ItAF simulation tools in support of a suborbital flight risk assessment

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ICAO/UNOOSA
Space Symposium
Abu Dhabi – 15th of March 2016

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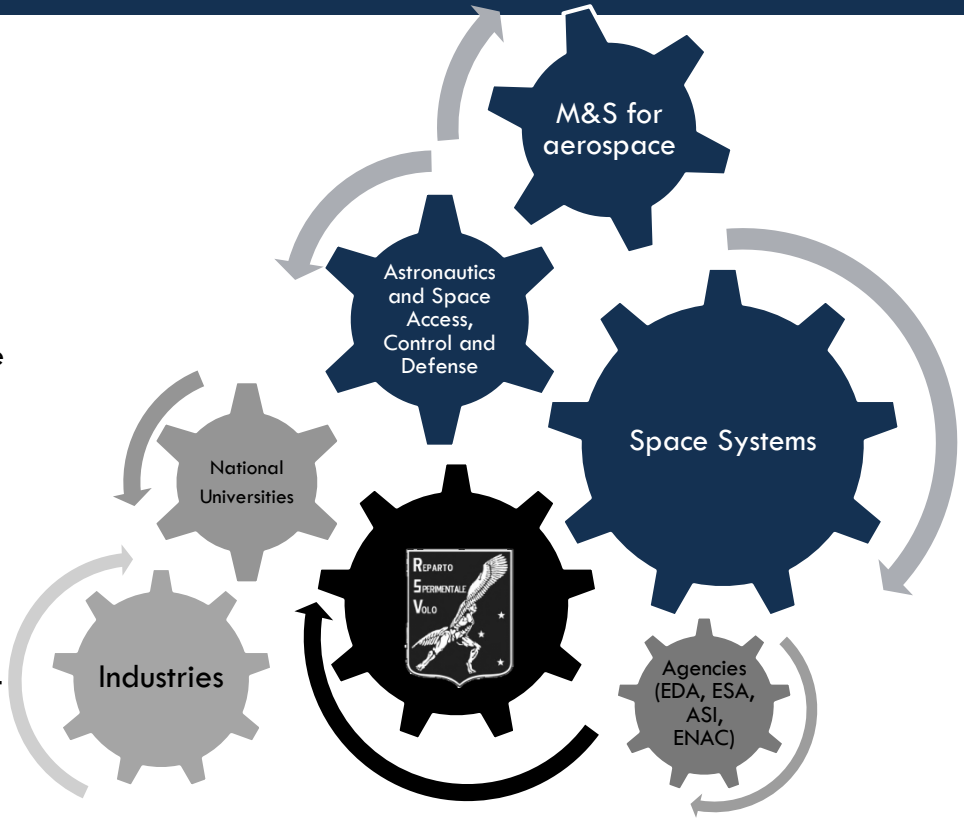
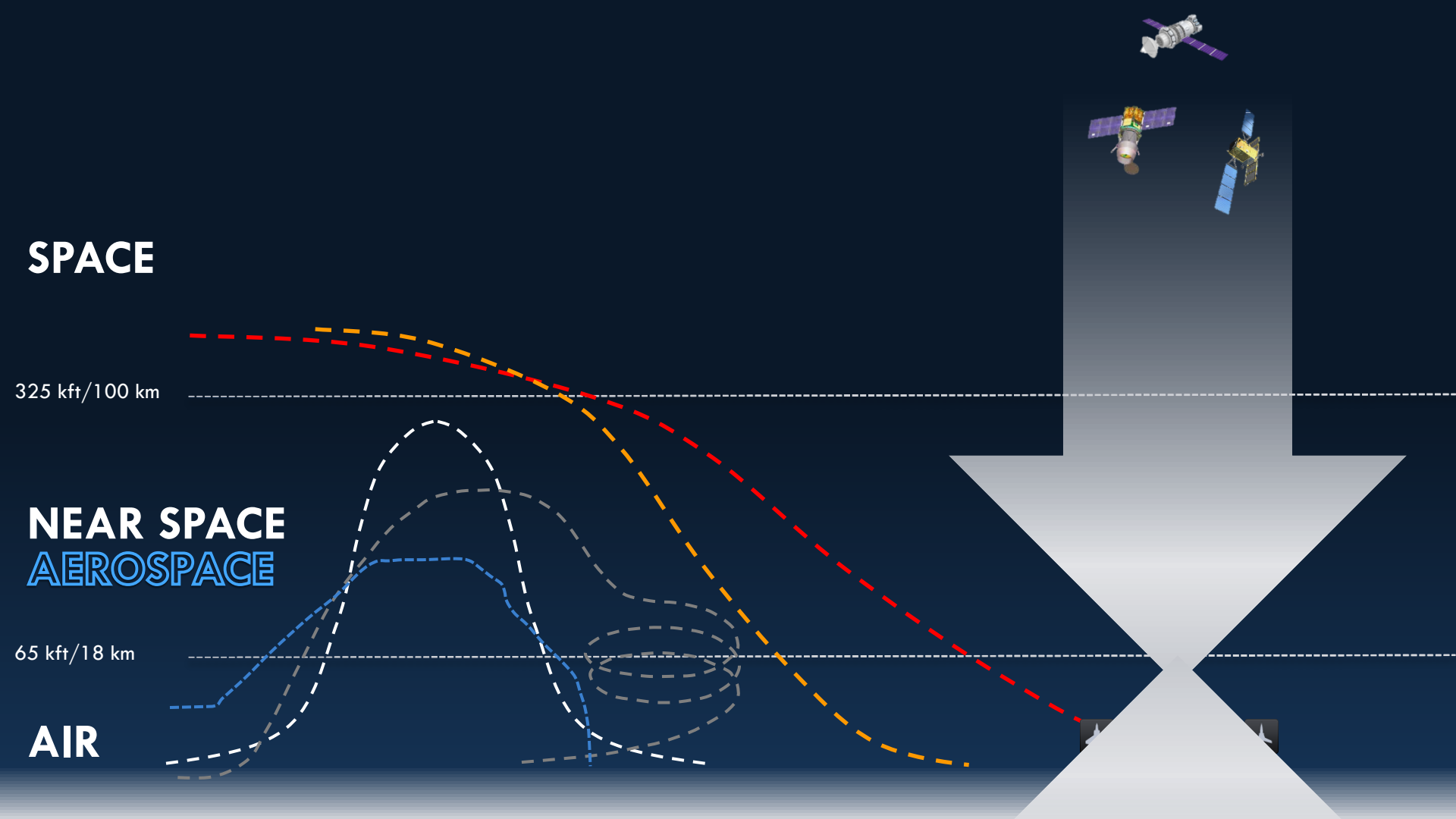
ItAF towards the aero-space domain

