International Re-Entry demoNstrator Action

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 640277

IRENA

"International Re-Entry demoNstrator Action"

A Coordination and Support Action funded by the European Union's Horizon 2020 research and innovation programme in preparation for an international technology demonstrator mission.

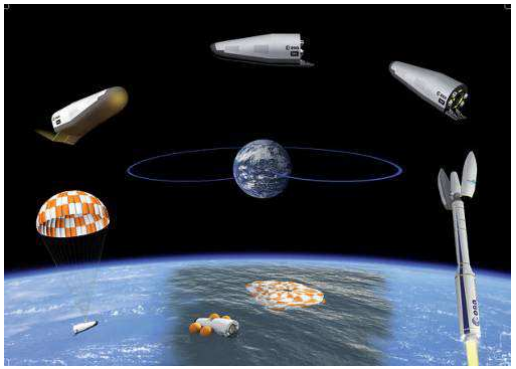
Presented at:
6th International Conference on Astrodynamics Tools and Techniques (ICATT)
ESOC, Darmstadt, Germany, 14-17 March 2016

What is IRENA ?

- R&D project funded by the EC's Horizon 2020 programme (Coordination and Support Action)
- Selected out of 2014 Space Call COMPET-09-2014: **"Technology "demonstrator projects" for exploration"**
- Objectives:
  - **define 2 entry/re-entry demonstrator projects** (flight or ground) aimed at **international cooperation** (esp. USA and Japan)
  - **Create the ground for their actual implementation** (funding, governance, international partnership)
- **Schedule**: January 2015 – April 2016
- **Budget**: 800 k€

ESA ARD

FP7 Rastas Spear



ESA IXV

Who is involved ?

