

HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)  
Human Exploration of Mars (2)

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## A PROPOSED ARCHITECTURE TO ESTABLISH A PERMANENT HUMAN PRESENCE ON MARS

**Abstract**

Like during the 1960s for the Apollo Program, an inspiring and an audacious goal—Unified Space Vision—is needed for space exploration to establish a permanent human presence on Mars. The proposed architecture establishes pathways of progressive missions to cis-lunar space, asteroids, Phobos, and eventually to the surface of Mars.

Missions begin 2018 launching 1st generation inflatable exploration modules (XM1), Bigelow BA330s, which are flown to Low-Earth Orbit, and to cis-lunar space (L1, L2). Orion's crew including several scientists supported by BA330 reaches an asteroid in 2026 simultaneously with a low thrust exploratory robot for 60 days; Earth return totals one year. Flights then test rigid XM2 exploration modules at manned lunar stations, remotely assembling and connecting the international lunar bases, and initiate tele-robotics for in-situ resources, asteroid exploration and sample extraction. Once lunar far-side and nearside bases have been assembled and vital experience gained, beginning in 2028 (before first humans to Mars) and by 2034—nine unoccupied 3rd generation exploration modules (XM3) would be launched to Mars and two habs to Phobos.

One unique innovation of the mission architecture is to use “cyclers” spacecraft that would travel between Earth and Mars perpetually, every two synodic periods in S1L1 cycler orbits. The two cyclers, outbound and inbound separated by synodic periods are identical and at a first outbound Earth encounter, three landers intercept the cycler via hyperbolic rendezvous. The outbound cycler carries three landers with three crew members. One unmanned lander lands on Mars demonstrating Mars landing procedures; and two landers land on Phobos with three crew members. The Phobos crew will remotely connect nine XM3s confirming interconnects using techniques developed for the assembling of both lunar bases. The outbound cycler returns in 4.135 years to receive three landers with a total of nine crew members. One lander with three crew members replaces the original three crew members on Phobos, the remaining two landers directly land on Mars with six crew members. At this point there are 18 crew members on the surface of Mars with four landers, and the first permanent settlement on Mars is established.

The proposed architecture is “evolvable” which could be readily updated and adapted to new technologies and concepts. The unified space vision is a viable plan for humanity's next bold step between our home planet and Mars, eventually to secure our future second home!