



NASA Advisory Committee

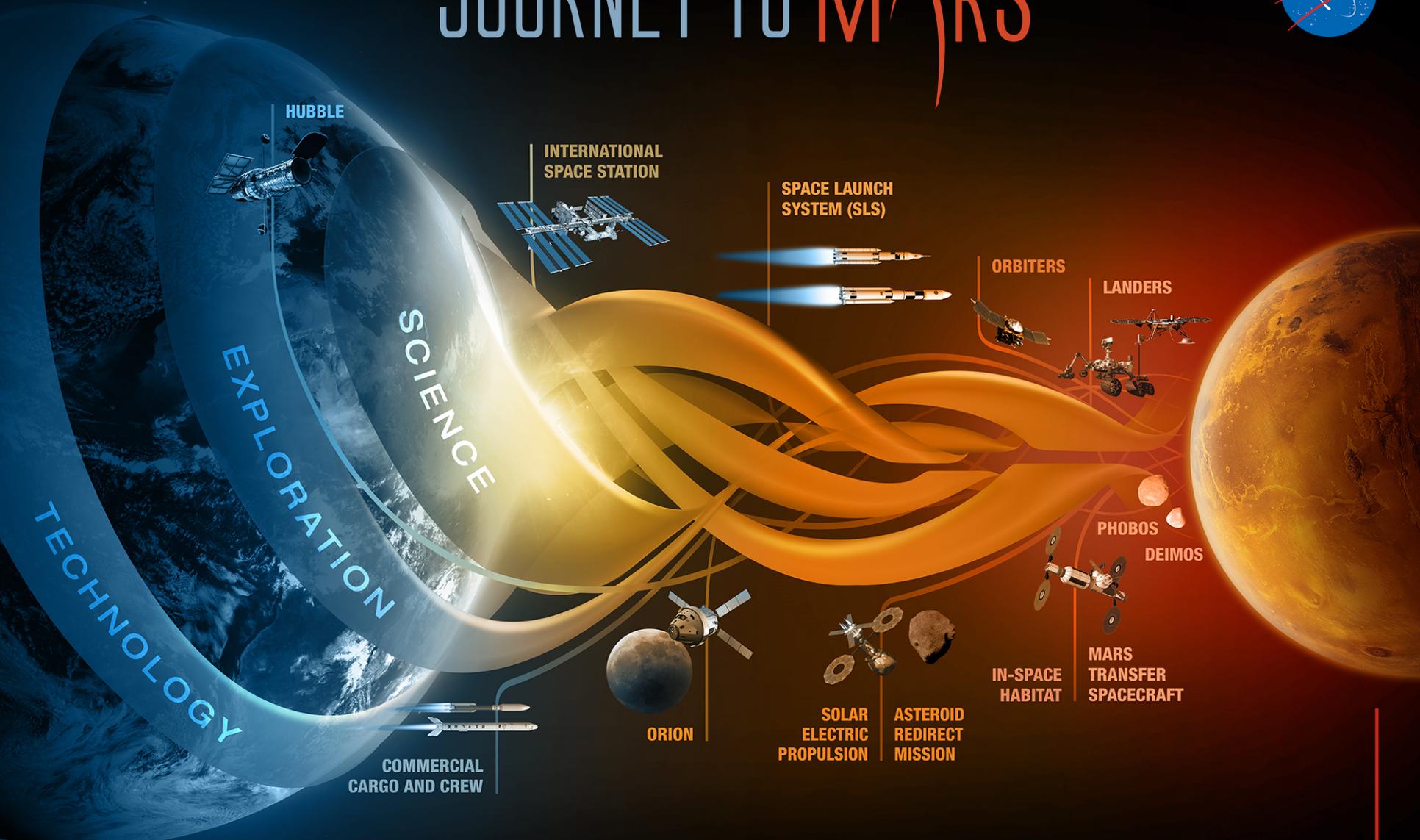
NASA Headquarters (HQ)

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April 7-8, 2015



JOURNEY TO MARS



HUBBLE

INTERNATIONAL SPACE STATION

SPACE LAUNCH SYSTEM (SLS)

