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NanoSpacecraft as deployable secondary payloads for science enhancements and technology demonstrations on planetary missions

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Following in the tracks of its first deep space CubeSats INSPIRE and MarCO, JPL has been building a portfolio of mother-daughtership architectures for planetary exploration. Building on the CubeSat form factor and subsystems, these concepts were primarily devised as vectors of infusion in planetary environments of new technologies developed under NASA and JPL sponsorship. However, the resulting concepts also enable powerful science enhancement to larger missions, in the form of secondary, deployable payloads "piggybacking" on larger spacecraft. The advantages of deployable nano-spacecraft working in concert with a host mission include the ability to perform investigations inaccessible to larger spacecraft (prohibited by risk posture or physical constraints), as well as providing opportunities for distributed or complementary measurements and fractionated payloads.

The proposed applications introduce relay telecommunication architectures, autonomous navigation and operations, miniaturized instrumentation, and software for on-board processing of science data. The proposed concepts are diverse and include short-lived free-flyers, CubeSats flying in coordination, landers/penetrators, and two long-lived CubeSats continuing independent missions after release from their host spacecraft. We describe the unique challenges and design philosophy for developing these concepts and commonalities between the designs. Many of the common spacecraft bus elements are inherited from JPL interplanetary CubeSat missions that are ready for flight (INSPIRE) or are under development (Lunar Flashlight, NEA Scout, and MarCO).

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