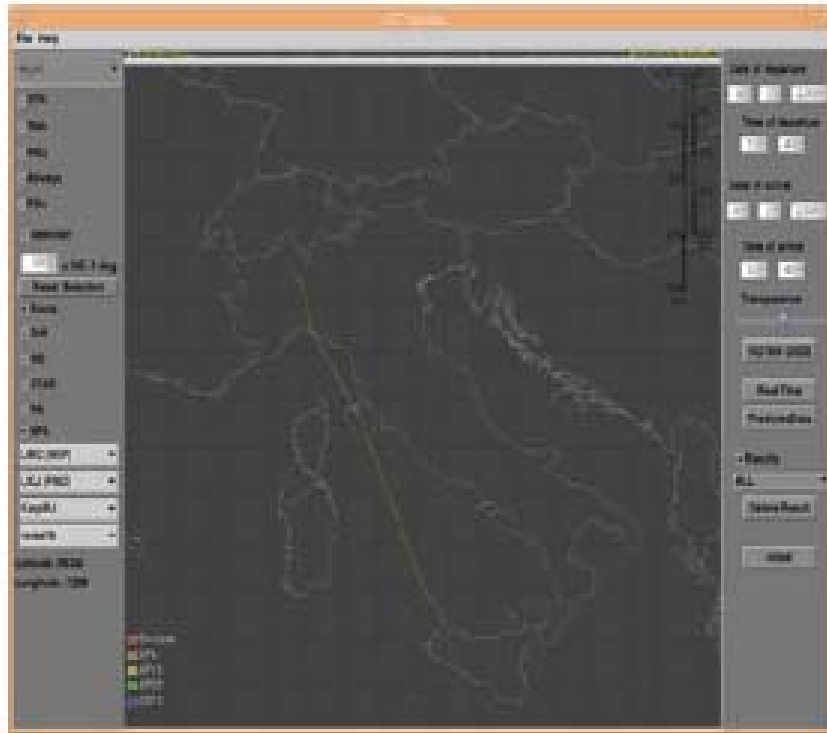
# ATC Interface – En-route Scenario

- Through the ATC interface the operator shall be able to select different scenarios (TMA or Airways)
- The scenario will be set by checking the appropriate checkbox in order to recognize the proper area of competence

