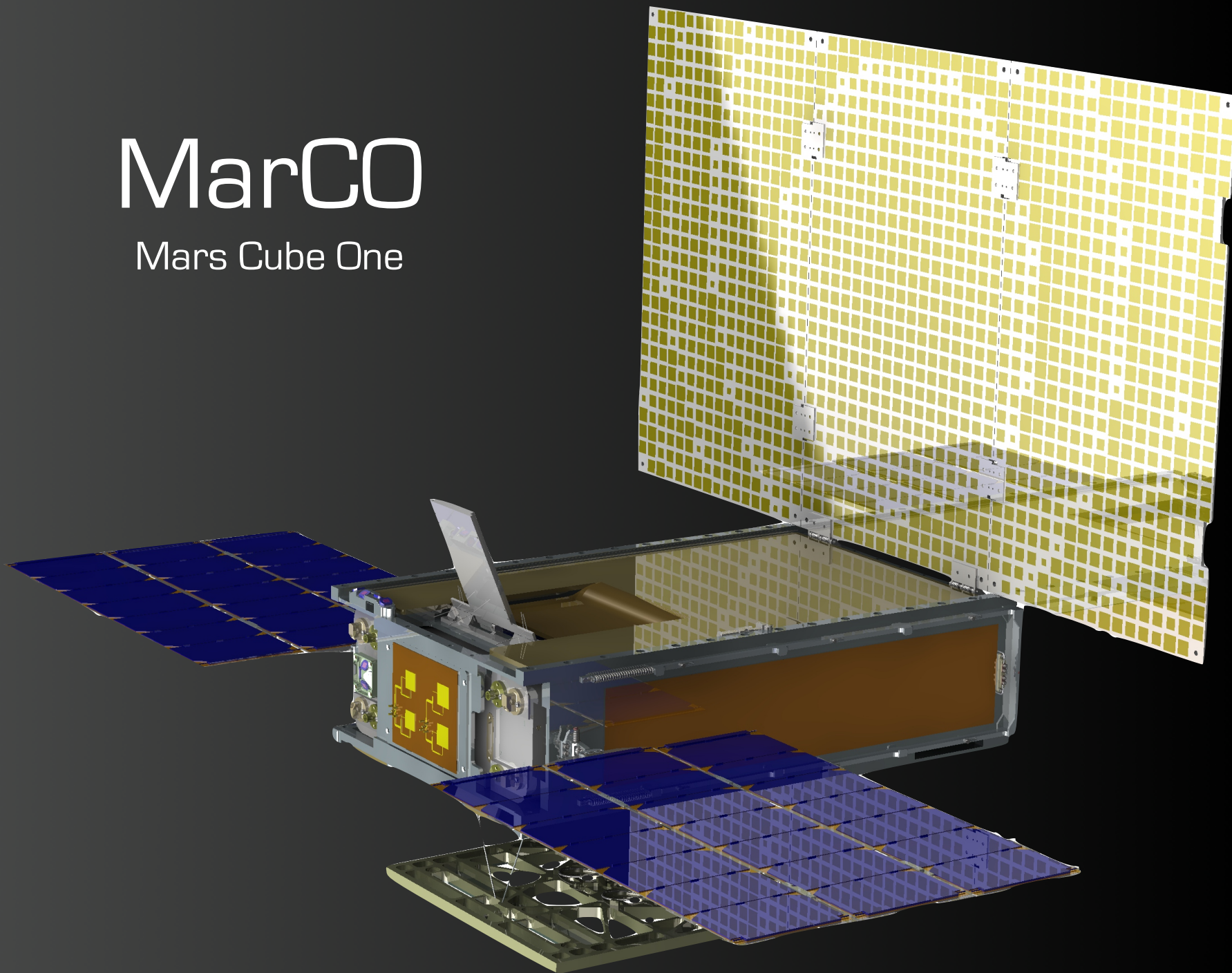


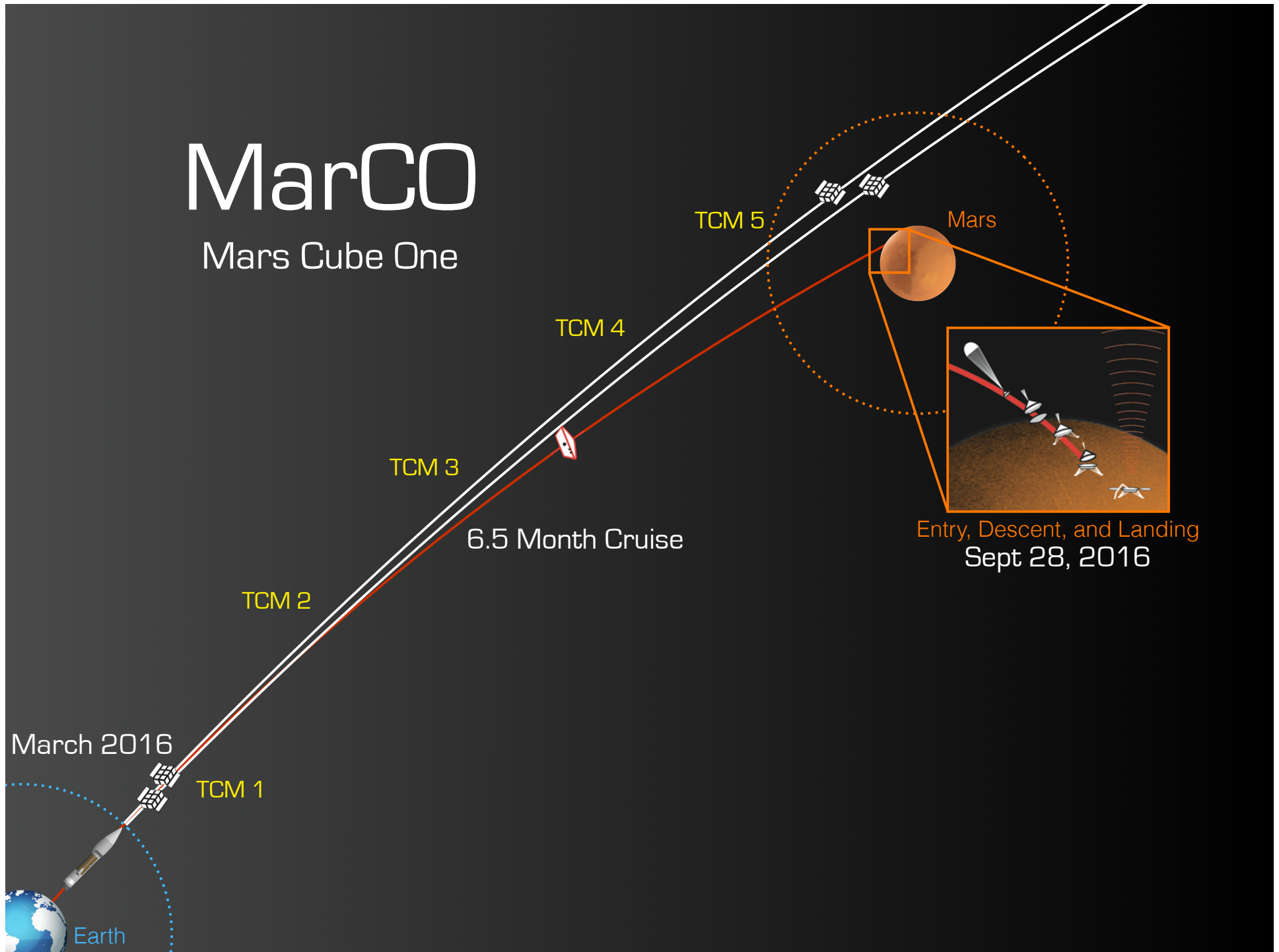
