

Orion Avionics Path to Deep Space Human Exploration

Keith Williams

NASA ESM Avionics Lead

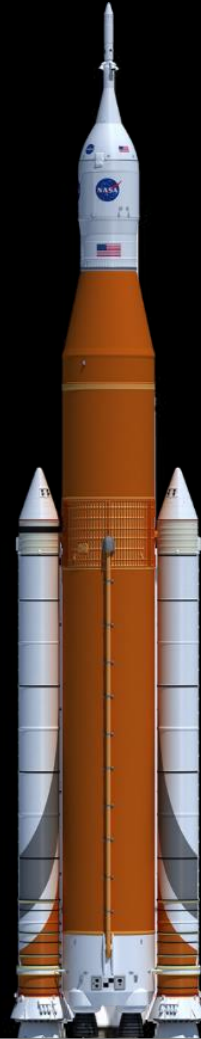
EXPLORATION MISSION PROGRESSION TO FIRST CREWED FLIGHT



May 2010
PA-1



Dec. 2014
EFT-1



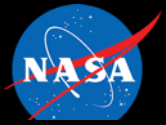
EM-1



AA2



EM-2

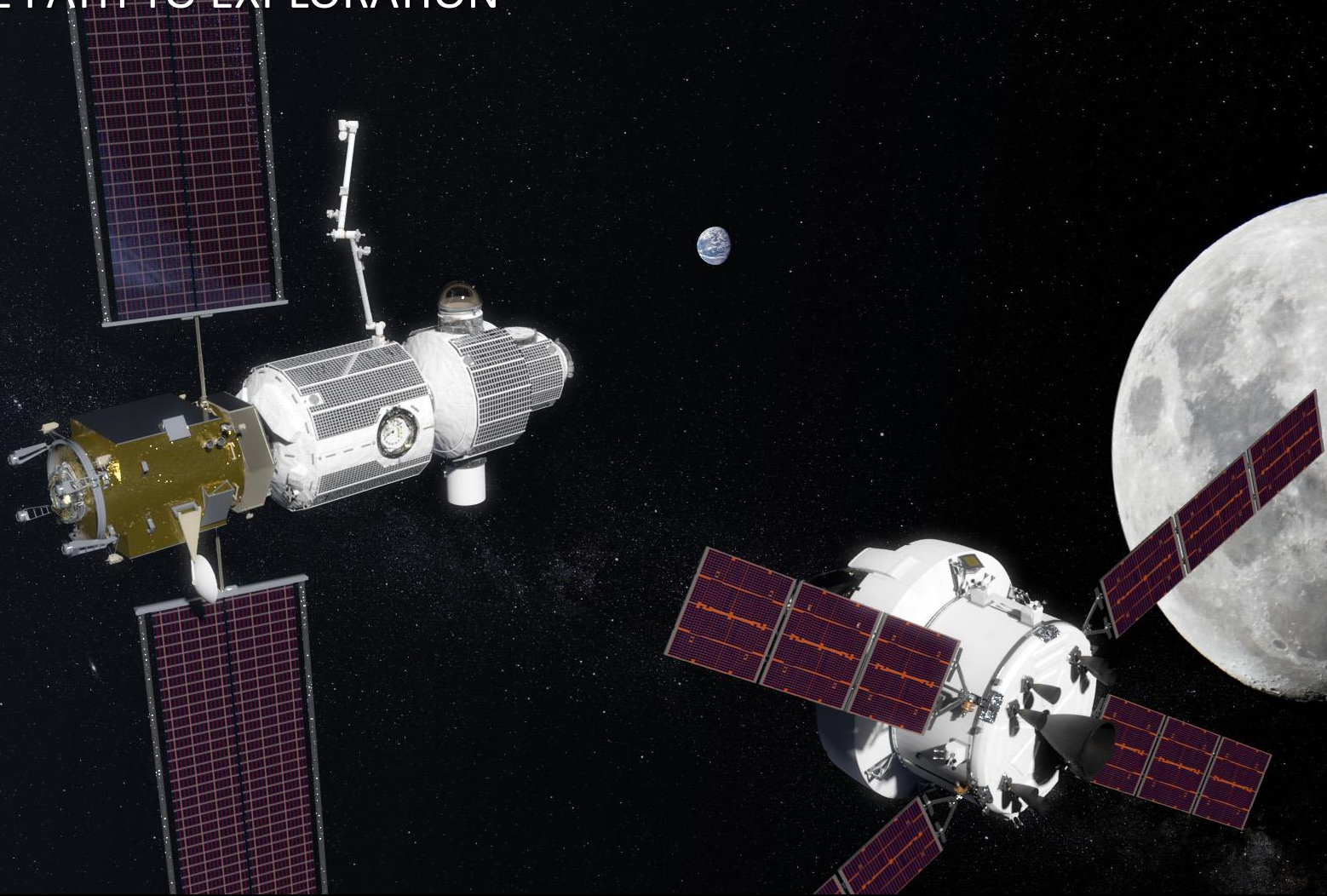


EXPLORATION MISSION-1





FUTURE PATH TO EXPLORATION



ORION IN-SPACE SYSTEM

CREW AND SERVICE MODULE

SERVICE MODULE

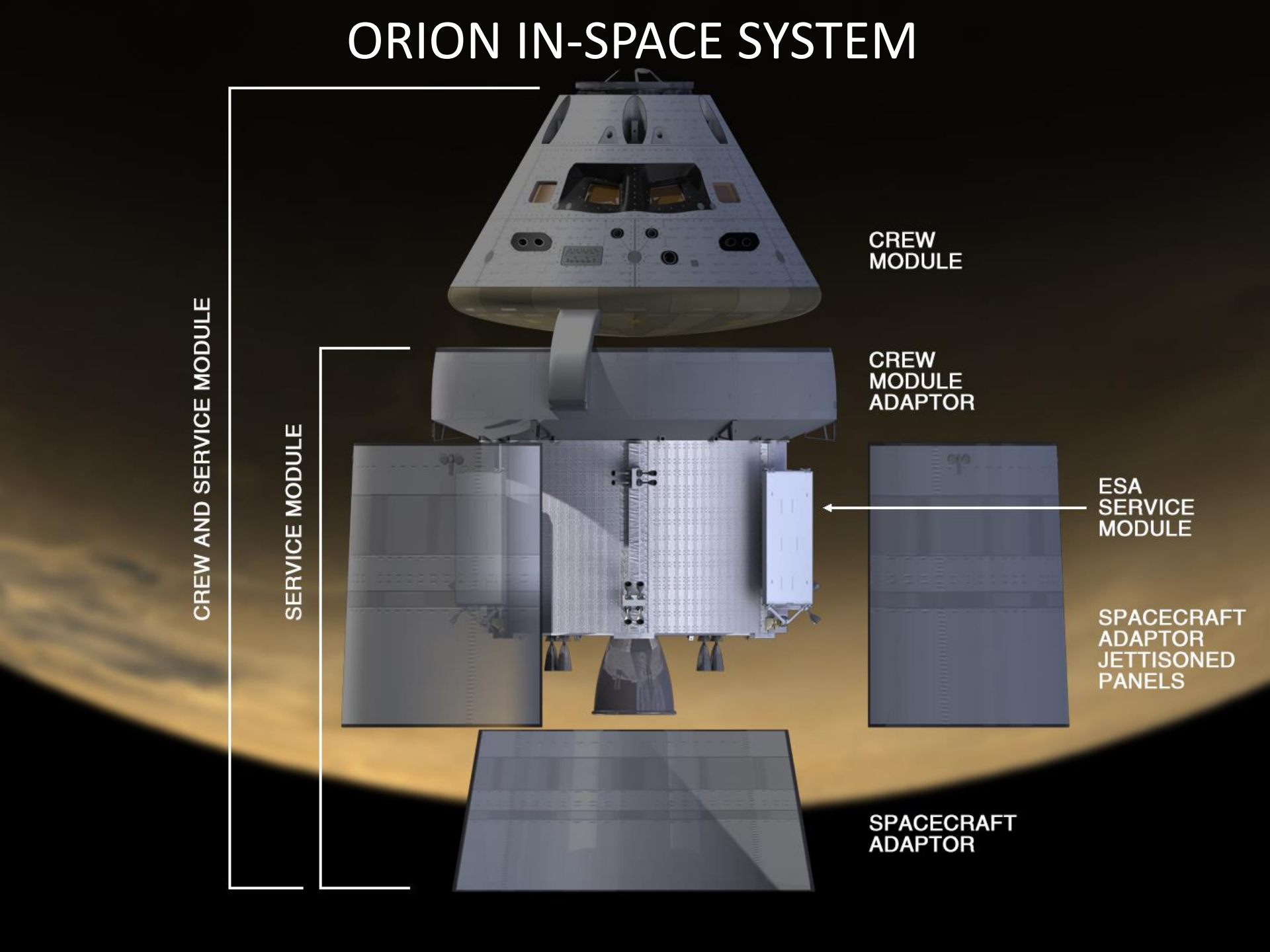
CREW
MODULE

CREW
MODULE
ADAPTOR

ESA
SERVICE
MODULE

SPACECRAFT
ADAPTOR
JETTISONED
PANELS

SPACECRAFT
ADAPTOR



MPCV – A MULTI-NATIONAL ENDEAVOUR



Germany

- Prime Contractor
- European Service Module Assembly Integration & Verification
- Propulsion and Propulsion Drive Electronics
- Centralised Parts Procurement Agent
- On Board Data Network Harness for Qualification Module

Italy

- Structure
- Thermal Control System
- Consumable Storage System
- Power Control and Distribution Unit
- Photovoltaic Assembly
- Meteoroid and Debris Protection System

Switzerland

- Secondary Structure
- Solar Array Drive Assembly
- Solar Array Simulator
- Mechanical Ground Support Equipment

USA

- Gas Tank
- Valves
- On Board Data Network Harness for Flight Module

France

- System Tasks
- Avionics qualification
- Direct Current Harness
- Front End Electronics
- Helium Filters

Belgium

- Tank Bulkhead
- Electrical Ground Support Equipment
- Pressure Regulation Units