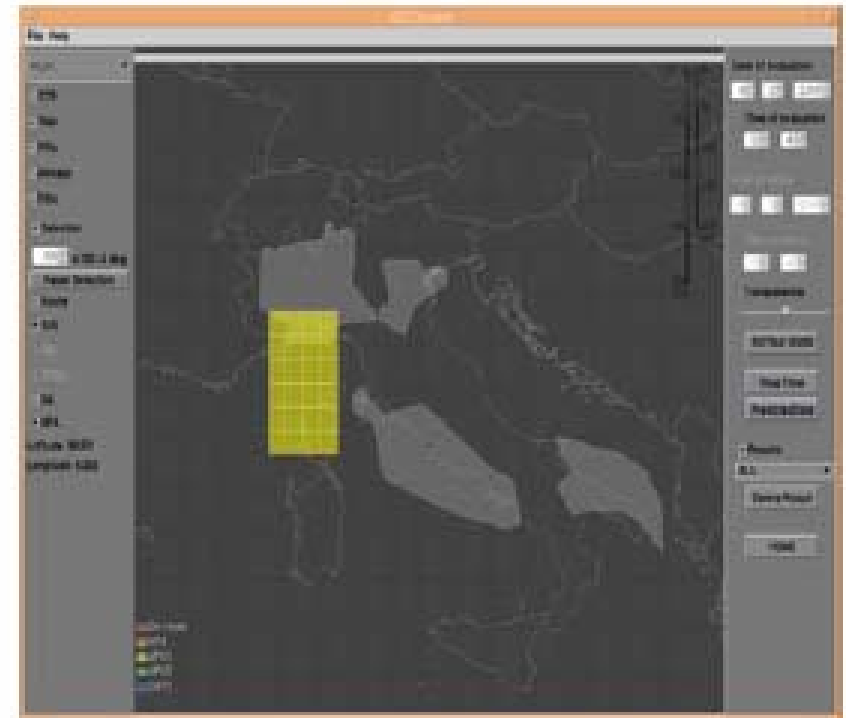


ATC Interface highlighting the TMAs

# ATC Interface – En-route Scenario

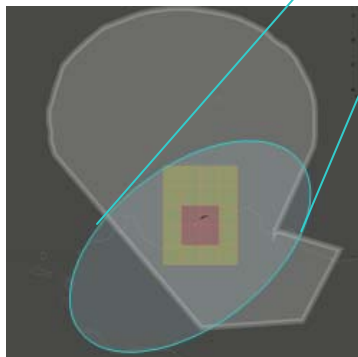
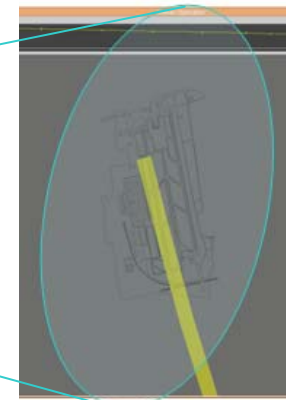
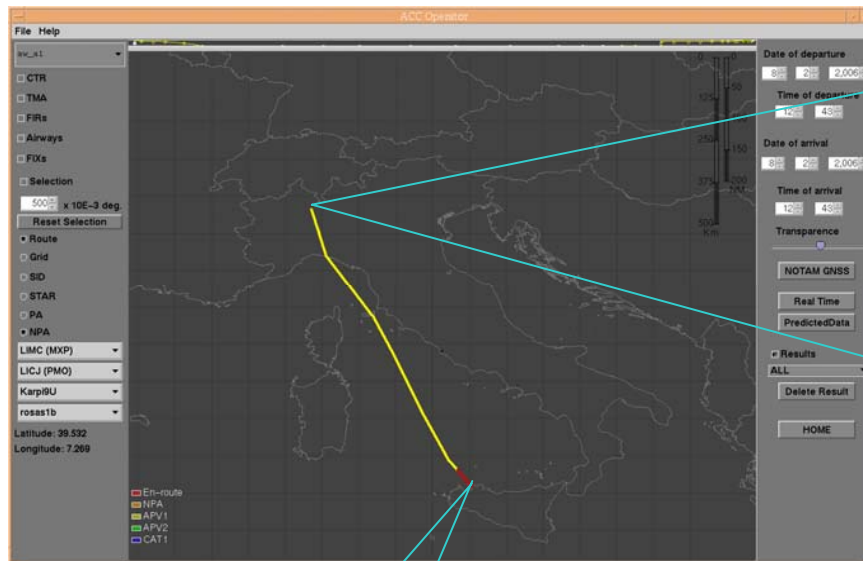


Real time for a given Route



Prediction in a given area

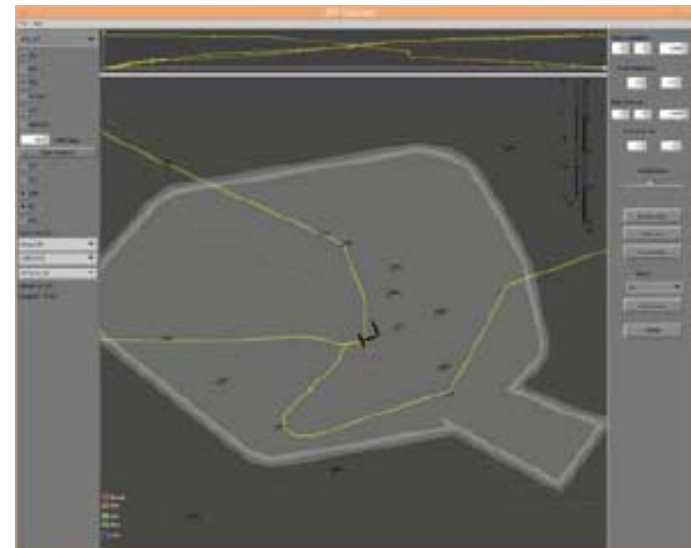
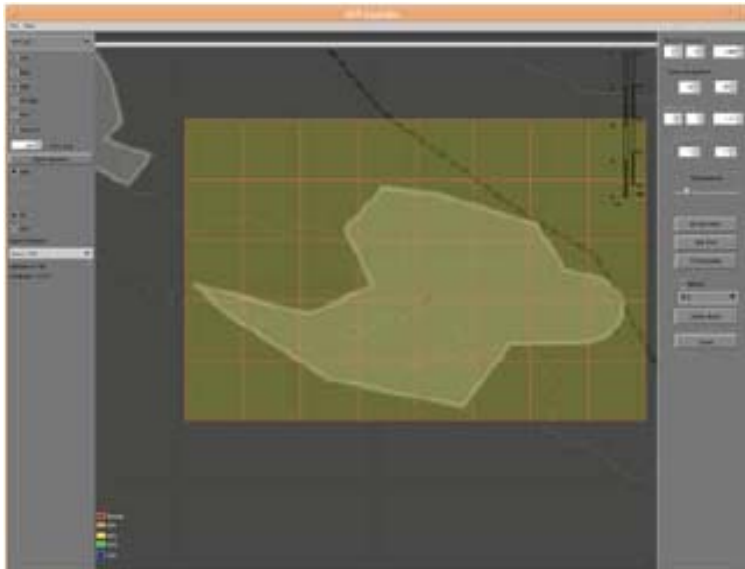
# ATC Interface – En-route scenario



