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DESIGN AND DEVELOPMENT OF A MODULAR AVIONICS SUITE FOR A UK MICRO-LAUNCHER.

Abstract

Orbex, a private company based in Scotland, UK, is developing a micro-launcher with a payload capacity of approximately 150 kg to Low Earth Orbit. Amongst other subsystems, Orbex is developing its own avionics suite. The avionics suite of a launch vehicle interacts with almost every other subsystem, including structures, propulsion, guidance, and software. Therefore, it is expected that requirements input comes from all these departments, too. However, due to an early need for avionics support to various ground test setups, the Orbex Prime avionics were one of the first formal areas of development in the company. This necessitated a development path which was more bottom-up evolution, than top-down design. Three important early design decisions made this unusual (within traditional aerospace) development process successful.

Firstly, the onboard computers were designed to be modular, with reusable processor and input/output cards. As the requirements for new capabilities became apparent, new avionics units could be developed with reduced hardware development overhead, and with extensive embedded software reuse. As an example, the same processor card exists within the power distribution system, flight computer, and engine control unit.

Secondly, the avionics architecture was designed to be distributed, with Ethernet as the primary communications interface. Additional I/O capacity, or processing power, can be added to the avionics architecture simply by adding more existing units to the network. As an example, every engine contains its own Engine Control Unit, which electrically interfaces the engine to the rest of the avionics using only power and Ethernet connections.

Finally, an early decision was made to reuse the launch vehicle avionics designs for ground support equipment. Since the earliest days of propulsion testing at Orbex, versions of the launch vehicle avionics have been controlling valves and collecting data in test stands. This was not only budget-friendly, but also gave early insight into what would be required from the avionics to operate a launch vehicle.

The avionics design, manufacture and testing process is reaching its final phase, as the first flight hardware is expected to be completed in mid-2024. This paper describes the process of going from concept, to working prototype, to qualification and flight hardware, in the absence of initial, comprehensive requirements. Practical lessons learned and the remaining steps to a historical first launch from UK mainland, are also covered.