Sweden

- Propulsion Qualification Module Integration

Denmark

- Front End Electronics
- Electrical Ground Support Equipment

Norway

- Hydrophobic Filter

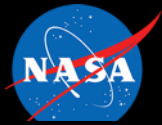
Spain

- Thermal Control Unit

The Netherlands

- Solar Array Wings





MPCV AVIONICS & SOFTWARE VERIFICATION AND VALIDATION PROGRAM



**SOCGRATES – SW Only
Development Environment**

VMC Test Bench

**Integrated Avionics &
Software Testing
(ITL Denver)**

**ESM Functional Chain Based
Verification (ESM-QF Les
Mureaux)**

**Vehicle Testing
(Bremen, KSC, &
Plumbrook)**

Avionic Unit Acceptance & Qualification

BILATERAL INTEGRATION AND VERIFICATION ACTIVITIES



**Integrated Avionics &
Software Testing
(ITL Denver)**

**ESM Functional Chain Based
verification (ESM-QF Les
Mureaux)**

**Vehicle Testing
(Bremen, KSC,
Plumbrook)**

**ESA/Airbus
Verification
Activities**

**Bilateral
Activities**

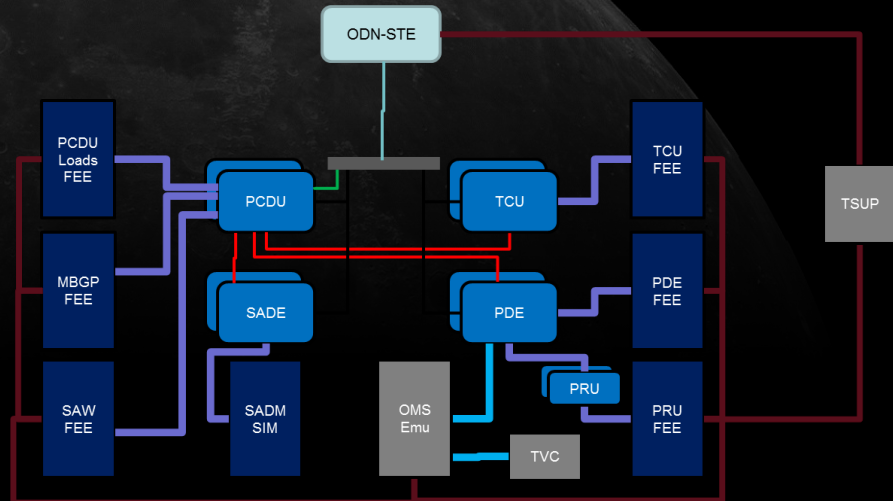
**NASA/LM
Verification
Activities**

MPCV High Fidelity Avionics Integration Labs



Integrated Test Lab Denver

ESM Qualification Facility Les Mureaux



PRIORITIZED ESM AVIONICS TEST PROGRAM IN THE ESM-QF



**Power & Solar
Generation
Functional Chain**

**Power & Solar
Generation
Functional Chain**

**Thermal & Crew
Consumables
Functional Chain**

**Thermal & Crew
Consumables
Functional Chain**

**Propulsion Functional
Chain**

**Propulsion Functional
Chain**

**Critical Testing for
Shipment**

**ESM Shipment
to KSC**

**Final
Verifications**

**EM-1
Launch**



ESM AVIONICS CONFIGURATION EVOLUTION IN THE ITL



**ESM-ITL
Acceptance**

**ESM-ITL
Standalone
Integration**

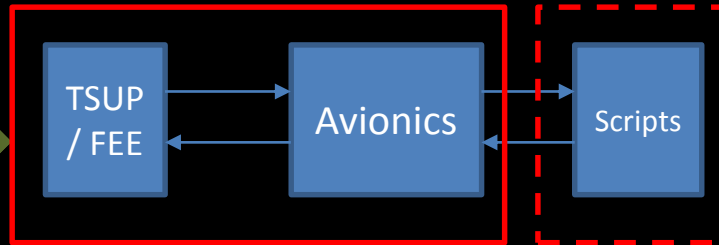
**ESM-ITL/Crew Module
Adapter Integration**

