Using µC & SW in Digital Control for Space Power Management Devices

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Digital Power Control, i.e. the management of power devices via digital rather than analog techniques, has been steadily gaining in market share in the industrial domain on ground for the past 5 years. Its application to on-board power management systems faces several challenges, foremost that of dependability in the Space radiation environment, which precludes the use of existing controller and regulation components.

Starting from existing components of the shelf from the industrial market, the presentation describes what are most important changes required for Space applications as a result of an ongoing feasibility work conducted at Thales Alenia Space in Belgium.

A µC core and peripherals have been identified as key element in the solution. The presentation will walk through the requirements for interfaces, processing speed, memory, power consumption, radiation protection mechanisms, software hardening support, …

An important aspect to cover is the software development from both the development tools point of view and the development process point of view. We have received multiple warnings about software development cost (e.g. to be expressed in hours of working time per line of code) especially as when the application reaches the "mission critical" level which is frequently the case for power supplies.

µC software usually target simple systems and doesn't require an operating system. The µC operation resumes to a simple (hence fully predictible) sequencer of math & IO operations & the management of a simple state machine of an equipment.

The tailoring of the ECSS Q40 & E80 applicable for software developments doesn't significantly reduce the amount of document and specially the overhead of document review process, although the document size itself could be very small. Hence the effort to spend is still large.

Modeling tools exist to capture the software behavior description and from there automatic document & code generation + verification take place without extensive human work. Tools like Scade widely used in aeronautics could offer such functionalities if they would be extended to ECSS.

However, for small µC software sizes in the order of 1kLOC, we wonder about the ROI of such a tool. Indeed the learning curve of such development suite is large and furthermore the tool doesn't provide large value in the IO management which is the key work expected from a µC.

As a consequence, µC software development is penalized (in term of development efforts) as compared to VHDL development in a FPGA.