- "Gruppo Ingegneria per l'AeroSpazio" (Aero-Space System Engineering Group) of Flight Test Wing is the technological enabler of ItAF space and aerospace policy, with a twofold objective:
  - explore and assess the capabilities offered by the space segment, generally owned and managed by MoD, for use in support of ItAF mission
  - expand the environmental expertise of ItAF over 60 kft, from the traditional aeronautical domain to the aerospace one in cooperation with Agencies, Universities and Industries
- A Letter of Intent between Italian Civil Aviation Authority (ENAC) and ItAF for sub-orbital space transportation has been signed




SPACE
325 kft/100 km
NEAR SPACE
AEROSPACE
65 kft/18 km
AIR

AIM

- To show how ItAF simulation tools can support a suborbital flight risk assessment, focusing on:
  - what risk can be assessed
  - what can be done with simulation tools developed by ItAF (debris + radar tracking)
  - preliminary qualitative results

What risk can be assessed

- Risk of casualties among third parties overflown by impact of aerospace vehicles or their parts (debris) due to accidents
- The risk formula adopted: $R = P\sum_{i=1}^{N}\sum_{j=1}^{M_i} D_{i,j}A_{i,j}$

wheras:

P is the probability that a certain hazard occurs and generates a certain distribution of debris

N is the number of debris

M_i is the number of areas with a certain homogeneous inhabitant density hit by a generic debris