- The en route application product will optimize the air traffic flow from the controller point of view, providing information about the GNSS performance within the Italian airspace
- In particular it provides a great support for the transition areas (such as north Africa and Middle East areas). Predictive tools matched used within the flow management units will allow to estimate GNSS availability along planned routes

# ATC Interface – Approach Scenario

- For the approach phase, the interface integrates also the ADS data

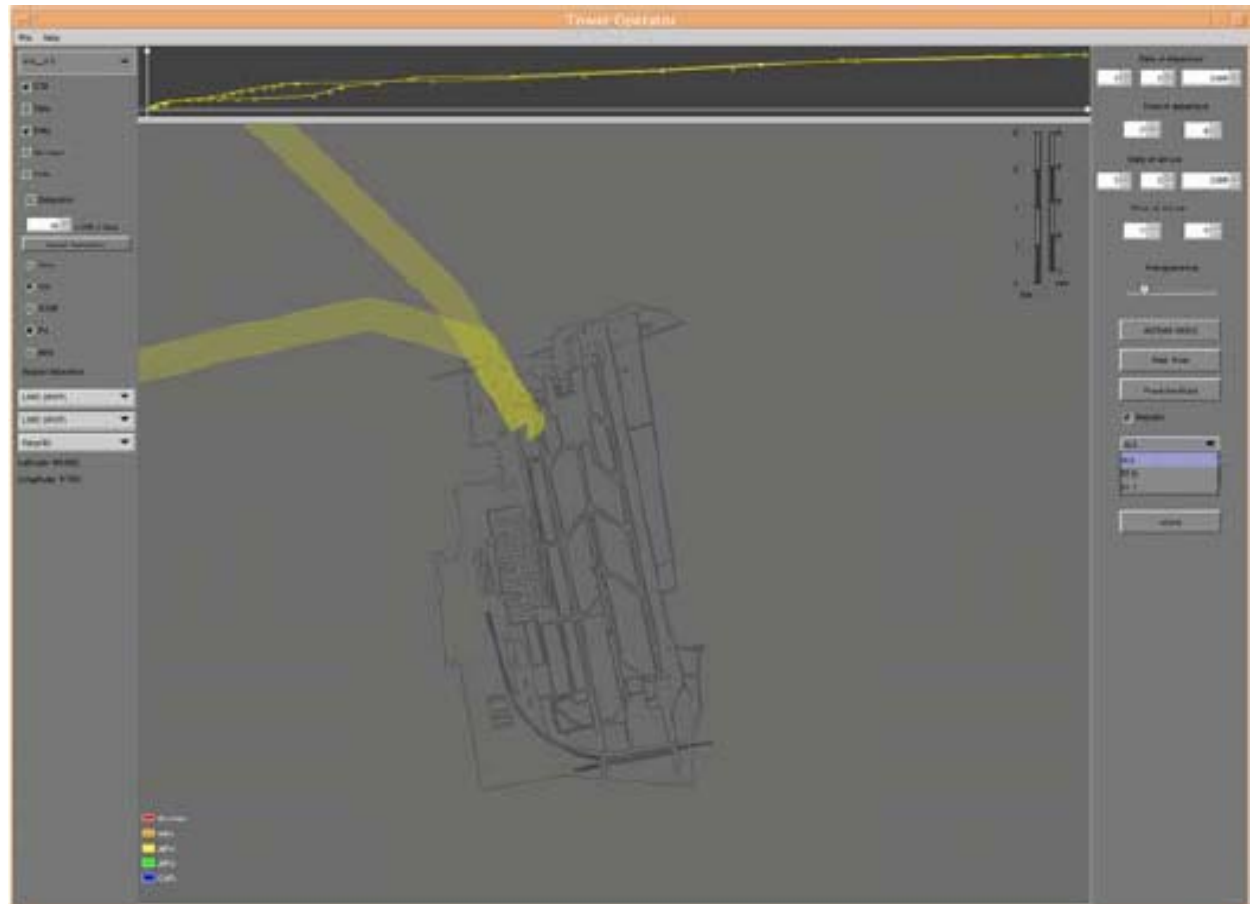


- In this example prediction on a particular airspace within the Naples CTR is presented

