An Evolutionary Approach to Small Satellite Technology Development
A Status Report on SSTL Platforms, Payload and Missions

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Between 1989 and 1995, 10 microsatellites were constructed using SSTL's 50 kg modular microsatellite design. Eight are presently in orbit, while two are scheduled for launches during summer 1995. Each satellite has incorporated design enhancements, which can be grouped roughly into six distinct design generations. This rapid design and test cycle, combined with in-orbit operational experience, has fostered rapid advancement of technology within the basic modular design.

When measured between the two extremes, the technological advance is startling. UoSAT-3 (launched 1990) contained three on-board computers and just over four megabytes of solid-state data storage. FaSAT-Alfa (to be launch 1995) contains 21 on-board computers and greater than 260 megabytes of solid-state data storage. Attitude determination sensors have expanded to incorporate star mappers and sun sensors and horizon sensors in addition to the three-axis magnetometer. Earth imaging cameras have gone from 2-kilometro resolution to 100-metre resolution in four generations.

This technological change has been rapid but incremental. By using items with flight heritage in redundant configurations with new items, confidence is maintained without thwarting advancement. Operational impacts are equally important: the safety of the spacecraft and the execution of basic mission functions depend upon proven operational techniques. New techniques are used experimentally to build operational experience. For example, FaSAT-Alfa carries a reaction wheel for yaw control, but the satellite will still be essentially gravity-gradient stabilized. If an experimental bus subsystem succeeds, it enhances the mission, if not, the mission is not lost.

A similar mixture of aggressive advance mixed with conservative system design is being applied to SSTL's new 300 kg multi-purpose minisatellite. SSTL's first minisatellite (slated for a 1996 launch) will re-use some microsatellite subsystems and concepts, while pushing forward where required. Power generation, attitude control, and orbit-control systems all require redial advances from the present microsatellite. On-board data handling communications and telemetry and telecommand subsystems can serve the larger bus without radical changes.

This paper reviews SSTL's microsatellite and minisatellite systems, using them to illustrate how small satellites built on rapid timescales permit the safe deployment of new technology. It emphasizes the advantages of making incremental rather then revolutionary changes in operational complexity from mission to mission.