FUJITSU

Fujitsu and Inova Help Automakers and Tier-One Suppliers Design and Manufacture High-Performance Graphics Display Systems

To meet the space, cost and performance challenges of sophisticated graphic systems, Fujitsu has integrated Inova Semiconductor's APIX® high-speed serial interface into its graphics display controllers.

"For us, it is important to discuss these matters in an early phase with chip manufacturers. Thus, we can achieve more stability in the development process."

– Robert Isele
Director of Driver Information Systems,
Display Technology at BMW

CASE STUDY

Introduction

Each year, automobiles use more and more electronics to provide high-performance, enriching graphics in a multitude of in-vehicle systems. Today that process is accelerating as car manufacturers move from analog to high-resolution digital displays for dashboards, cameras, GPS and multimedia entertainment systems. However, the increasing use of media within the car presents significant performance, space and cost challenges.

Fujitsu, an industry leader in graphics display controllers (GDCs), is helping car manufacturers and tier-one suppliers meet these challenges efficiently and cost-effectively. GDCs are the core drivers of display systems, and the Fujitsu GDC is optimized for the demanding embedded environment of automobile applications. This means the company is in an optimal position to work with car manufacturers and component suppliers early on, and to use its expertise in embedded graphics technology to facilitate the development process.

As part of that facilitation, Fujitsu can integrate its technology with third-party technologies to develop system solutions. Such is the case with Fujitsu's integration of the Automotive PIXel Link (APIX®) high-speed serial interface from Inova Semiconductors with the Fujitsu GDCs. This integrated technology enables car manufacturers to provide flexible, high-quality, cost-effective displays.

The Situation

Today's emerging graphics applications require thin film transistor (TFT) liquid crystal display (LCD) panels mounted throughout the car—in everything from the center console and instrument cluster to the heads-up display (HUD) and rear-seat entertainment systems.

To produce these high-performance graphics, GDCs are increasing proportionally in size, power consumption, and implementation complexity.

The problem with this increased electronics content is that larger system-on-chip-based GDCs and their supporting peripherals do not always lend themselves to being located on a printed circuit board (PCB) on the back side of the LCD. In fact, designers are continually "space-constrained" and search for ways to reduce the number of circuits and subsystems behind the dashboard.

Traditional approaches, such as using more highly integrated controller chips, are being offset by the push to integrate more and larger displays, and to add more "infotainment" functionality, in the dashboard space. The added functionality introduces a dramatic number of variables that increases costs as original equipment manufacturers (OEMs) try to provide multiple options for every vehicle.

All this is occurring at a time when designers are trying to reduce costs, cut down the number of cables, and modularize designs so they can get maximum value from their development expenses.

Semiconductor providers such as Fujitsu are quickly developing and adapting new technologies to meet these growing challenges. One such initiative is the use of Inova's APIX, which offers costs and performance advantages over competing technologies.

The combined Fujitsu and Inova technologies provide a solution to the cost, space and modularity challenges. The Fujitsu GDC with the integrated APIX technology gives tier-one suppliers and automakers flexible options for high-quality, cost-effective displays.

This integrated graphics system is the result of a collaboration among Fujitsu, Inova, the automakers and suppliers. The four groups worked closely together on the development process, with Fujitsu and Inova providing much needed input.

This is an example of a growing trend, namely, that semiconductor and component companies are playing a partnership role in automobile development. Companies like Fujitsu and Inova are working as team players with automakers and tier-suppliers, providing not just components, but system solutions. This helps

reduce re-designs, control costs, improve performance and stabilize the development process. This kind of involvement also makes it easier for car companies and tier-one suppliers to develop system solutions and modular approaches.

The Fujitsu Graphics Display Controller—Optimized for Automotive Applications

To understand the value of the integrated Fujitsu-Inova-APIX technology, it's essential to understand what each company brings to the partnership.

The Fujitsu GDCs are optimized for automobile applications, with video input, many 2D and 3D rendering functions, a flexible layer capability, support for screen resolutions up to XGA (1024x768), and other features in the area of navigation, such as alpha-blending and anti-aliasing.

Fujitsu currently has three automotive GDCs with integrated APIX.

The MB86R02 "Jade-D"

The MB86R02 is a SoC featuring an industry-standard ARM926 processor, the Fujitsu MB86296 "Coral-PA," two APIX channels, a TFT timing controller (TCON), and other automotive peripherals as illustrated in Figure 1.

The MB88F332 "Indigo"

The MB88F332 combines an APIX deserializer, APIX Remote Hander (ARH) and APIX Automotive Shell, a sprite engine, a TCON, and other automotive peripherals needed for driving a cluster, HUD or center console. A block diagram of the MB88F332 is illustrated in Figure 2 on following page. The MB88F332 "Indigo" especially targets state-of-the-art systems, CID (Central Information Display) and RSE (Rear Seat entertainment) systems.