- Real time evaluation for one Standard Arrivals (STAR) and two Standard Instrumental Departures (SIDs) for the Rome CTR
- The operator will be able to display the distance between the aircraft and the ground (in terms of Flight Level –FL)

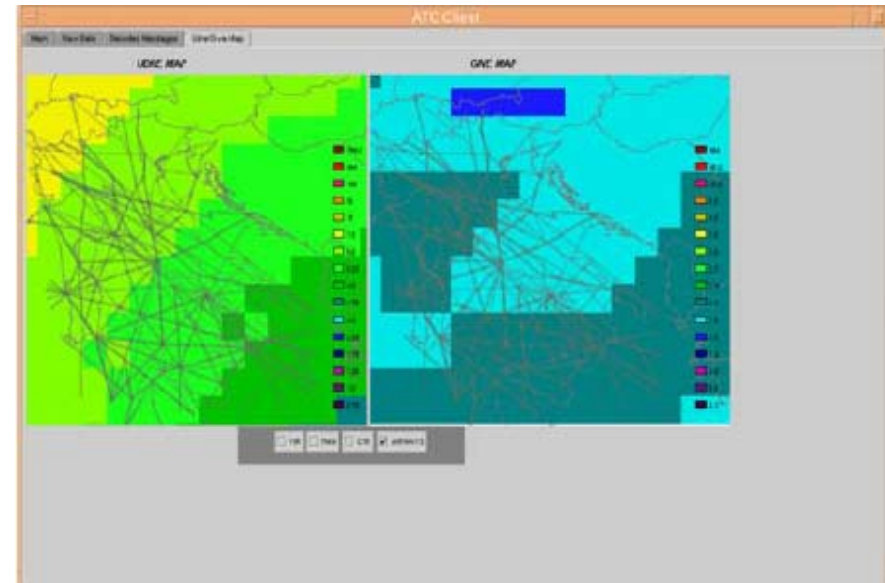
# ATC Interface – Airport Scenario

- Prediction evaluation for two different SID for Milan Malpensa Airport
- Use of EM interference analyzer is under investigation

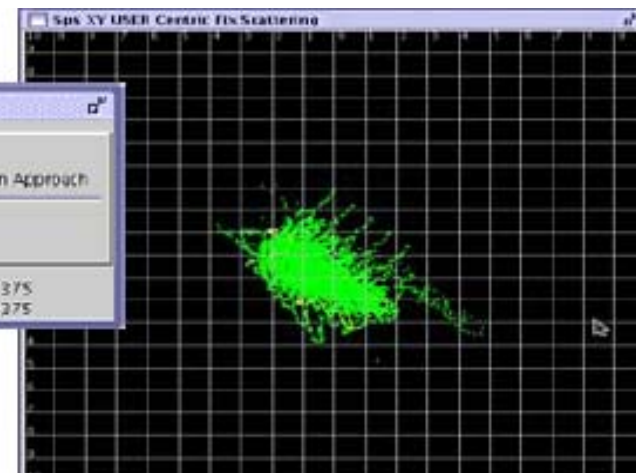


# Supervisor Operator

- Predicting the performance of the GNSS/SBAS system in terms of integrity parameters
- Displaying other elaboration such as the computation of the User Differential Ranging Error and Grid Ionospheric Vertical Error parameter, the average local error, the user fix scattering and others results



SEAS Data		
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HPL = 5.5764	VPL = 8.7800	SBAS Count = 462
HPE = 0.9726	VPE = 6.4716	Flight Phase = Precision Approach
HPL Max = 6.4213 meters	VPL Max = 9.7085 meters	
HPE Max = 2.6258 meters	VPE Max = 7.8859 meters	
Time HplMax = 126705.3984375	Time VplMax = 126708.3984375	
Time HpeMax = 126710.3984375	Time VpeMax = 126710.3984375	



## Conclusions

- The system developed connected GNSS and the ATM/ATC through the processing and dissemination of information suitable by the ATC Operators
- The system integrates the ADS data
- Future integration of GALILEO information



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