

## ABSTRACT

In this thesis, maintenance consideration for long life cycle embedded system is presented. Various issues can bring trouble for maintaining a long life cycle embedded system, such as component obsolescence and IP (intellectual property) portability.

For products like automotive, avionics, military application etc., the desired life cycles for these systems are many times longer than the obsolescence cycle for the electronic components used in the systems. The maintainability of long life cycle embedded systems for different design technologies is analyzed. FPGA platform solutions are proposed in order to ease the system maintenance. Different platform cases are evaluated by analyzing the essence of each case and the consequences of different risk scenarios during system maintenance. It shows that FPGA platform with vendor and device independent soft IP has the highest maintainability.

A mathematic model of obsolescence management for long life cycle embedded system maintenance is presented. This model can estimate minimized management costs for different system architecture, which consists of two parts. First part is to generate a graph in Matlab which is in the form of state transfer diagram. A segments table is then output from Matlab for further optimization. Second part is to find the lowest cost in state transfer diagram which can be viewed as a transshipment problem. Linear programming (LP) is used to calculate the minimized management cost and schedule, which is solved by Lingo. A simple Controller Area Network (CAN) controller system case study is shown to apply this model. The system contains a microcontroller and a CAN controller which is used in the industrial construction machinery. The model is validated by a set of synthetic and experimentally selected values. A minimized management cost and an optimized management time schedule are given as the result. Test experiments of maintenance cost responding to interest rate and unit cost are implemented. The responses from the experiments meet our expectation.

The reuse of predefined IP can shorten development times and help the designer to meet time-to-market requirements. System migration between devices is unavoidable, especially when it has a long life cycle expectation, so IP portability becomes an important issue for system maintenance. An M-JPEG decoder case study is presented in the thesis. The lack of any clear separation between computation and communication is shown to limit the IP's portability with respect to different communication interfaces. A methodology is proposed to ease the interface modification and interface reuse, thus to increase the portability of an IP. Technology and tool dependent firmware IP components are also shown to limit the IP portability with respect to development tools and FPGA vendors.