# MarCO

Mars Cube One



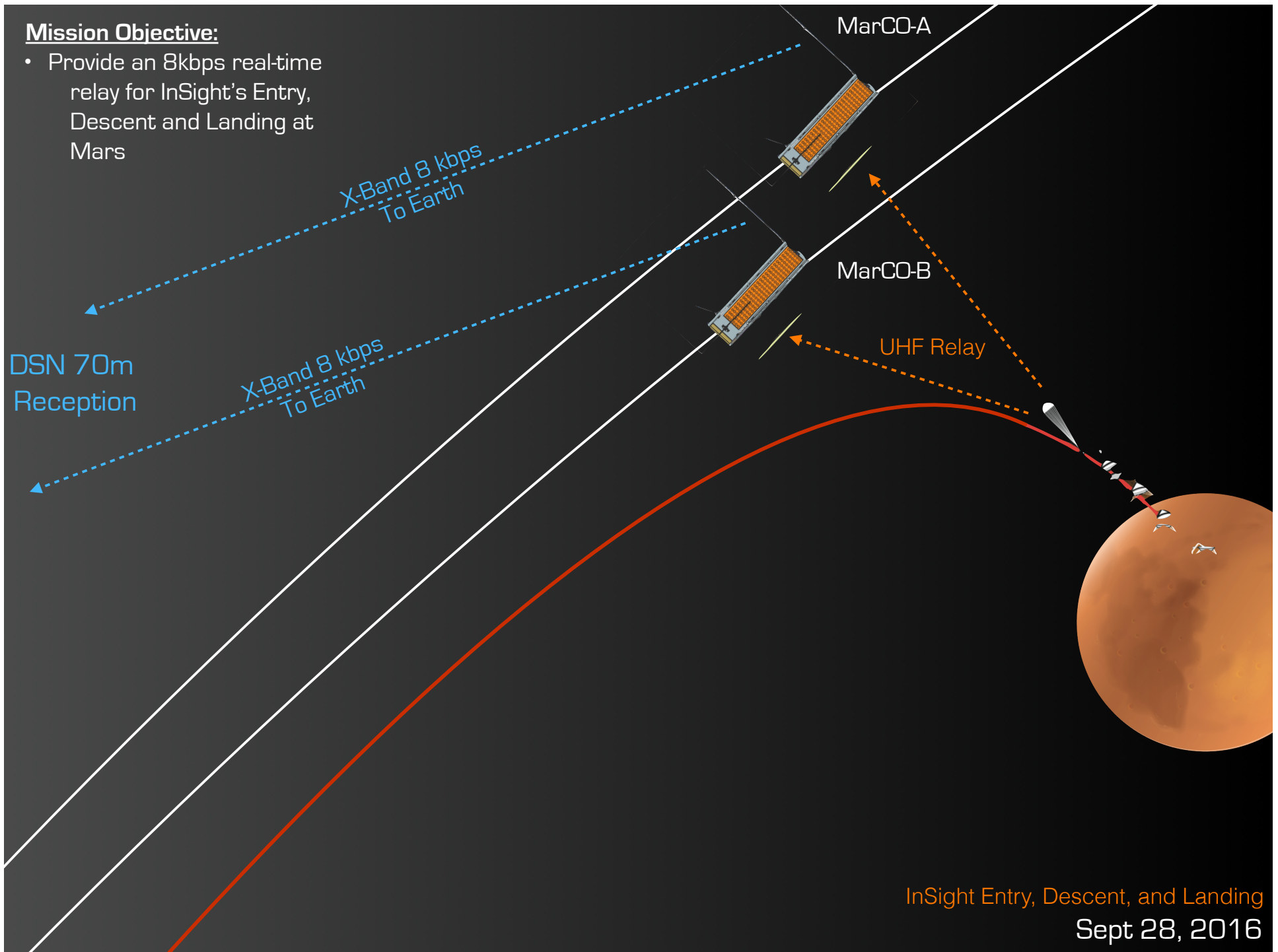
# MarCO

Mars