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Integrated Utility Module for Future
NASA Miniature Spacecraft

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Future NASA space programs are going to consist of many small and inexpensive spacecraft. The goal is to design and fly operational miniature spacecraft that range in size down to 5 kg in mass, 1 liter in volume, and 5 watt power consumption that are autonomous and require minimum ground support during its operation. Many recent advances in technologies such as micro-instruments, micro-electronic mechanical systems, smart actuators/sensors, miniaturized electronics provide the opportunities to achieve these goals. The traditional approach of independently designing, fabricating and assembling the structure, thermal system, cabling, interconnects, and environmental protection subsystem cannot be utilized to integrate the spacecraft. In addition, the currently approach is not scalable to future spacecraft needs. At least an order of magnitude improvement is required.

One proposed approach is to develop an integrated utility module. Utility is redefined to include electrical, power, load carrying capability, geometry control, optics, and many other spacecraft functions necessary to integrate the various subsystems. The objective is to utilize the ideas of integrated circuitry to develop multipurpose miniaturized utility modules that are used as the building blocks for many miniature spacecraft. Thus the development cost are amortized over many spacecraft applications and are available "off-the-shelf" for rapid insertion into short schedule programs. The utility module will then be integrated through appropriate interconnects with the other similar modules to form the spacecraft. Interconnects are broadly defined as mechanical, thermal, electrical, and optical connections and distribution. The attached figure shows an example integrated utility module concept.

The paper will develop the initial rationale and the requirements for the integrated utility module. The technology challenges will be identified and addressed. Recent applicable technology developments and new technology required for achieving the desired goal will be described.

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