**Integrated Crew &
Service Module**

ESM AVIONICS CONFIGURATION EVOLUTION IN THE ITL



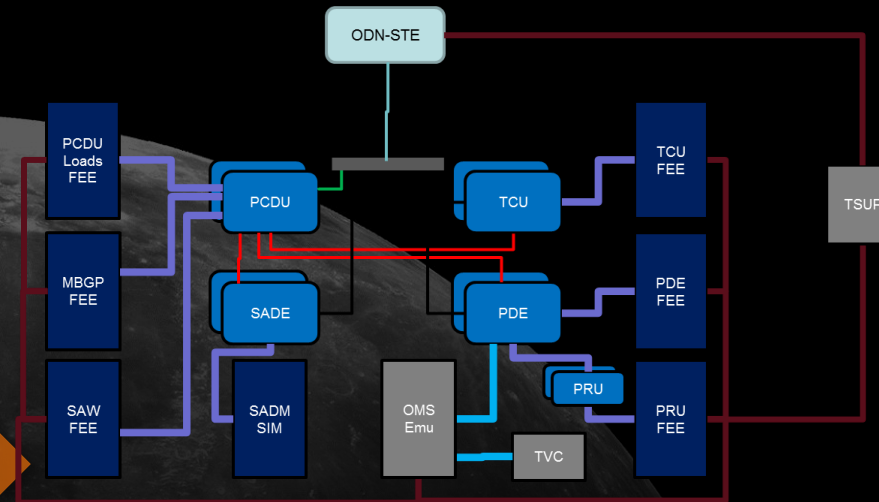
**ESM-ITL
Acceptance**



**ESM-ITL
Standalone
Integration**

**ESM-ITL/Crew Module
Adapter Integration**

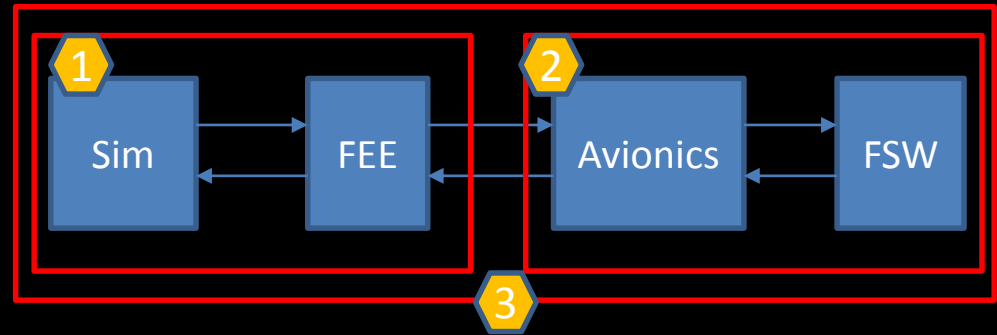
**Integrated Crew &
Service Module**