Cube One



**Mission Objective:**

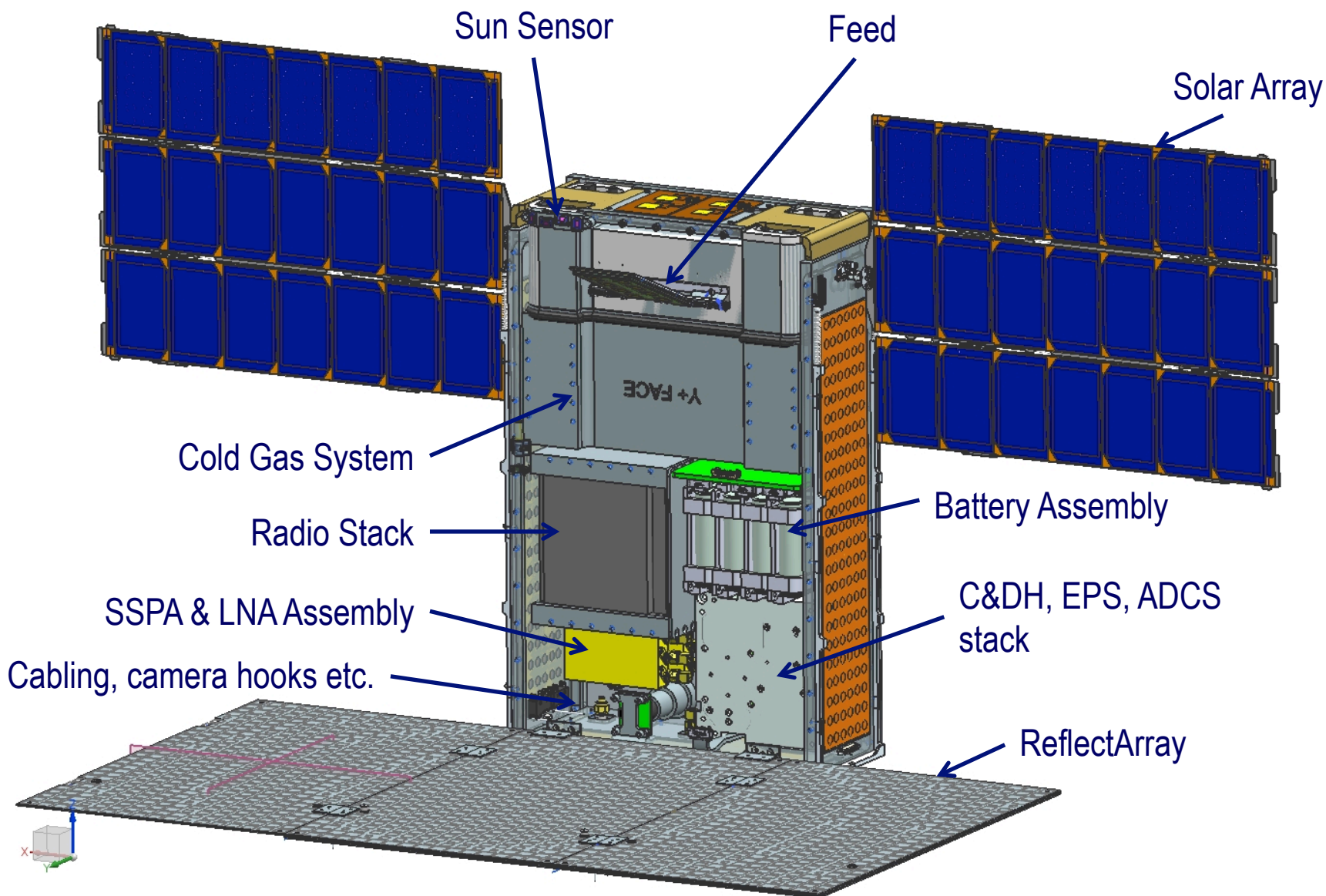
- Provide an 8kbps real-time relay for InSight's Entry, Descent and Landing at Mars



