A cluster of expertise

Silicon and support for driver information systems.
*By **Thomas Kuschel**.*

Summary

Graphics displays in the automotive industry are increasingly common and increasingly complex. To help designers implement systems, a variety of SoC driver solutions is now available. The engineer must consider many factors when choosing a suitable device, including processor horsepower, display resolution, and variety of on chip interfaces. As always in the automotive industry, size, weight, cost, robustness and EMI tolerance are also key concerns. Just as important, however, is the provision of a supporting ecosystem of HMI development tools, that can be used to bridge the gap between visual designers and engineers, to create a unified development, testing and implementation environment for any graphics based interface.

The move towards the use of colour TFT LCDs in automotive applications is long established. Drivers and passengers have become comfortable with their use in the cabin and on the console, through the proliferation of products such as GPS and in car entertainment. Their wider deployment – for instance in the instrument cluster, either supplementing or substituting for traditional dials and read outs – has been driven equally strongly by their ease of use and their practical (engineering) benefits.

Displays themselves have become more robust and perform better than ever before. Unit costs are lower and solutions based on graphic displays are more flexible and adaptable. Designers can produce multiple product variants using a single hardware platform; and they can more easily refresh or redesign existing products, making a major impact on consumer perceptions. For the end user, it becomes possible to assimilate more information, and to customise the look and feel of the vehicle to individual preferences.

For the systems engineer, the display itself is only the (very visible) tip of a much larger iceberg – the overall driver information system. Quickly and cost effectively implementing such a TFT based system represents a considerable challenge. This is particularly true now that Human Machine Interface (HMI) design has become well established as a discipline in its own right, so that the overall system design is likely to require the participation of a diverse group of professionals, with expertise in hardware, software, graphic and HMI design.

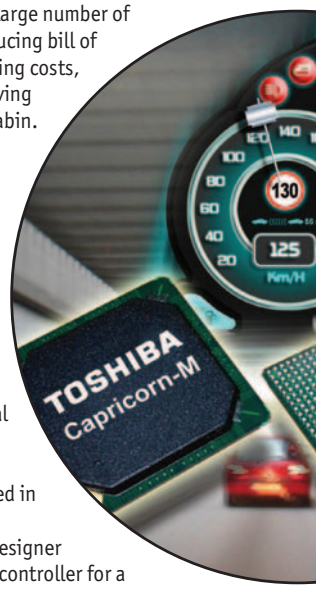
These changes have led hardware engineers away from discrete display driver designs towards the use of more integrated solutions. A growing number of SoC TFT drivers is becoming available, many offered with a supporting ecosystem to facilitate a multi disciplinary HMI design approach.

Toshiba's Capricorn family of single chip TFT drivers provides a good example of such an integrated approach. First launched in 1998, the range has continues to evolve to support market trends.

The devices themselves provide various combinations of core hardware including a 64bit MIPS based processor, graphics controller, a floating point unit (FPU) to accelerate image processing functions, embedded DRAM and a camera interface. Dedicated hardware for image presentation is also provided, including anti aliasing filters. As well as this range of functionality, controllers are available in a choice of clock speeds.

Solving synchronisation

One of the most important consequences of using an integrated graphics SoC is the reduction in the need for discrete timing controllers. Synchronisation is one of the biggest challenges in any video display system and the integrated approach can eliminate a large number of external components, reducing bill of materials and manufacturing costs, cutting complexity and saving space within the vehicle cabin.



Capricorn devices also feature a range of automotive oriented connectivity, to accommodate a range of video sources and displays. An integrated frame grab function accepts most data formats, allowing easy interfacing with peripheral components such as rear facing cameras that are increasingly being deployed in cars.

All of this adds up to designer choice when looking for a controller for a

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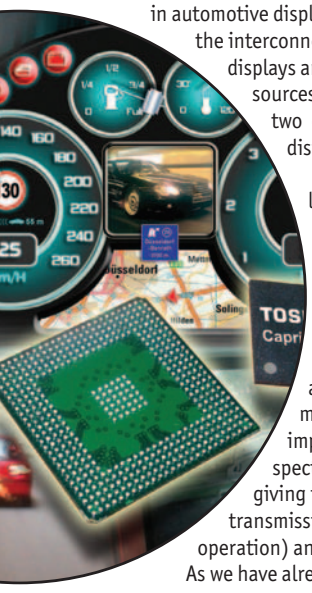
particular application. The Capricorn-M and Capricorn-L chips, for example, are designed specifically for driver information displays working at VGA resolution or better. In fact, the -M version supports 1600 x 600 displays in 32bit RGBA mode.

More recently, Toshiba further expanded the line up with the launch of the Capricorn-A, aimed at designers of physically smaller information systems and integrating the DRAM (eDRAM) necessary to display complex graphics.