ESM AVIONICS CONFIGURATION EVOLUTION IN THE ITL



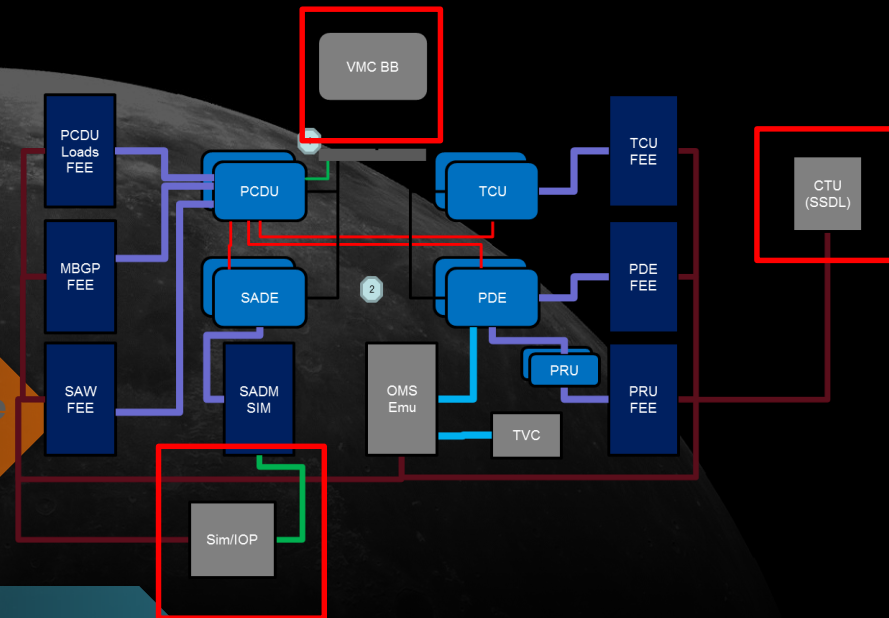
ESM-ITL
Acceptance



ESM-ITL
Standalone
Integration

ESM-ITL/Crew Module
Adapter Integration

Integrated Crew &
Service Module



ESM AVIONICS CONFIGURATION EVOLUTION IN THE ITL

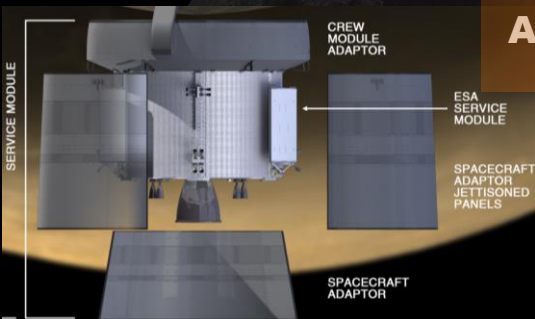
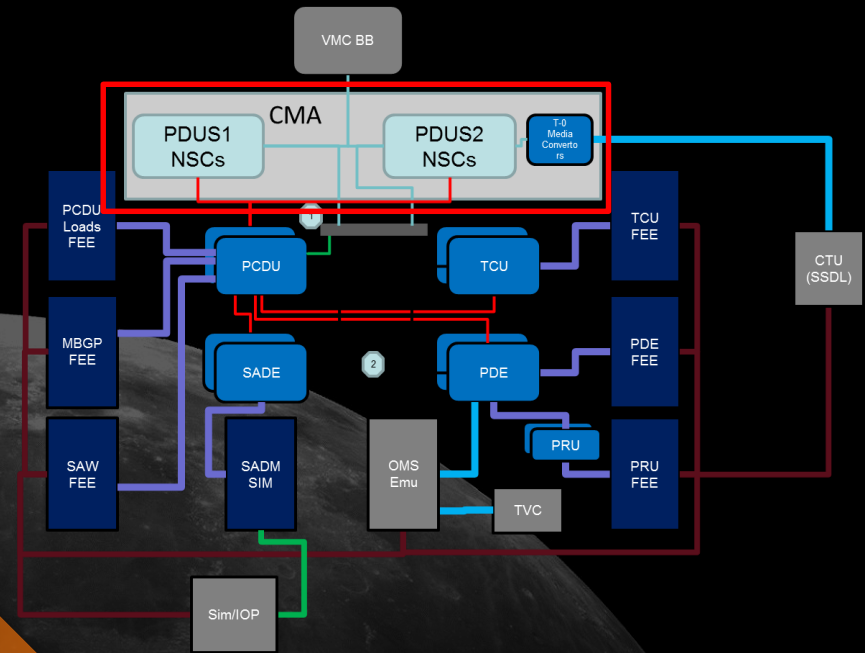