- Space agencies

observer

observer

- Large space integrators

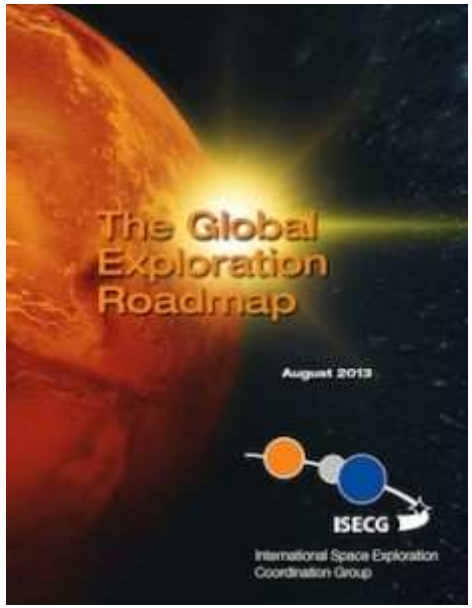
coordinator

- Research institute

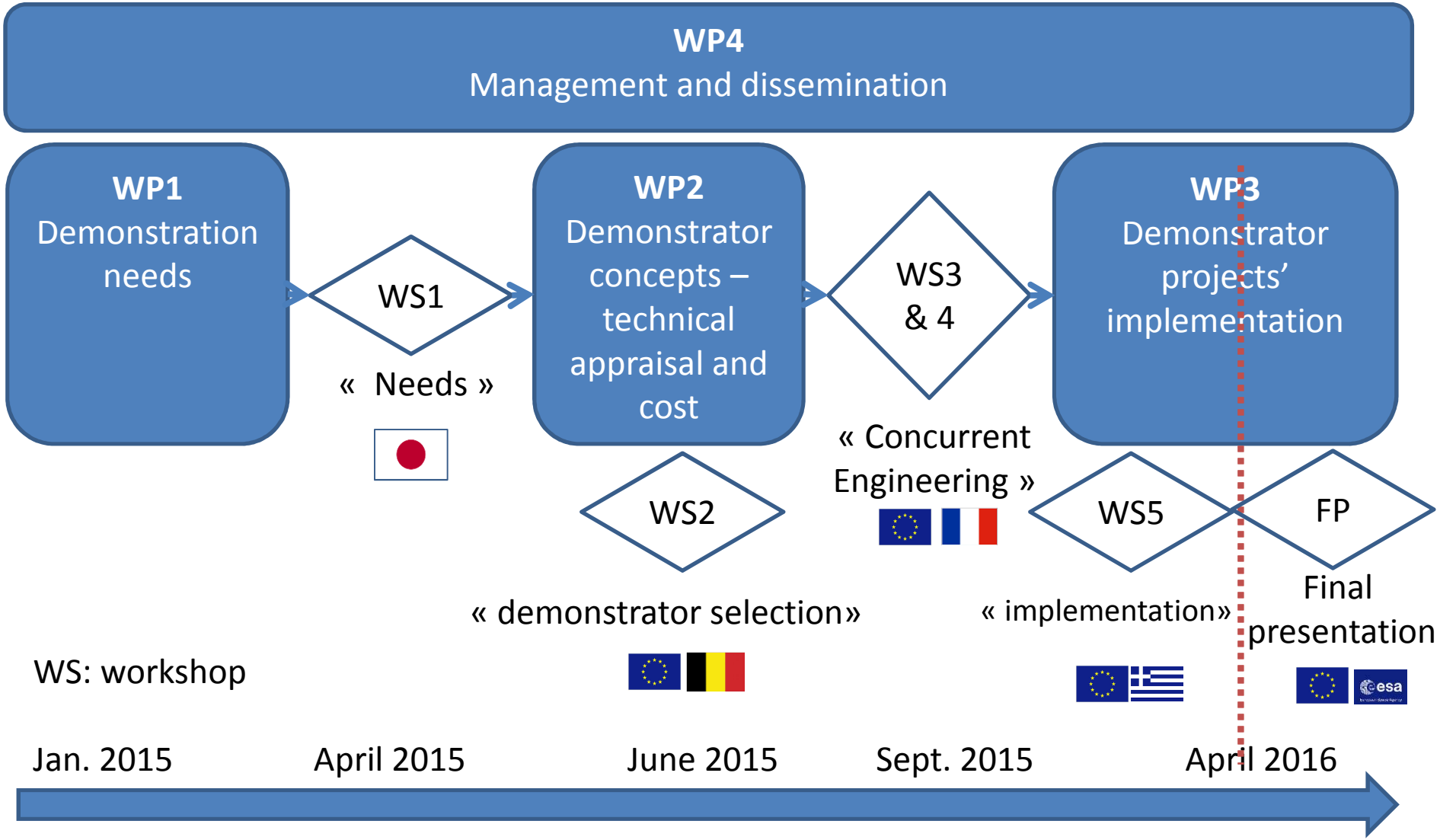
Why ?

- **International Space Exploration Coordination Group (ISECG)'s vision and roadmap (GER)**
  - need for entry, descent, and landing technologies
  - test and demonstrate
  - International cooperation is key
- **EC also selected entry/re-entry as a key technology**
- **Interest to create and promote new initiatives in Europe**

ISECG
International Space Exploration Coordination Group



How is the work done ?



Where we stand

- Demonstration needs defined
- Demonstrator candidates selected
- Demonstrator preliminary design completed (4 demonstrators)
- 2 final demonstrators for the implementation selected
- Implementation plan defined
- 4 workshops completed, including a CDF session
- Pending final presentation and review

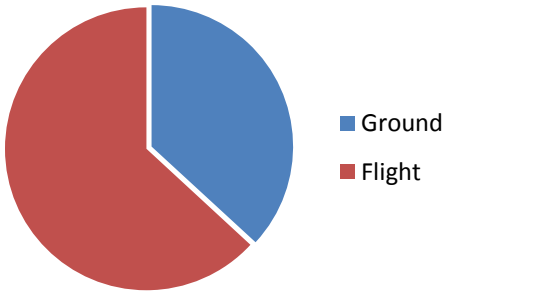
Call for ideas for demonstrator candidates

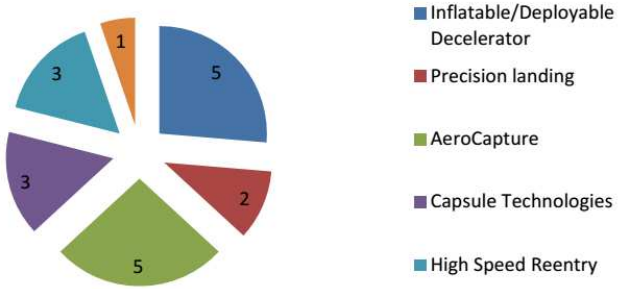
- 19 proposals received:
  - 7 ground, 12 flight
  - 2 proposals merged, one proposal integrated

- Major Topics:
  1. Aerocapture / Aerodynamic decelerator (8)
  2. GNC partly combined with aerocapture (6)
  3. High speed entry/TPS (4)

