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High Science Value Return of Small Spacecraft at Mars

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In the coming decade, small spacecraft missions, both orbiters and landers, can provide decadal-class science capability, augment flagship missions, establish dedicated Mars infrastructure, and gather key reconnaissance in preparation for human exploration of Mars, at mission costs of a fraction of current Discovery Program cost caps. The paradigm shift in capability cost is enabled by many factors, including order-of-magnitude reduction in cost to emerging launch enabled by rideshare and small launch vehicles, new advances in propulsive and aero-braking technologies, existence and development of small spacecraft compatible science instruments capable of high precision measurement required for decadal-class science, the proliferation of commercial development and use of small spacecraft technology, and new policies and programmatic frameworks to enable a future small spacecraft program. The small spacecraft community has matured and has developed high-TRL components that are a fraction of the mass and cost of larger conventional flight systems. The opportunity for low-cost, frequent access to Mars is optimal and will only become greater over the next decade.

This white paper will focus on five key areas: science, implementation, technology, applications, and policy; with the primary focus on science. Small spacecraft can play an integral role in being pathfinders for future large-scale missions and campaigns, and encourage collaboration from partners in academia and other institutions around the world. They provide a mechanism for entry of new participants to learn and eventually lead in their own missions for interplanetary exploration. Small spacecraft present a unique opportunity to take continuous and simultaneous measurements of high-temporal planetary processes when used as a multi-element network. These networks could consist of orbiters from different viewing perspectives and/or small landers as single elements or networks of landers working in concert to provide multi-dimensional science return. Small spacecraft provide tremendous science value because of their low-cost basis and high-value measurement capability.