ORBITERS

LANDERS

SCIENCE

EXPLORATION

TECHNOLOGY

PHOBOS
DEIMOS

MARS TRANSFER SPACECRAFT

IN-SPACE HABITAT

SOLAR ELECTRIC PROPULSION

ASTEROID REDIRECT MISSION

ORION

COMMERCIAL CARGO AND CREW

MISSIONS: 6-12 MONTHS
RETURN: HOURS

EARTH RELIANT

MISSIONS: 1 TO 12 MONTHS
RETURN: DAYS

PROVING GROUND

MISSIONS: 2 TO 3 YEARS
RETURN: MONTHS

EARTH INDEPENDENT

Installation of the International Docking Adapter (IDA) Cables



EVA-29 involved very intricate work with a large amount of delicate cable to provide power and data to the International Docking Adapters (IDAs).

Soyuz Launch and Docking



A Soyuz FG rocket launched the Soyuz TMA-16M spacecraft from the Baikonur Cosmodrome ahead of a successful docking with the International Space Station (ISS)

ISS One-Year Mission

- 2015 marks the launch of astronaut Scott Kelly and cosmonaut Mikhail Kornienko to the ISS for 12 months – the longest mission ever assigned to a US astronaut
 - Joint US/Russian ISS research includes studies on: ocular health, immune and cardiovascular systems, cognitive performance testing, and effectiveness of countermeasure against bone and muscle loss
- HRP study of identical twins astronaut Scott Kelly, and retired astronaut, Mark Kelly
 - Provides unprecedented opportunity to research effects of spaceflight on twin genetic makeup, and better understand the impacts of spaceflight on the human body



Scott Kelly
STS-103, STS-118, ISS 25/26

Kornienko



Retired astronaut Mark Kelly (left) and his twin brother, astronaut Scott Kelly, who will spend a year on ISS

<http://www.nasa.gov/exploration/humanresearch/index.html>

Commercial Crew Program Status



- NASA recently awarded Commercial Crew transportation Capability (CCtCap) contracts to two companies – Boeing and SpaceX.
 - Fixed price contracts with IDIQ components
 - Contract scope includes final development, certification, and initial ISS missions
 - Current schedules show development and certification complete by the end of 2017 for both companies, depending on budget and technical progress
- CCtCap was the second phase of a two-phased acquisition strategy. The first phase was the Certification Products Contracts (CPC).
 - \$10M contracts each to Boeing, Sierra Nevada, and SpaceX
 - Scope included submittal of specific, early development certification products and allowed NASA to provide technical feedback on the products
 - This feedback enabled our partners to make technical changes to better align their designs with NASA's requirements
 - Overall, this phase of the contract was critical to allowing the partners to understand the human rating requirements and NASA's understanding of how the partners' approaches intend to meet those requirements

Progress and Outlook



- Boeing and SpaceX have successfully completed their initial milestones, including the mandatory Certification Baseline Review, which baselined a plan for achieving certification of the commercial systems to transport crew and cargo to/from the ISS.
- These crew transportation systems are very complex and the development and test activity planned over the next three years will be extremely challenging.
- The FY 2016 President's Budget Request for CCP of \$1.2B supports the CCtCap contracts and keeps us on track toward the goal of returning human spaceflight launches to U.S. soil by the end of 2017.
- If NASA does not receive the full requested funding for CCtCap in FY 2016 and beyond, NASA will have to adjust (delay) milestones for both partners proportionally and extend sole reliance on Russia for crew access to the ISS. The partners may request contract cost adjustments and the certification dates will be delayed.

2015 – Major Milestones

NET Jan: RS-25 engine hot fire (SLS)

March: Orion EM-1 pathfinder 1st weld

March: QM-1 Booster fire (SLS)