- Programmatic and technical selection criteria

- **4 proposals selected** + **2 back-up**

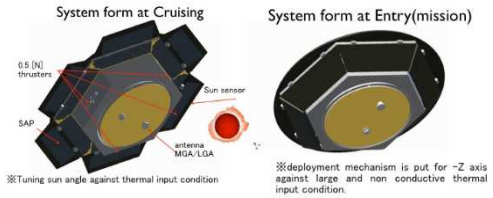




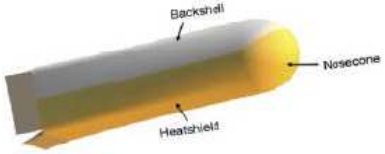
Flight Demonstrators

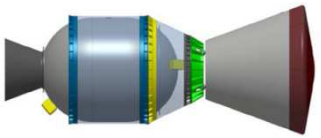
- Aerocapture Vehicle to Mars (JAXA)
- Aerocapture Mars Demonstrator (CNES)

merged

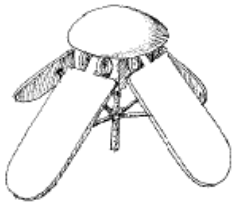


- HEARME : Heatshield for Earth Aerocapture and Re-Entry(Ext.)
- Aerocapture Earth Demonstrator (CNES)
- Skip Re-entry demonstrator (ADS)
- Multiple Re-entry System Demonstration platform (JAXA)
- High speed re-entry demonstrator (TAS-I)
- High Speed demonstrator for radiative heating measurement (ADS)





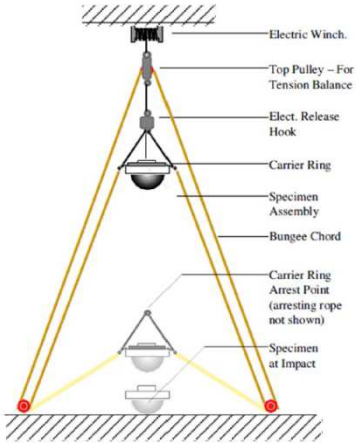
- Ablative TPS recession sensor (Demokritos) (integrated in selected proposals)
- Inflatable heat shield & decelerator demonstrator (TAS-I) backup
- Inflatable Decelerator for EXPERT-like vehicle (TAS-I)
- Aerodynamic Decelerator Demonstration (DLR)



Ground Demonstrators

- Mars Precision Landing preparatory demonstrators (TAS-I)
- Prototype of vision based precision landing GNC (CNES)

backup& merged

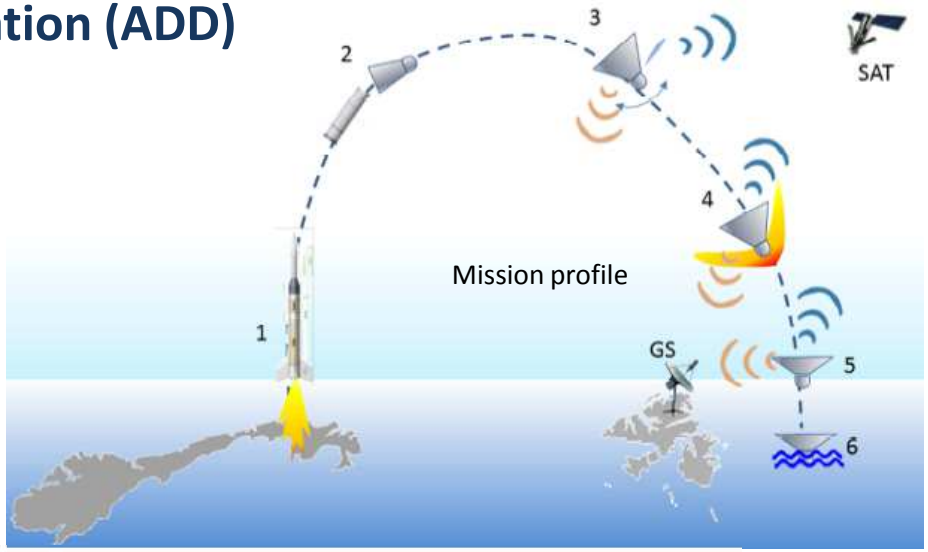


- Ground Test Facility for crushable capsule (ADS)
- Adaptive and Versatile Front shield Test bed ”Test as you Fly” (ADS)

