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APPSAT: A CASE STUDY IN SOFTWARE DEFINED MICROSATELLITE DESIGN BASED ON CONSUMER ELECTRONICS DEVELOPMENT EXPERIENCE

Abstract

Unlike conventional satellite design, software design is the vital part in the software-defined satellites. Using the standardized hardware platform with different software implementations enables the design of a microsatellite with less duration, lower cost, and more functions. Much similar development experience has been accumulated in the consumer electronics industry such as developing on mobile phones. For example, developing a new function on majority of Android phones in the market has focused on App development but has litter work in hardware design. Learning from this concept, this paper proposes a case-specific study in the development of a software defined satellite.

Following this concept, this paper firstly describes the correlations between the hardware and software development on the microsatellite. Compared with the phone, a standardized hardware platform, namely integrated electronic system, is introduced to play the same role. With the support of the proposed hardware, this concept allows on-board subsystems flexibly defined by the software loaded on it. Additionally, in order to design the software like designing Apps, this paper introduces a five-layer software framework, from top to bottom of which is: waveform application components, framework structure components, COBRA middleware, operating system and hardware drivers. In this framework, designing microsatellites can use the same waveform application components to achieve the required functions. The waveform application components can pass the frame interface and COBRA middleware, access the application environment description, and call hardware resources through the operating system. The operating system provides basic management services and resources, establishes a connection with the application environment description and the bottom hardware device driver.

Based on this concept, on-board software development mainly includes two parts: framework setup and application software development. Framework setup provides a standard operating environment, allowing developing application software components under the relevant rules of the framework. The framework ensure that different application software can work together in coordination. The application software is responsible for the realization of the system functions. The functional software of the satellite is packaged and object-oriented the same as the App development on the phone. Meanwhile, this method is used for analysis and design with good reusability. When a functional needs to be upgraded, only the specific part needs to be modified locally the same as the App update on the phone. Therefore, more than 90% of the software development can be transplanted and reused, which greatly improves the capacity

building of future microsatellite space missions.