March: Mobile Launcher structural modification complete

April: EM-1 heat shield design complete

June: Orion EM-1 pathfinder welds complete

July: SLS Critical Design Review

3rd Quarter: Orion EM-1 Parachute Drop Tests

August: SLS LVSA Structural Test Article (STA) Construction Complete

September: SLS LVSA /MSA/ICPS mated and on Test stand

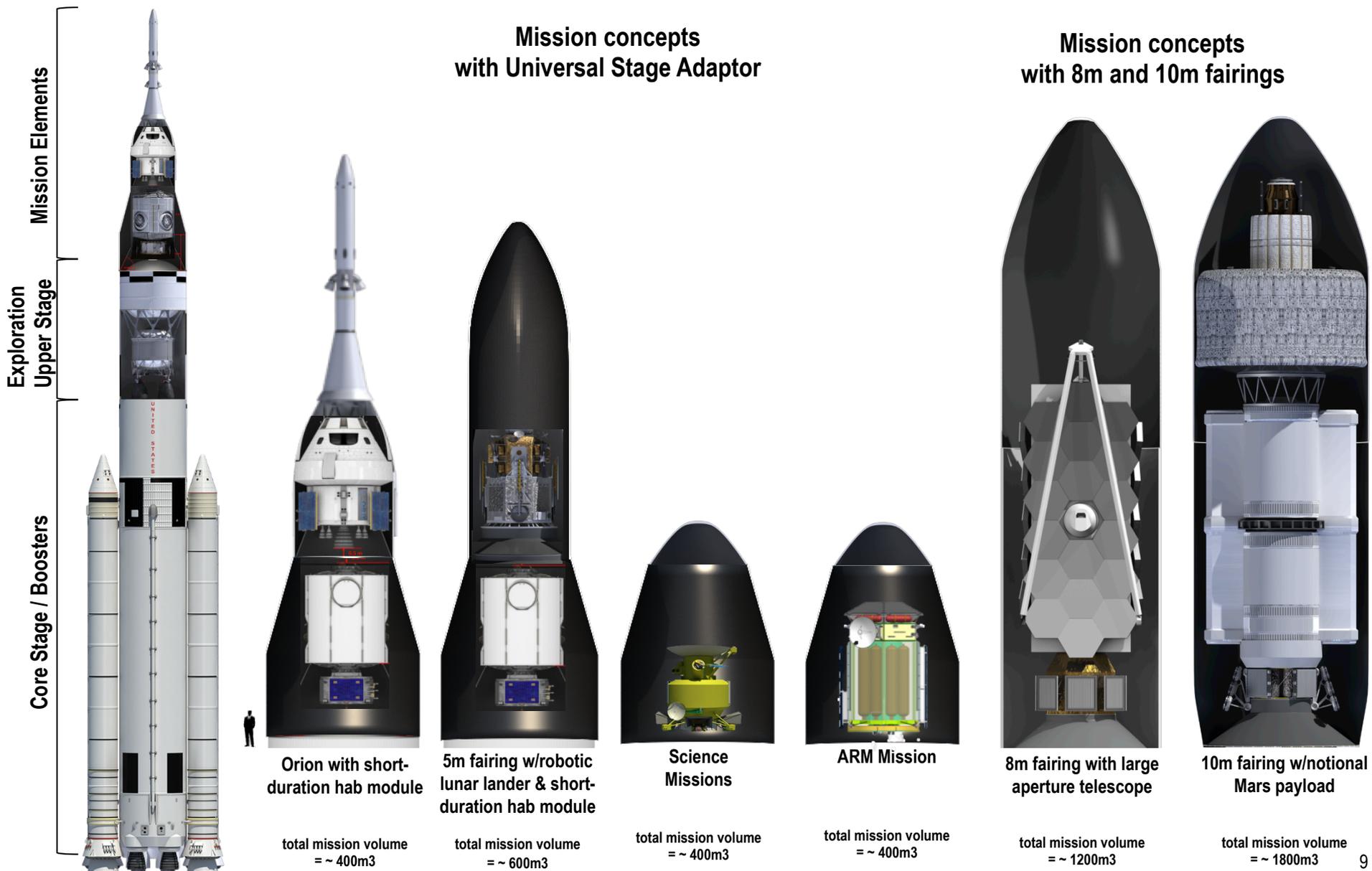
October: Orion Critical Design Review

October: SLS LO_x/H₂ STA's finished in VAC