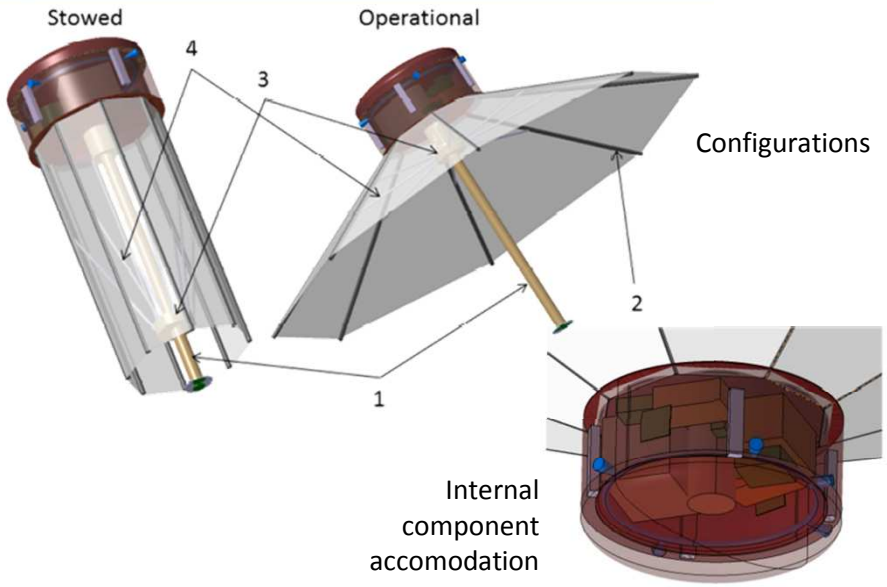
- Inflatable Ground demonstrator for upper stage safe re-entry (ADS)
- Winged Re-entry vehicle approach and landing demonstrator (TAS-I)
- Inflatable/deployable rotary decelerator for re-entry capsule (ADS)

Aerodynamic Decelerator Demonstration (ADD)

- **Objective**: flight demonstration of moveable and foldable decelerator systems
- **Application**: aerocapture and g-load reduction
- **Main features**:
  - Deployable decelerator screen with fabric TPS
  - Test of specific GNC technics using drag modulation
  - Active attitude control before EIP
  - Variable deployment angle of the decelerator as an active aerodynamic actuator
  - Launched by Sounding rocket
  - Recovery of the experiment data and optionally also the vehicle
  - Mass approx 150kg, length 1,2m
  - EIP velocity 2500m/s at -35deg FPA



Mission profile

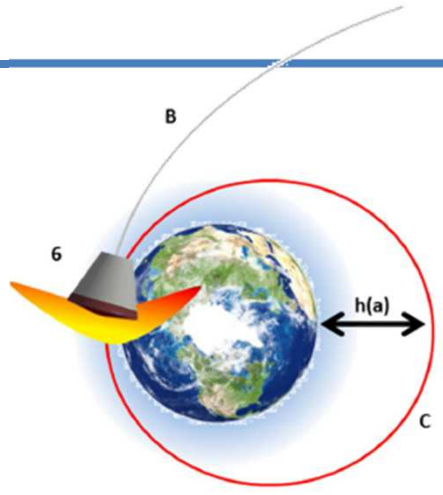


Configurations

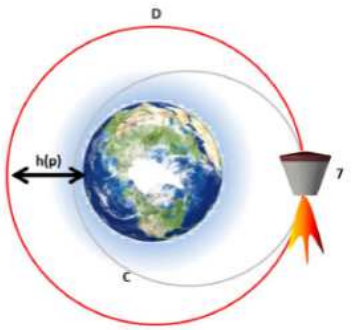
Internal component accomodation

Earth Aerocapture Demonstrator

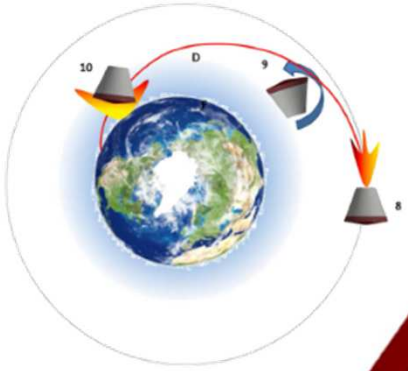
- **Objective**: Demonstration of an autonomously controlled earth atmospheric pass allowing to decrease apogee altitude and possibly changing inclination of the orbit as Piggy back .
- **Application**: Future missions to planets with atmosphere
- **Main features:**
  - Test specific dual pulse TPS
  - Test aerocapture GNC technics and algorithms in a realistic environment.
  - Familiar aeroshape (Orion)
  - Autonomous navigation and guidance, but ground commanding for improved accuracy
  - Onboard orbital and RCS propulsion
  - Recovery optional, experiment data transmitted
  - 10 h mission
  - Mass approx 260kg, D=1.02m