The device is particularly suitable for use with 3in and 5in displays, with resolutions of up to half VGA. Such small scale displays are particularly important in applications such as dashboards, where space is at a premium, but large amounts of information need to be conveyed clearly and quickly. Many designers are now meeting this requirement by combining LCD screens with traditional mechanical gauges.

One of the most important consequences of integrating eDRAM is a reduction in the need for EMI shielding, as fewer PCB tracks are exposed. In fact, simplified EMI design is one of the key considerations in the drive to reduce component count by SoC integration, and was an important factor in Toshiba's recent agreement to licence INOVA's APIX digital serial data link technology for use in future versions of the Capricorn range.

APIX is a gigabit transmission technology, with the potential to become a de facto standard in automotive display systems, that allows the interconnection of high resolution displays and cameras to video sources and frame grabbers via a two or four wire interface at distances of up to 15m.



Using a DC balanced, low latency serial link, embedded APIX devices provide lower system cost and better performance than external SERDES (serialiser deserialiser) circuitry. In particular, it allows superior EMI management capabilities by implementing spread spectrum clocking, and by giving the designer control over transmission speed (0.5 or 1Gbit/s operation) and driver characteristics. As we have already observed, however, hardware is only a part of the solution required for interface design. Not only is HMI design increasingly performed in a multi disciplinary environment, the task is becoming intrinsically more complex as the sheer volume of driver information grows. HMI modelling tools can help to reduce this overhead; indeed, their availability may be as important a part of the driver purchasing decision as the specification of the chip itself.

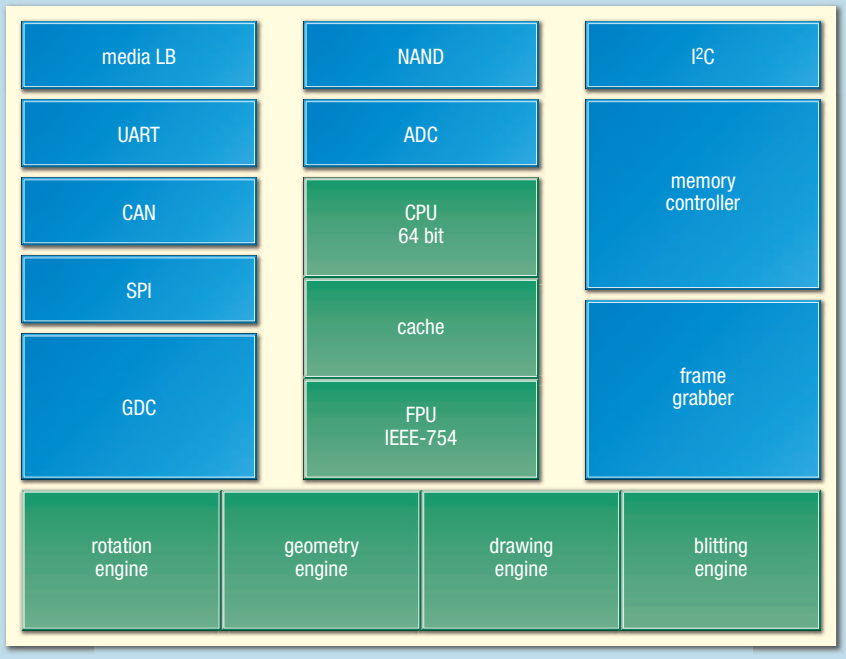
The Capricorn family is supported by a comprehensive toolchain developed by Toshiba in conjunction with HMI specialist Altia. The software is intended to bridge the gap between graphic designer, HMI expert and engineer, by combining the technical and artistic aspects of creating an effective user interface.

One of the most important aspects in the HMI development process is allowing the interface designer to quickly and interactively move an idea from concept via demonstration to prototype. The Capricorn toolchain facilitates just this by importing files directly from the tool of choice for many visual designers: Adobe Photoshop. The graphic designer can thus create graphics layers, buttons, screens and other interface objects, before using the Altia software to generate a working, interactive, user driven prototype.

The Altia Design environment can itself be used to build visual elements from scratch, and supports the integration of visual elements with application code or third party design tools. It includes language translators, APIs and graphics libraries. The output is a functionally complete, accurate simulation model that can be used to test code, algorithms, concepts and systems.

The final step in the implementation process is to transform the model or prototype into deployable code. This is also done automatically within the toolchain, resulting in optimised code with high memory efficiency, that is tuned specifically for Capricorn processors. This automatic code generation step also eases much of the graphics programming burden, allowing programmers to focus on the application code and significantly reducing product time to market.

Figure 1: Capricorn-M block diagram



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