November: Crawler Transporter-2 Life Extension Phase II complete

December: GSDO Critical Design Review

SLS Block 1B & Mission Element Concepts Under Study



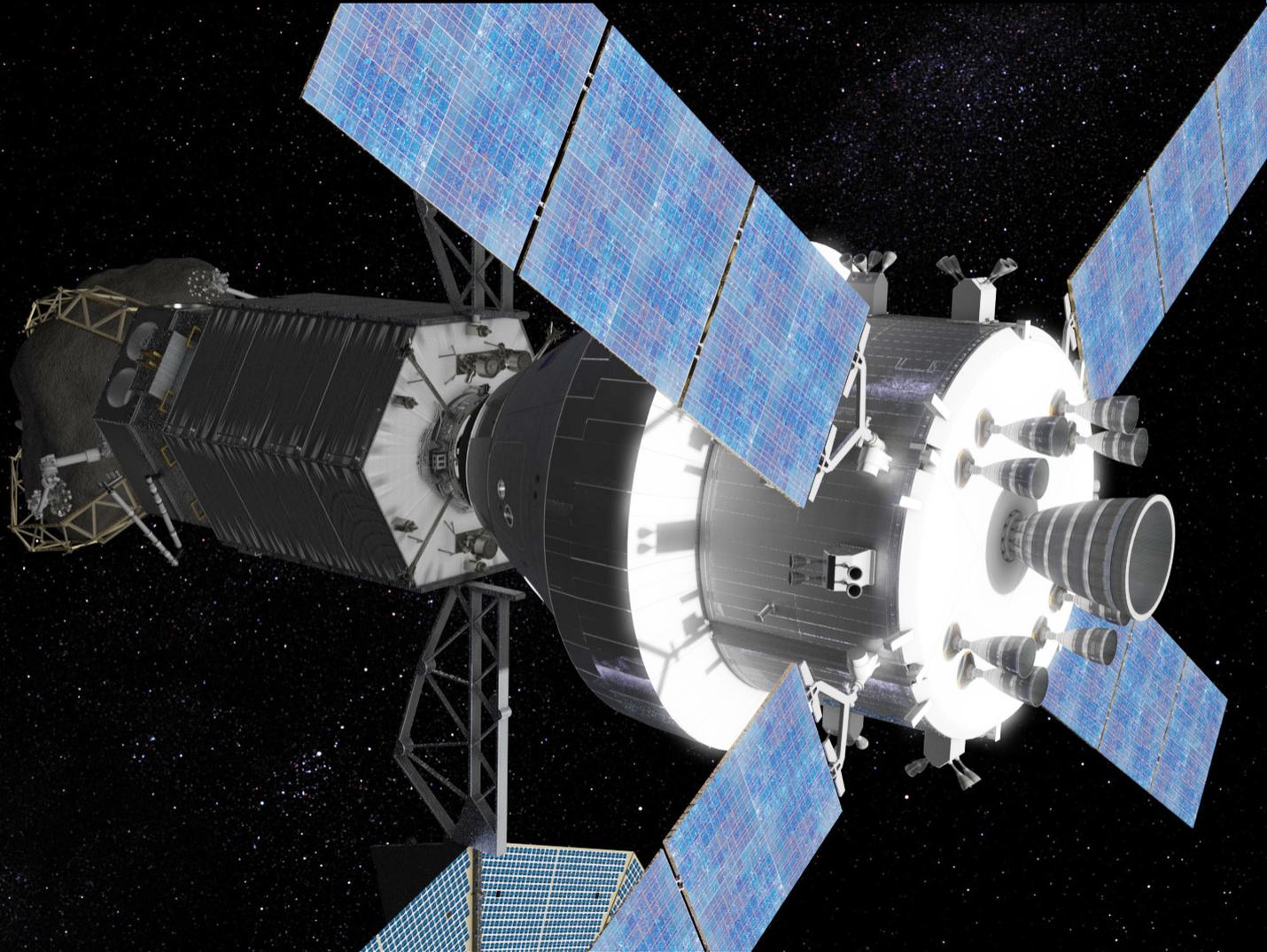
Qualification Motor-1



Asteroid Redirect Mission



Already, ARM has pointed us to the utility of both SEP and Distant Retrograde Orbits around the Moon for efficiently transporting large masses in space, e.g. from lunar orbit to Mars orbit.