ESM-ITL
Acceptance

ESM-ITL
Standalone
Integration

ESM-ITL/Crew Module
Adaptor Integration

Integrated Crew &
Service Module



ESM AVIONICS CONFIGURATION EVOLUTION IN THE ITL

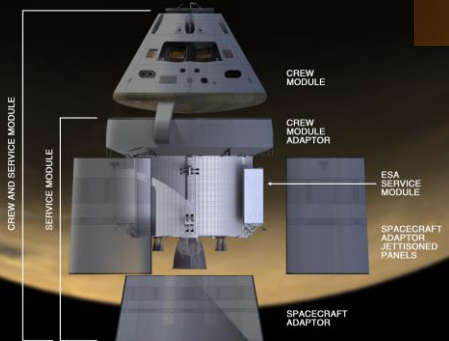
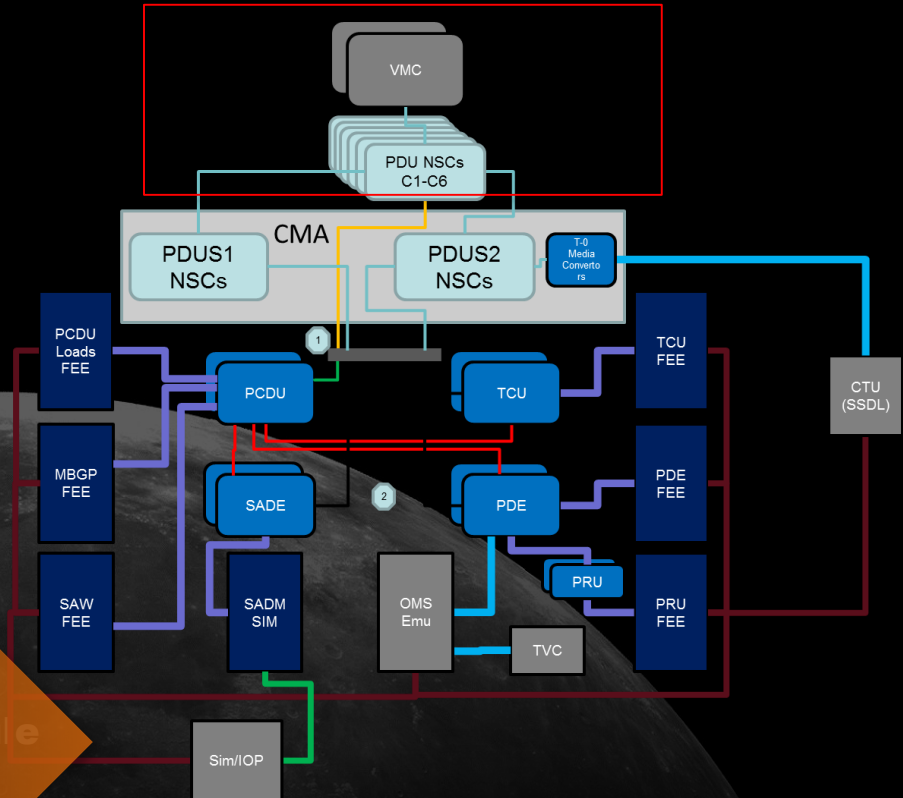


ESM-ITL
Acceptance

ESM-ITL
Standalone
Integration

ESM-ITL/Crew Module
Adapter Integration

Integrated Crew &
Service Module





EUVASS
CLEMESSY

MPCV

TCU FE

PH : 000

SW : 000

CI : CHMPC

Weight : 000

TIME TO FLY



CONNECT WITH US



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[*instagram.com/explorenasa*](https://instagram.com/explorenasa)

TO THE MOON AND BEYOND



EXPLORATION
MISSION - 1



EM1 CREW MODULE AT KSC

INITIAL POWERED UP CONFIGURATION



CREW MODULE ADAPTER

KENNEDY SPACE CENTER, FLORIDA



EUROPEAN SERVICE MODULE

BREMEN, GERMANY

