



Mars Exploration Program Update

Jim Watzin

Director Mars Exploration Program

NASA

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Current Status of the MEP

Our operational assets remain healthy and productive:

- All six Mars missions did well in Senior Review and are going forward in extended missions
- Odyssey continues imaging in sunrise-sunset orbit
- MRO continues to provide reconnaissance imaging and mineralogical mapping
- Opportunity has left Marathon Valley
- Curiosity heading up Mt Sharp, soon to exit the Murray formation
- Mars Express continues

M2020 development on-track and proceeding well:

- Start Phase C June 27, 2016
- Heritage H/W fabrication underway; some delivered
- Sampling system development labs up and running

Foreign partnerships continue to be integral to the success of our program:

- Two NASA Electra payloads on TGO and on the way to Mars
- Prepared to support TGO MOI and EDM landing activities (Oct 19)
- MOMA is proceeding in development, supporting ExoMars delay to 2020
- Strong international interest in participating in potential future MEP activities

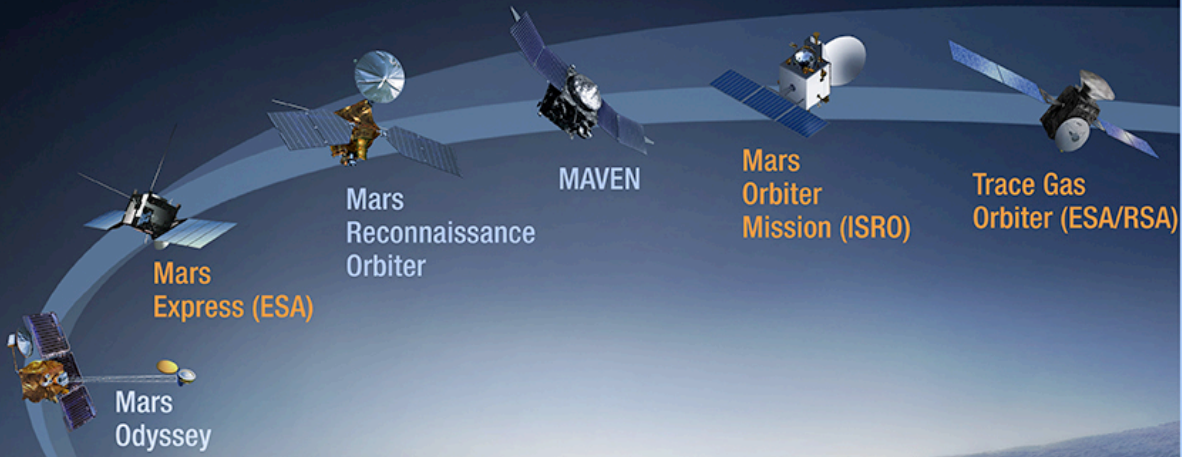
No missions beyond M2020 have been budgeted or approved:

Operational 2001–2016

2018

2020

2020s



Planning for the Future



Ongoing studies

Follow the Water

Explore Habitability

Seek Signs of Life

Prepare for Future Human Explorers

MEP Future Planning Tenets

Address Decadal science priority for Mars Sample Return

Provide for continuity of operations at Mars

- Communications
- Reconnaissance

Provide support for the Journey to Mars

- Potential landing site studies
- Identification & characterization of resources
- Sample assessment

Engage in meaningful partnerships

MEP as *precursor* for J2M

Experience with operational infrastructure at Mars

- Communications
- Reconnaissance
- Remote ground operations

Knowledge of Mars geology, geography, and habitability

- Potential landing site studies
- Identification & characterization of resources
- Sample assessment

Potential for Mars roundtrip experience

- Decadal priority for Mars Sample Return

Evolved international and domestic partnerships

JOURNEY TO MARS



All elements needed for a human Mars mission are in development now.



EARTH RELIANT

NOW - MID-2020s

- International Space Station operation through 2024
 - Commercial development of low-Earth orbit
- Development of deep space systems, life support, and human health