$D_{i,j}$ is the inhabitants density in $A_{i,j}$

$A_{i,j}$ is the area involved by the impact of a generic debris

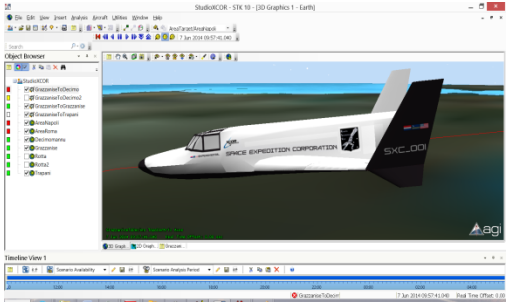
- In particular, M&S tools support the $D_{i,j}A_{i,j}$ term evaluation

Modelling&Simulation interfacing

X-Plane to STK interface

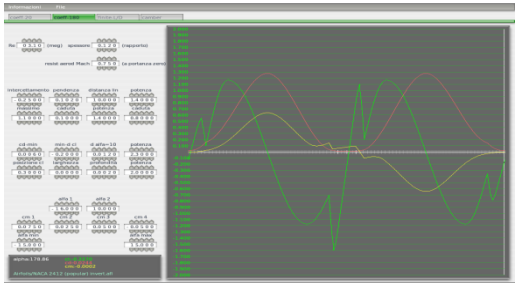
The flight model was flown in a real time simulation software with X-plane and it is shared with the STK (System Tool Kit) through a C# interface specially designed using the UDP protocol

STK (Satellite Tool Kit)



Through the use of softarwe STK it was possible to connect the flight model within an infrastructure of Modelling & Simulation DIS / HLA

Data exploitation



Through the use of DIS / HLA interface, it was possible to verify the data generated in the simulation environment and to plot in real time the physical parameters

