RE-DESIGNING OBSOLETE ICs – CAN THIS BE A COST EFFECTIVE OPTION?

Martin J Rutter
Swindon Silicon Systems Ltd
Radnor Street, Swindon SN1 3PR UK
Tel: 44 1793 649400
Fax: 44 1793 616215
mjr@sssl.co.uk

Abstract

Solutions to obsolescence issues caused by IC manufacturers withdrawing components can always be found. However, the cost of these solutions quite often are not commercially viable for many military (and industrial) projects.

Strategies for obsolescence prevention are key to managing costs and other papers deal with this topic. For the many existing legacy systems in deployment, obsolescence planning turns into "fire-fighting" of day to day problems. Global searches for parts held by distributors, last time buys, wafer banking, up-screening of lower grade parts, etc. are options that are usually explored when the inevitable problems arise.

Re-designing and creating a plug-in replacement part is very often seen as a last resort because of cost, timescale and technical feasibility issues. This paper looks at a number of innovative approaches to produce cost effective replacement parts that guarantee supply over the lifetime of military projects.

A number of solutions to real obsolescence problems are examined with the focus on commercial issues. Actual costs will be shown that demonstrate "win win" solutions for both user and supplier.

Introduction

Those involved in Military and Space projects have an ever increasing concern over device obsolescence and these issues have been well documented. In each instance of obsolescence, there are usually a number of technical solutions but one underlying reason why the problem occurred and why it is difficult to fix – cost.

The cost issue that causes obsolescence can be on both sides of the customer/supplier relationship. Suppliers withdraw devices from the market when insufficient returns can be earned and this will always be the case. Customers all to frequently put too little resource into obsolescence avoidance at the outset of the project and pay heavily for this mistake through the project life.

From the project stand point, managing obsolescence is therefore key and different strategies are required for inherited legacy problems compared to new programmes. This paper concentrates on legacy issues but first briefly looks at some commercial considerations for new programmes.

Commercial Issues - New Programmes

To perform a particular electronic system function, a number of design routes using different classes of semiconductors can often be considered, e.g. standard part, ASIC, FPGA, etc. The final choice of components should balance the technical performance, design cost and lifetime cost with the obsolescence risk correctly costed. In the ideal situation, the design can be totally described in a high level architectural language so that the design can be hardware transparent and ported to the available technology of the time.

This idealised approach works well for digital design but is more difficult to apply to aspects of analogue and mixed mode design. Therefore, many designs cannot be totally hardware transparent and component selection is still critical.

In these cases, one approach to minimise the obsolescence risk is to carefully select the type of supplier rather than just the semiconductor type. As stated in the introduction, devices are made obsolete for commercial reasons but different types of suppliers have different business models. Major semiconductor manufacturers are focused on fast moving consumer products because of the high volumes required to sustain cutting edge technologies. The typical product life of a device from a major semiconductor manufacturer is now 1 to 2 years and the trend is downwards. Designing these types of devices into a military project is a certain way of creating long term obsolescence problem and potential system re-designs.

As an alternative for long running military programmes, a full custom design from a fabless semiconductor supplier gives a very efficient design solution and excellent protection against device obsolescence. It is in the commercial interests of the fabless supplier to supply the devices for as long as possible, even in relatively low volumes, because they will want to maximise their revenue from each design.

The fabless supplier business model does not have to fully load a foundry. However, they have to have sufficient total business to get the attention and service from a foundry. Smaller design houses may find it more difficult to deal with foundries because they do not have the commercial strength and may be forced to buy large minimum number of wafers.

Supply is possible for long periods because foundry processes are supported for many years. Should the foundry process be withdrawn, then the design can usually be migrated to a smaller geometry process or wafers can be banked to ensure the lifetime requirement of the project.

The initial engineering costs will be higher by going down the full custom approach but it is the total lifetime cost and technical performance that should be considered.

Legacy Systems – The Re-design Option.

