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## A MARS 2033 HUMAN FLYBY

**Abstract**

Once every 15 years, Earth and Mars experience a very close opposition while Mars is near perihelion. This offers a unique opportunity for a low energy transfer between the two planets, minimizing the amount of fuel and mass needed to make the journey. The next such opportunity is in 2033. Taking advantage of this opportunity would demonstrate the capability for humans to travel to Mars and return safely at a relatively low cost. Sending astronauts to Mars is within our technological grasp and has been imagined since before our space program began.

Boeing continues to study how to accomplish this historic mission by using currently planned capabilities, architectures, and systems to minimize cost and new development. Numerous scenarios were conceived and evaluated to develop a wide range of possible elements combinations, aggregation points, and trajectories. This paper discusses the results of these efforts. The elements needed and the different scenarios are reviewed and the challenges and benefits of an early flyby mission to Mars are discussed. How the flyby mission will interact with current lunar planning is also examined.

A flyby mission will provide the first human close encounter of Mars and is achievable starting now. By exercising the full potential of SLS and Orion, taking advantage of commercial systems, and building on the systems testing and human research accomplished on ISS, a flyby mission will prove human courage and perseverance in the deep space environment, focus technology development to take the next steps of orbiting and landing on Mars, and create unparalleled interest in human space exploration and education.