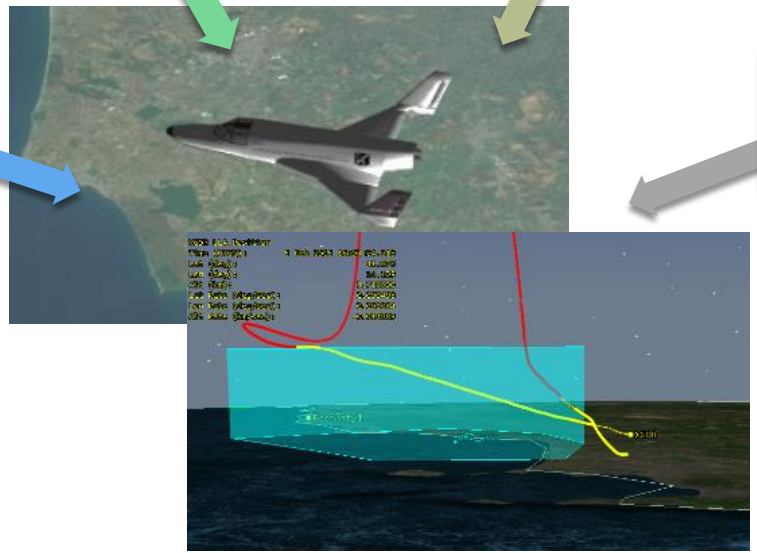
What can be done

Mission data

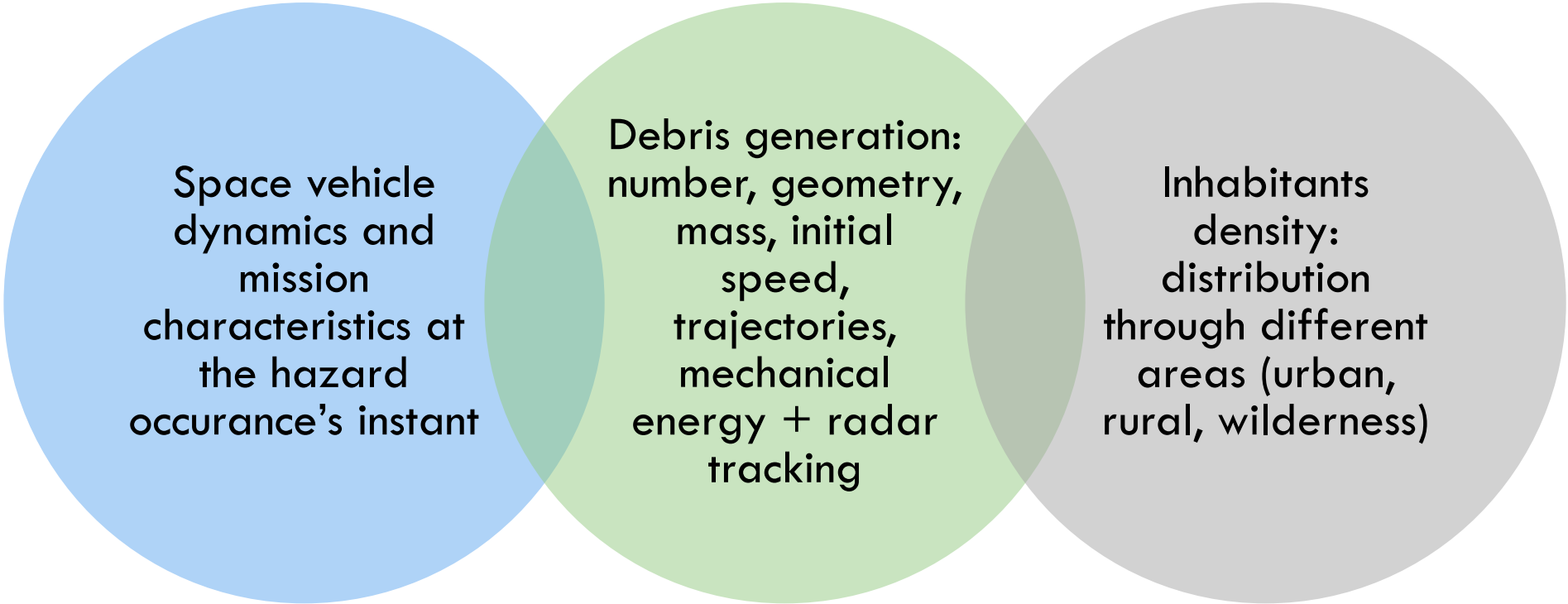
Meteorological conditions

Aerospace vehicle selection

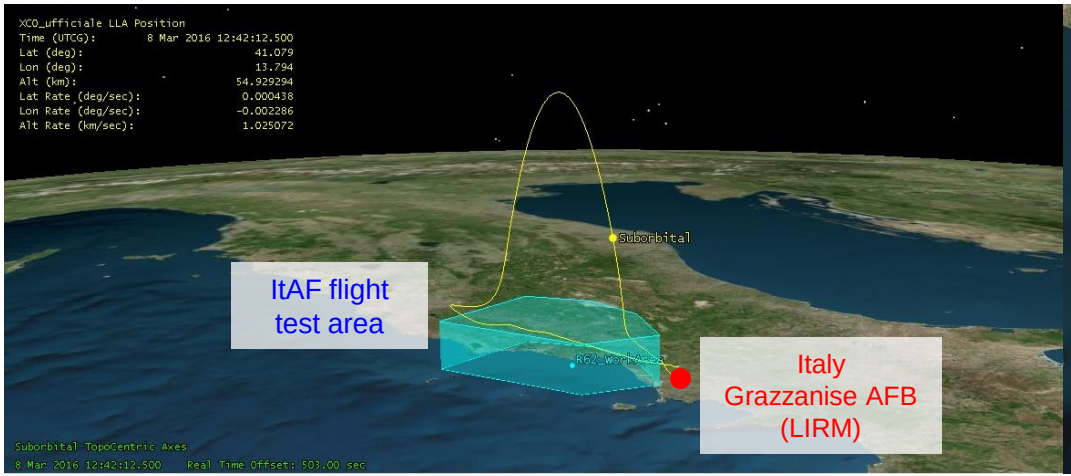
Hazard events

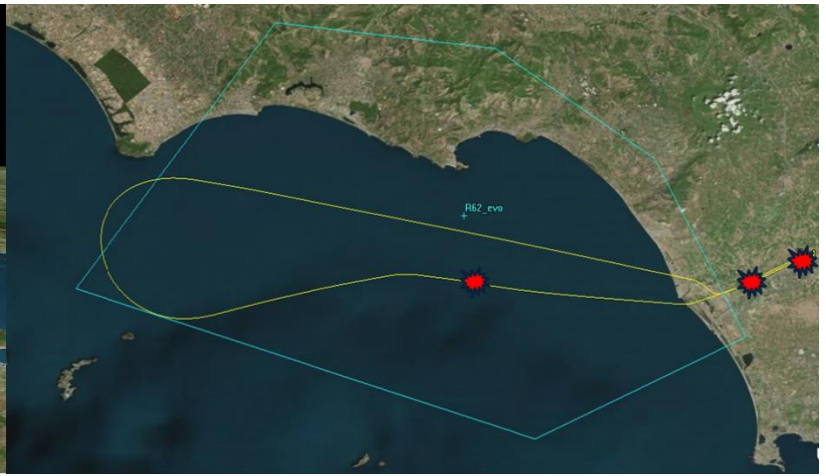


What can be done



ItAF reference scenario





Scenario 1
Low altitude Explosion

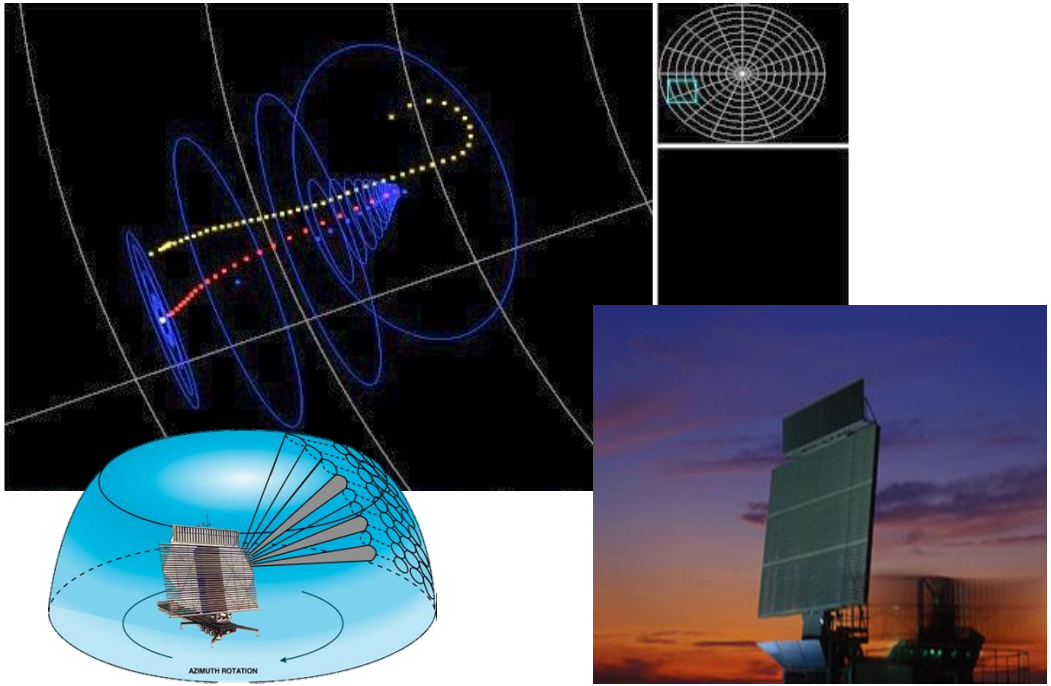
Radar tracking

The existing radar network can support the aerospace vehicle tracking during a mission

Through the use of a real ground RADAR with HITL Emulator and a DIS / HLA interface, it was possible to verify the detection and the tracking performance

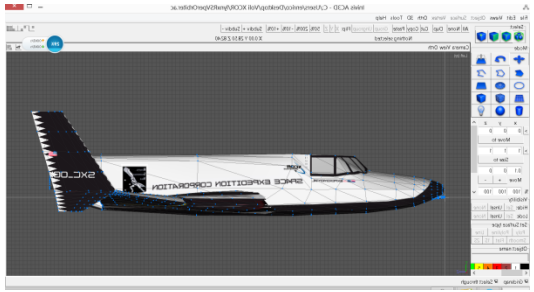
It is to be evaluated if it is sufficient to fully satisfy this function, without any augumentations

Radar tracking



- An aeropsace vehicle radar tracking simulation during its descent and turn (gliding)
- Radar located at about 30 Km distance from the airport

The way ahead



Software automation of simulations and data collection

Introduction of simulated/real air traffic

Further analysis on risk assessment through different case studies

Build-up approach: gradual implementation of the models

Thank you

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