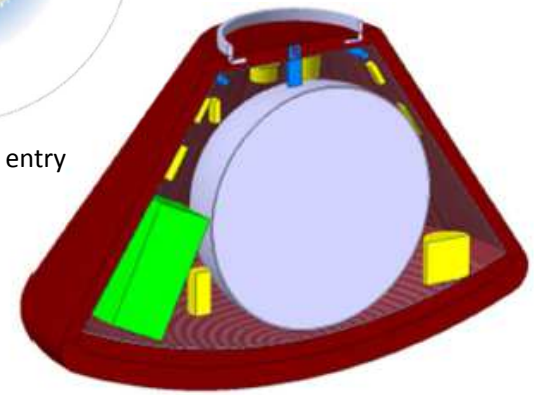
Aerocapture



Orbit circularisation



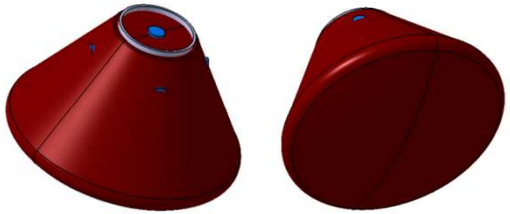
De-orbit and entry


Internal accomodation

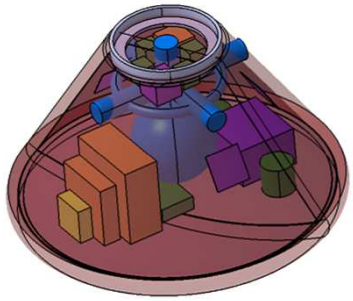
Mars Aerocapture Demonstrator

- **Objective**: Demonstration of aerocapture in Mars atmosphere

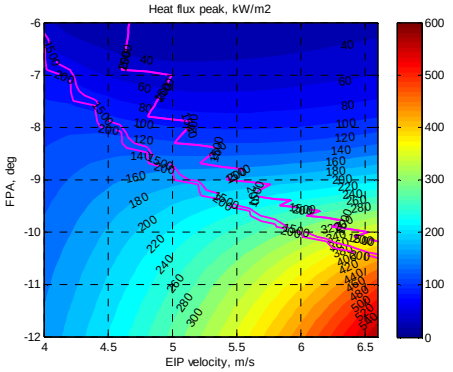
  → Piggy back on a future Mars mission (MPL etc.)
- **Application**: Future missions to Mars
- **Main features**:
  - First aerocapture on Mars in representative atmospheric conditions
  - Mission potential for both human and robotic on Mars and other inner and outer planets
  - Aerocapture is beneficial for high mass landings on the surface of Mars.
  - Lift modulation control for secure aerocapture
  - Sensors and instrumentation in order to acquire aerothermal environment close to thermal protection systems
  - Mass 74kg, Ø890mm



Orion aeroshape



Internal accomodation



Aerocapture corridor

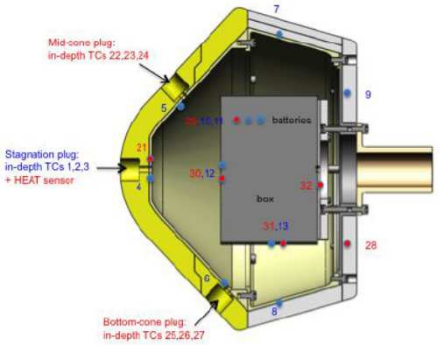
Generic capsule test bed

- **Objective:** Demonstration of scale 1:1 capsule TPS configurations testing in arc jet facility

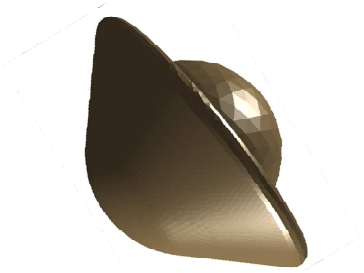
  → Validated with flight test

- **Application**: TPS development and qualification
- **Main features**:
  - Different heat shield shapes and TPS designs tested
  - Comparison of experimental data to validate models and characterize disparities (Instrumentation to measure and gather information during the arc-jet testing and in-flight).
  - Elimination of flight test needs due to absence of geometrical scaling issue (Ø600mm)
  - Easy to replace heat shields with various materials, shapes from different manufacturers
  - Utilization of SCIROCCO Wind tunnel test facility as a baseline

SCIROCCO test chamber



SPRITE probe cross section and instrumentation



Pioneer aeroshape

More information on IRENA:

www.irena-project.eu

irena@irena-project.eu