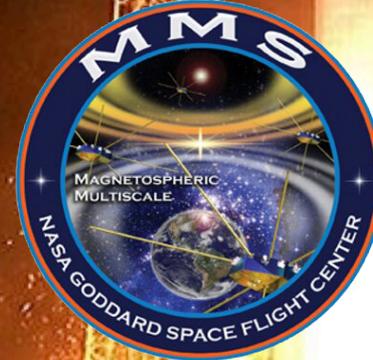
Asteroid Redirect Robotic Mission (ARRM)

Mission Concept Review (MCR)



- **Objective: Review and Decisions**
 - **MCR:** Evaluate the feasibility of the proposed mission concept(s) and its fulfillment of the program's needs and objectives. Determine whether the maturity of the concept and associated planning are sufficient to begin Phase A.
 - **For approval to enter Phase A/KDP-A:** Project addresses critical NASA need; Proposed mission concept(s) is feasible; and associated planning is sufficiently mature to begin Phase A, and the mission can likely be achieved as conceived.
- **Meeting product:** Decision memo including high level formulation authorization
- **Meeting forum:** March 24, 2014 via VITS
- **MCR Board:**
 - Chair: NASA Associate Administrator Robert Lightfoot
 - Members: Mission Directorate Associate Administrators
 - Office of the Chief Engineer
 - Office of Safety & Mission Assurance

Successful Launch of the SMAP and MMS



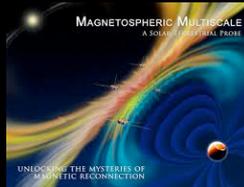
2015-2016 Launch Schedule



2015



SMAP
Soil Moisture Active
Passive
**Successfully
Launched!**
January 31, 2015



MMS
Magnetospheric
MultiScale
**Successfully
Launched!**
March 12, 2015



Jason-3
July 2015!

2016



INSIGHT
Interior Exploration
using Seismic
Investigations, Geodesy and
Heat Transport
March 2016!



GOES-R – Geostationary
Operational Environmental
Satellite
March 2016!



OSIRIS-Rex - Origins Spectral
Interpretation Resource
Identification Security Regolith
Explorer
September 2016!



CYGNSS - Cyclone
Global Navigation
Satellite System
October 2016



JPSS-1 – Joint Polar
Satellite System
November 2016!

Space Communication & Navigation (SCaN)



• Network Services

- Space Network (SN) provided communications and tracking services to MPCV until splash down on EFT-1; 100% data returned until spacecraft power down.
- Launch Communications System(LCS) will provide launch and early orbit communications and tracking services to SLS; successfully completed CDR in March.
- Space Network (SN) TDRS-L (F-12) satellite and Deep Space Network (DSN) DSS-35 34-meter Beam Waveguide antenna (Canberra, Australia) are now operational.
 - SN missions include ISS and HST
 - DSN missions include New Horizons, MAVEN, and MRO

• Spectrum

- Spectrum Management / WRC Preparation -- (WRC-15) 2-27 November, Geneva
 - Protection of NASA spectrum interests
 - Increase spectrum allocations for science
 - Remove regulatory restrictions for ISS visiting vehicles
- Continue spectrum strategy for commercial partners
- Conference Preparatory Meeting (CPM) 15-2: 23 March–2 April
 - Success on NASA interests

• Advanced Comm and Nav Systems

- NASA GSFC's Lunar Laser Communications Demonstration(LLCD) wins the National Space Club's 2015 Nelson P. Jackson Award for Aerospace Achievement
 - Due to LLCD's success, SMD is including a laser comm terminal demo on a deep space Discovery 2020 mission.
- Glenn Research Center's Space Communications and Navigation (SCaN) Test Bed on the ISS demonstrated a software-defined radio (SDR) that was reprogrammed to have 5x more bandwidth than it was launched with (now 575 Megabits per second).
- NASA JPL and Boeing have demonstrated laser communications from the OPALS experiment on the ISS using adaptive optics on a ground telescope to correct for the distortion of the atmosphere, which could open up bandwidths over 100 Gigabits per second.



Pioneering Space



“Fifty years after the creation of NASA, our goal is no longer just a destination to reach. Our goal is the capacity for people to work and learn and operate and live safely beyond the Earth for extended periods of time, ultimately in ways that are more sustainable and even indefinite. And in fulfilling this task, we will not only extend humanity’s reach in space -- we will strengthen America’s leadership here on Earth.”

- President Obama, April 2010