InSight Entry, Descent, and Landing  
Sept 28, 2016



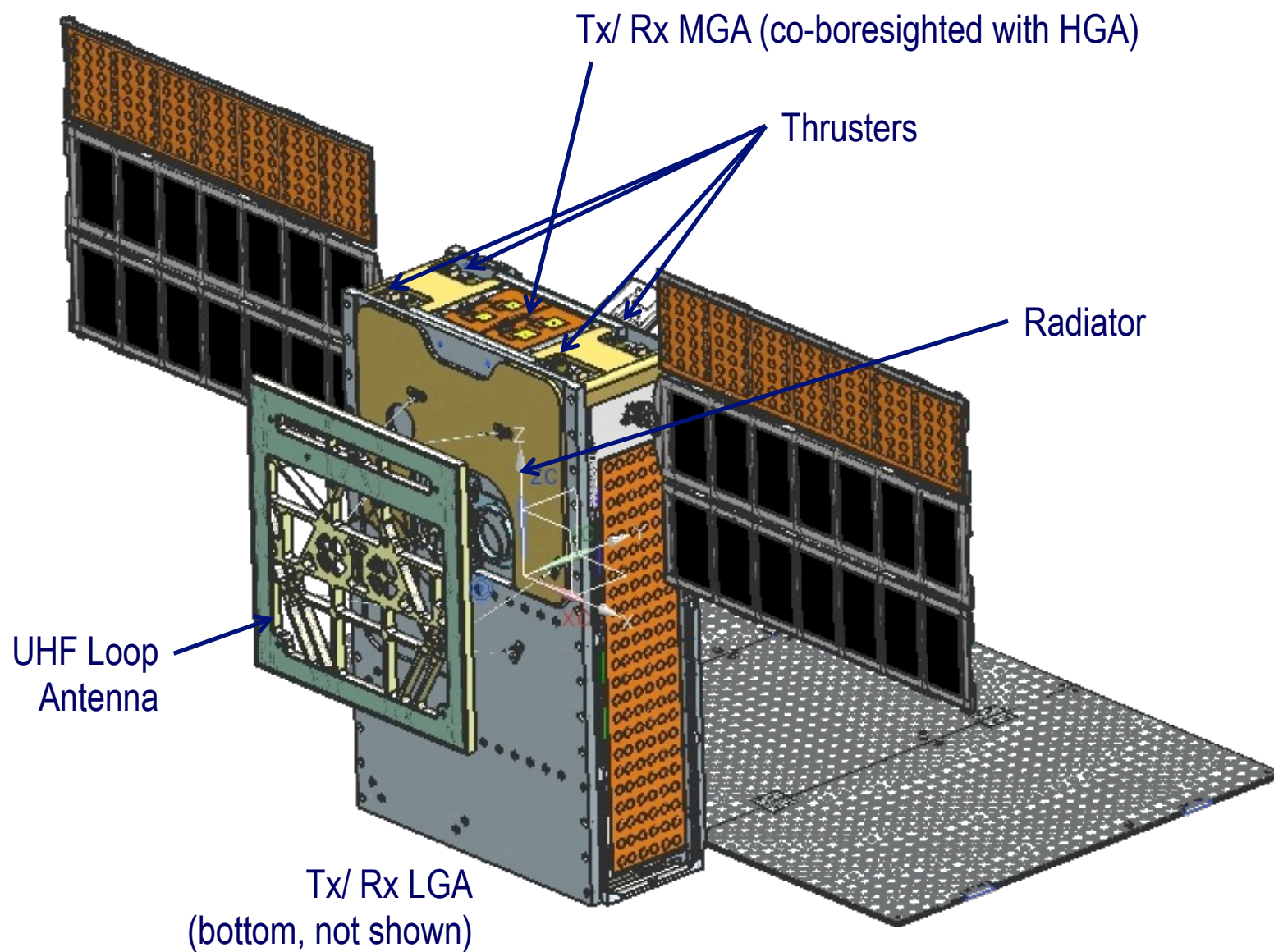
# Mechanical Configuration: Deployed



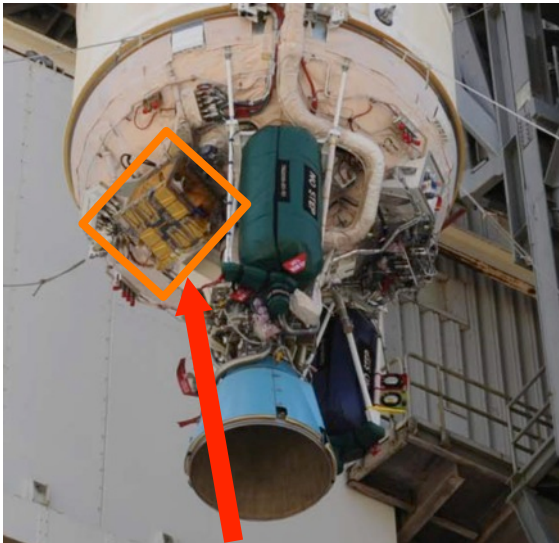




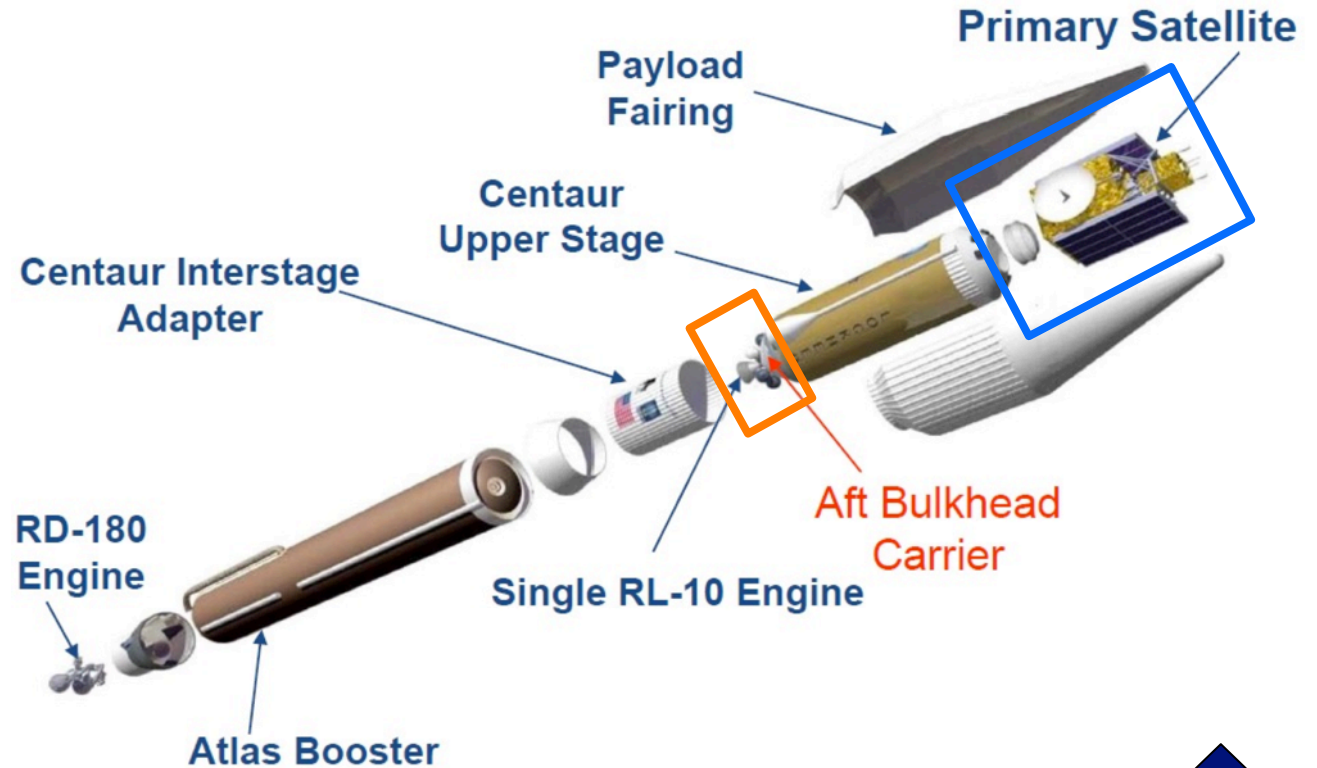
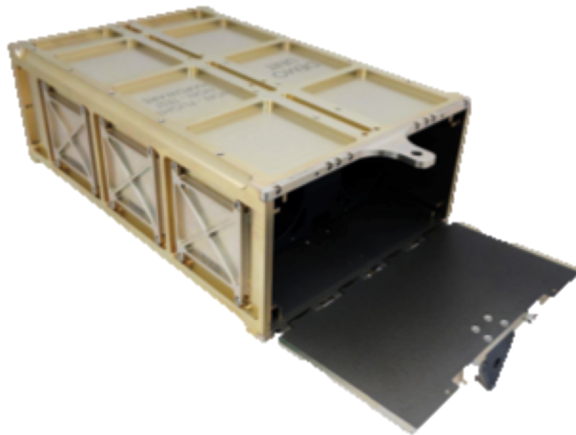
# Mechanical Configuration: Deployed



# LV Accommodation on Aft Bulkhead Carrier (ABC)



Paylads Integrated on ABC



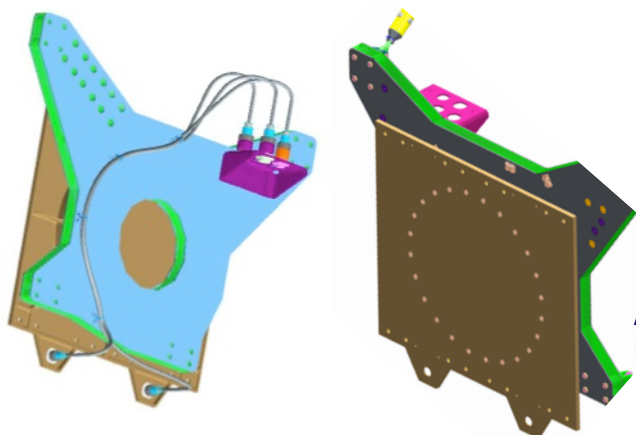
On 400-series Atlas, the ABC is in a separate volume from the primary fairing volume, with no vent paths between the volumes within the launch vehicle.

Each MarCO spacecraft will be contained within an enclosed NLAS dispenser during launch operations, and separate after InSight separation.

