Using XAP processors in Space Applications

XAPs are 16-bit processor cores developed by Cambridge Consultants that have been sold since 1995. There are over one billion XAPs in silicon. They are optimised for low power, small silicon area and easy verification. They have been used in high-reliability applications such as in-body medical products.

The latest XAPs are XAP4 (12k gates, 64kB memory) and XAP5 (18k gates, 16MB memory). They are modern RISC processors with a Von Neumann memory architecture. They have powerful user and privileged modes and achieve very high code density. The GNU software tools include compilers for C and Ada. The verification and debug tools are world class, exploiting XAP's patented non-invasive debug interface. The published API also enables users to control and test the hardware target from a PC with their own applications in C++, C, Matlab or Python .

It is easy to include one or more XAPs in radiation-hard ASICs or FPGAs for space applications. The Verilog RTL can even be synthesised to limited logic libraries. XAPs can be used as the main processor or as a peripheral processor for house-keeping functions such as power and temperature management. A XAP is ideal for an ultra low power radiation-hard general purpose microcontroller.

The customisable Memory Management Unit and Interrupt Vector Controller provide access to all the signals needed to make a high reliability interface. The user can customise them to provide the error-detection and error-correction schemes that they want for their space application. The customisable MMU can generate an exception for any detected memory condition, which causes an exception handler to be called that can perform the desired action.

This paper provides examples of how XAP processor cores can be used in ASICs and FPGAs to create high-reliability space systems. It focuses on the hardware and software techniques that a XAP can support to maximise the reliability and fault-tolerance of electronic systems for space.