PROVING GROUND

2018 - 2030

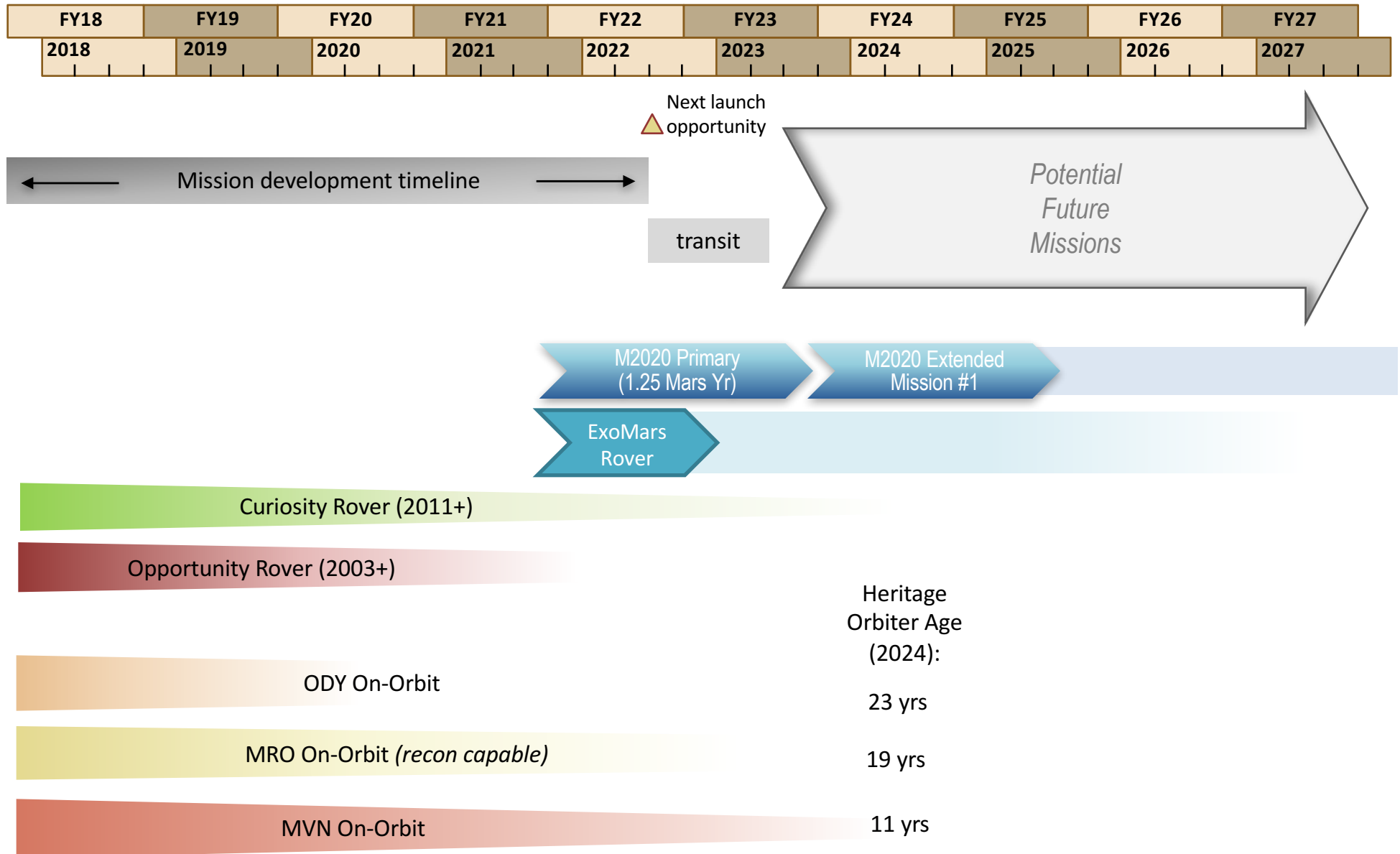
- Regular crewed missions and spacewalks in cislunar space
- Verify deep space habitation and conduct a yearlong mission to validate readiness for Mars
- Demonstrate integrated human and robotic operations by redirecting and sampling an asteroid boulder

EARTH INDEPENDENT

NOW - 2030s & BEYOND

- Science missions pave the way to Mars
 - Demonstrate entry, descent, and landing and in-situ resource use
- Conduct robotic roundtrip demonstration with sample return in the late 2020s
- Send humans to orbit Mars in the early 2030s

Evolution of MEP Capabilities at Mars



Future Orbiter Pre-Formulation

- Conducted an RFI (July 2014) to survey for new business models for providing telecommunication relay services [NASA buys service from commercial provider]
 - All required some combination of NASA funding for launch, an early deposit, and a guaranteed subscription/lease arrangement to recoup cost and ensure a reasonable ROI
- Reviewed recent Discovery-class orbiter analogs that demonstrated affordability
 - MAVEN
 - Osiris-Rex
- Completing (Jun-Oct 2016) multiple (5) industry studies exploring high TRL heritage system approaches
 - Industry capabilities, heritage designs, and strategic interests are well suited to meeting Orbiter needs



Conclusion

Mars missions are accomplishing great science

MEP mission & instrument developments are on-track

Future planning has begun for continued robotic exploration at Mars, with an orbiter as the logical next step

- Bolster an aging infrastructure
- Needed to support continued surface exploration
- Would require minimal development
- Industry studies are underway (~October 2016)

Continued robotic exploration of Mars is an important enabler for US leadership in exploration