# Integration Flow

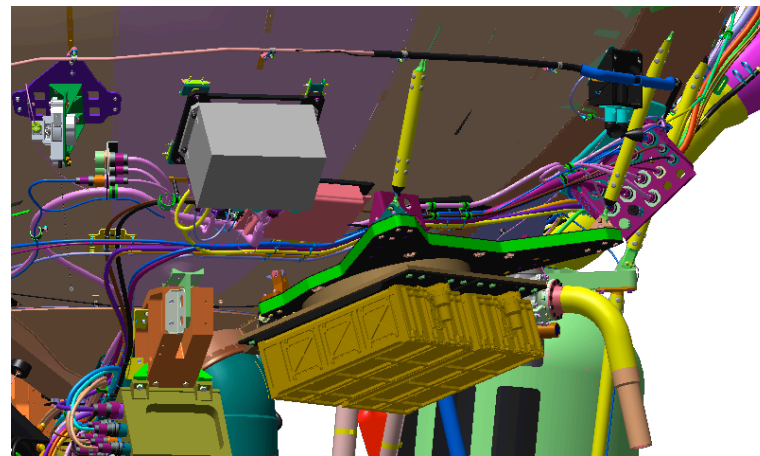


Aft Bulkhead Carrier (ABC) Plate

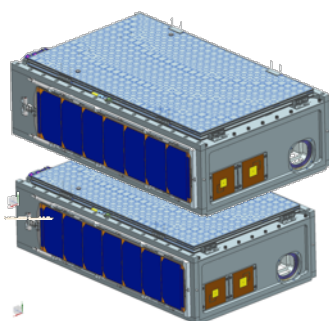


ABC Plate W/ Adapter Plate  
Installed to Aft Bulkhead

Atlas / Centaur Aft Bulkhead



Tyvak NLAS & MarCO Adapter  
Plate Mated to ABC Plate  
on Centaur Aft Bulkhead  
(SLC-3, VAFB)



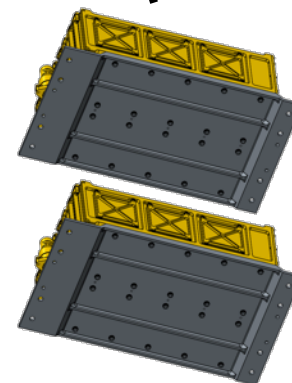
MarCO  
(Mars Cube One)

Installed in  
Tyvak NLAS  
(San Luis Obispo)