Re-designing an obsolete device is often considered a last resort option because of the perceived engineering costs involved. Swindon Silicon Systems, as an independent fabless supplier, employs a number of design and commercial techniques that demonstrate that the re-design option can be a very cost effective solution. Examples are given below to demonstrate how a number of these techniques have been used in real applications to produce cost effective solutions to device obsolescence.

<u>Example 1</u>

The system is a ground to air missile now approaching its third decade of operation with new orders still anticipated. The manufacturer of the seeker electronics had a number of obsolescence issues and had three devices that were no longer available. The system was not being upgraded at this stage and budgets for engineering activities were severely restricted.

The function of the three obsolete devices and how they were used in the system were analysed. It was decided that it would be technically feasible to integrate the required functions into two devices by greater on chip integration. Also, it was possible to use the same semiconductor process, which meant that both devices could be put on the same wafer. The advantage of this is that only one mask set and wafer batch would be required therefore dramatically reducing the engineering cost. The foundry cost for the mask set, prototype and production wafers was 33K Euro. The overall cost of supplying fully qualified replacement parts was comparable to the cost if the original parts had they been available at last time buy prices.

<u>Example 2</u>

This example is for the same missile system in Example 1 but for the main contractor with responsibility for the main E-pack. The problem was with one CMOS device that was obsolete but fortunately the original design data was available. SSSL undertook a search of CMOS foundry processes that might be compatible with the original design. A current 4 micron CMOS process was identified with process design rules similar to the original process. The design migration to the new process was accomplished within a few weeks. A new mask set generated and the first silicon was available 8 weeks later. Total foundry cost including masks and production wafers was 22K Euro

Example 3

This military ground base equipment had one obsolete device on a board, again with very limited budgets to solve the issue. In addition, a number of other components on the board were in short supply and the after market re-sellers prices for these components were considerably inflated reflecting the scarcity value.

The total board function was analysed and it was clear that greater on chip integration was possible thus eliminating many of the expensive components. The function of the obsolete device existed in one of SSSL standard cells so that the IP could be re-used to reduce the design cost. The additional functions were added to the standard cell without the necessity to change the diffusion layers. Therefore, only the top metal layers of the existing cell design had to be changed. This meant that only 3 new masks were required compared to 17 masks for a complete new design. Another benefit of the design being a metal revision of a standard cell was that part processed wafers were in the line (prior to metal 1) so that wafers of the modified design were available 3 weeks after the design was completed. The total foundry in this case was 8K Euro.

The combination of greater integration and re-use of IP created a very cost effective solution in a very short time frame.

Example 4

With the withdrawal of many families of devices from major semiconductor manufacturers, SSSL receives enquires for the same obsolete part from a number of customers. The majority of these enquires have no budget for engineering charges and the volume requirement is low. The combined quantity of all these enquires however can make a viable business case for SSSL to create a standard cell that can be modified to meet the varied requirements. Modifications to enable different functions are achieved by wire bond or top metal custmisation and the device assembled into the appropriate package style, plastic or ceramic.

An example of this approach is our standard divider cell. This cell can replicate the function of many divider products in the range including prescalers from divide–by 2 up to divide-by 129 operating from 1Hz to 3.5GHz.The devices can be screened to meet full military specifications in ceramic packages or to commercial specifications in plastic packages.

A standard pricing structure has been developed that means that no engineering charges are made for any new device that can be derived from the standard cell. The minimum order quantity where a new bond or metal option is required is as low as 100 parts. In addition, a fast turnaround time can be given because a stock of part processed wafers are always in the line. Typically, a new device would be available in 4 weeks.

Summary

A number of different commercial approaches to re-designing obsolete devices have been presented that demonstrate cost effective strategies for re-designing obsolete ICs. These can be summarised as follows:

- Re-use of IP
- Design migration
- Use of standard cells that can be easily modified
- Greater on-chip integration reducing device count
- Multiple designs per mask set

A fabless supplier can offer good protection against obsolescence and should be seriously considered for both new projects and solving obsolescence issues in legacy systems.