Tyvak NLAS  
6U Dispenser

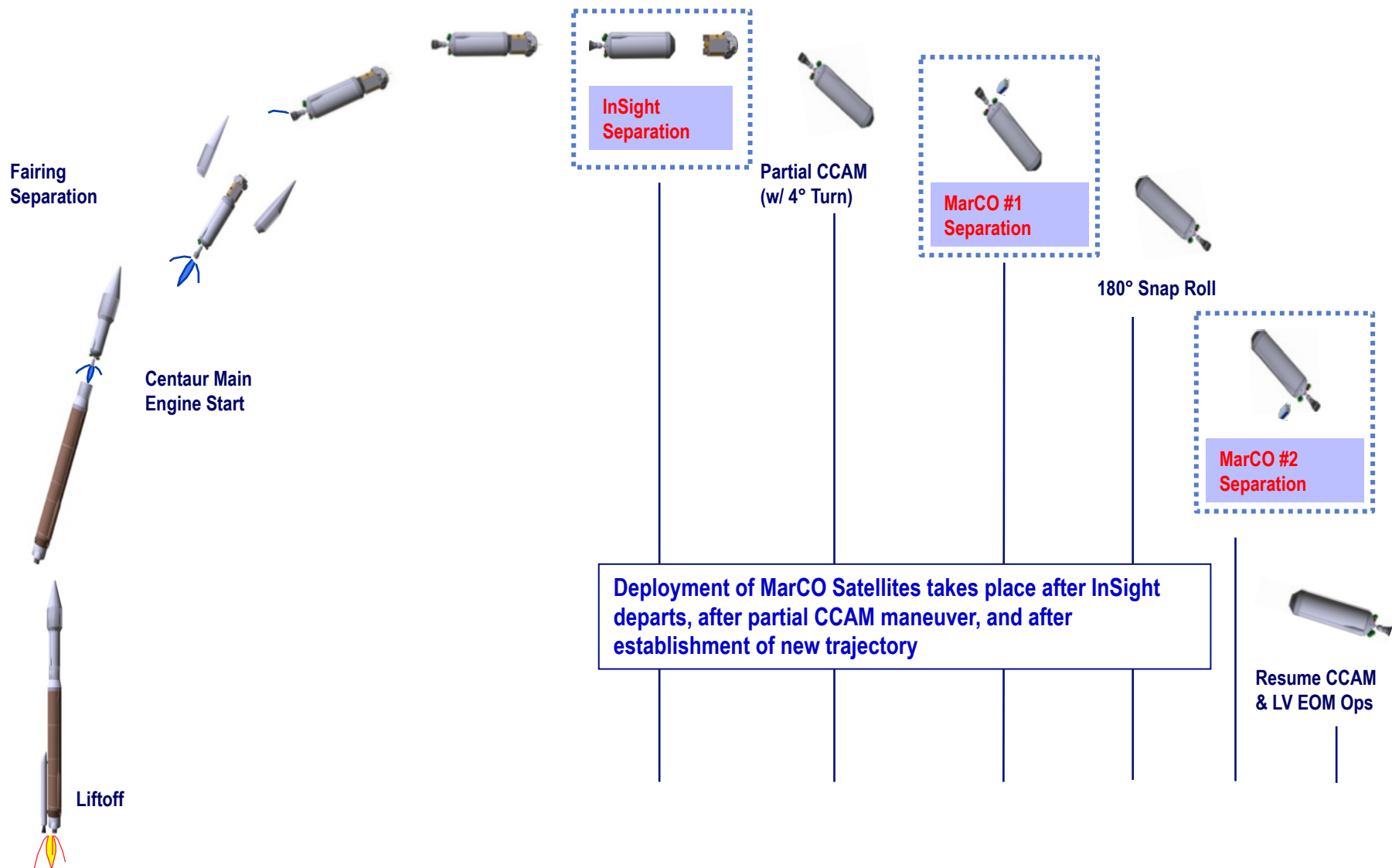
NLAS/MarCO  
System Mated to  
MarCO Adapter Plate  
(VAFB)



Adapter Plates



# MarCO Deployment Timeline





# Contamination Control & Planetary Protection

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- CC/PP Overview
  - › **MarCO is expected to be Category III (Mars Flyby) and will comply with NPR8020.12D**
    - Received initial response from PPO to categorization request letter, with a request for additional information
    - MarCO will supply documentation in accordance to NPR8020.12D. Delivery dates are negotiated separately with the PPO, as there are no formal KDPs
    - Plan developed in coordination with InSight PP lead and NASA PPO, delivered 6/8/2015
  - › **MarCO must mitigate potential impact on InSight's PP/CC approach**
    - ATLO contamination risk minimized; MarCO is physically separated from InSight on launch vehicle aft bulkhead carrier
  - › **Generally, MarCO flight systems have no organic contamination control requirements**
    - Spacecraft maintained at “generally clean” level during ATLO
    - Special consideration will be taken for propulsion system (e.g. filtered propellant) and star tracker optics (e.g. RBF covers) as needed



# Planetary Protection Implementation

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- **Baseline Plan is *Impact Avoidance***

- › MarCO intends to comply with the impact avoidance requirements for *launch vehicle elements*, ( $10e-4$  for 50 years) as opposed to the more typical (less stringent) requirements levied on orbiters or flyby spacecraft
  - Rationale: Typical spacecraft impact avoidance is predicated on 100k cleanroom (unlike MarCO)
  - **PPO indicates that if MarCO can demonstrate impact avoidance requirements for launch vehicle elements, no cleanliness or assay requirements will be levied**
- › Must bias all TCMs to maintain this probability threshold, including in the event of spacecraft failures (no credit is taken for presumed spacecraft reliability).
  - Analysis indicates TCM bias maintains probability threshold

- **Contingency Plan is *Burn-Up & Break-Up analysis***

- › In case that the above impact avoidance constraints cannot be met, MarCO intends to demonstrate via *burn-up and break-up analysis* that no more than  $10e5$  viable spores (per NPR 8020.12D) get delivered to the surface of Mars in the event of an impact of either spacecraft
- › This approach would entail biological assays and possibly additional cleaning and/or cleanroom procedures to establish/verify initial cleanliness
- › This approach is not preferred due to potential risks and cost growth. Current trajectory analysis indicates this backup is not required.