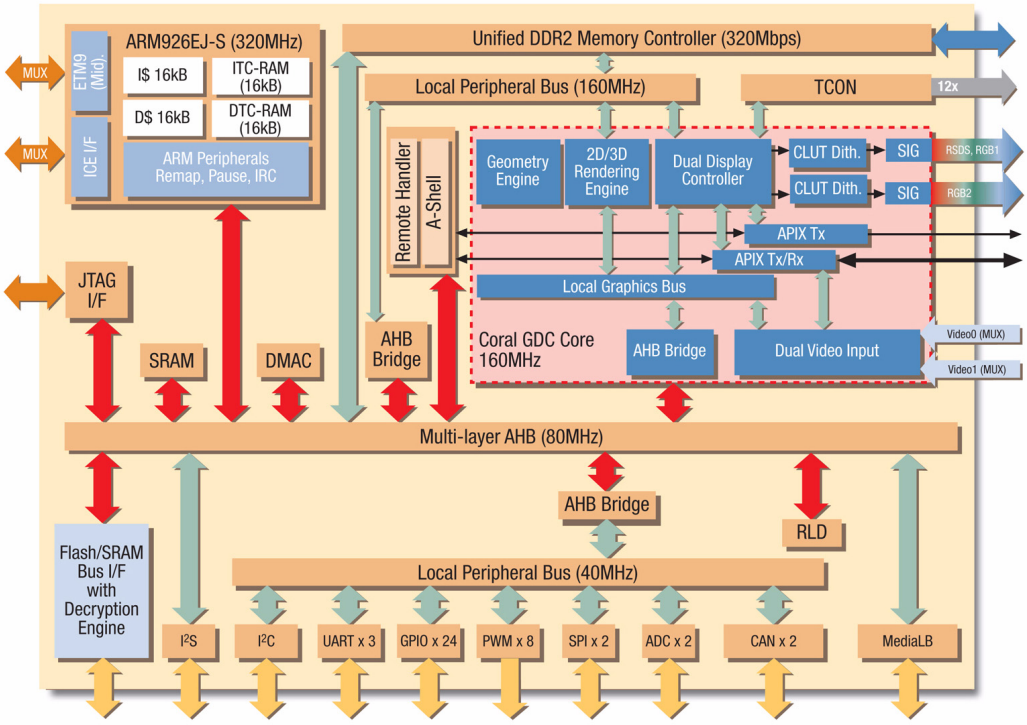

Figure 1 — MB86R02 "Jade-D" Block Diagram

The MB91F467S

The MB91F467S is a 32-bit Fujitsu RISC (FR) microcontroller (MCU) with embedded APIX as illustrated in Figure 3. This GDC does not drive graphics over APIX to the remote node, but otherwise has all the other capabilities of APIX. Both the ARH and APIX automotive shell are implemented in hardware to maximize performance.

Fujitsu is noted not just for the quality of its individual GDCs, but for its ability to integrate other technologies to provide a system solution. A prime example of this capability is Fujitsu's integration of Inova's APIX high-speed serial interface into its graphics display controllers.

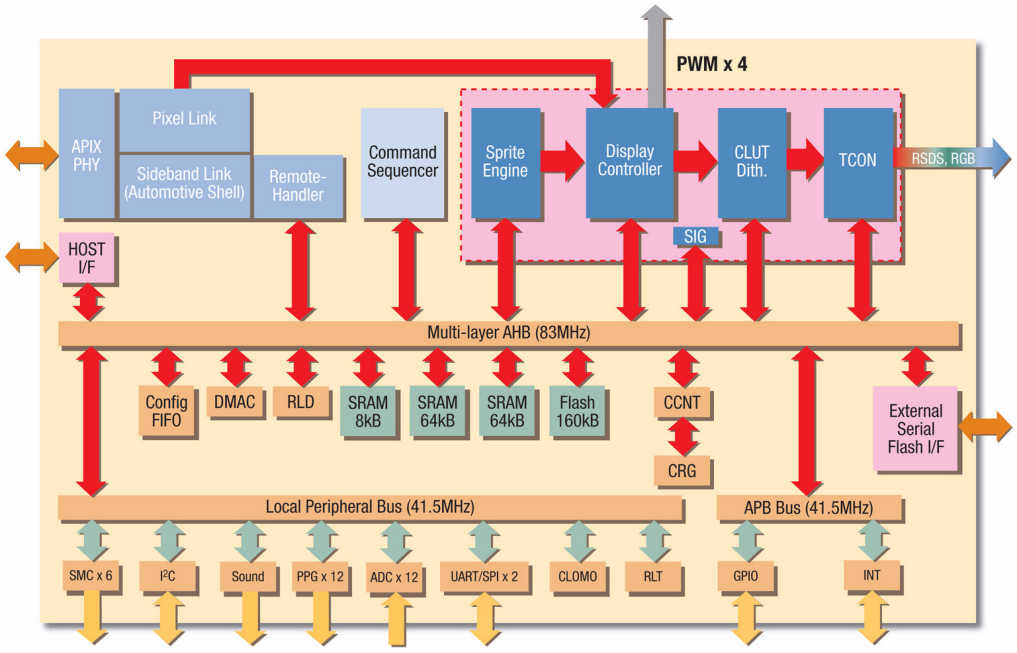

Figure 2 — MB88F332 "Indigo" Block Diagram

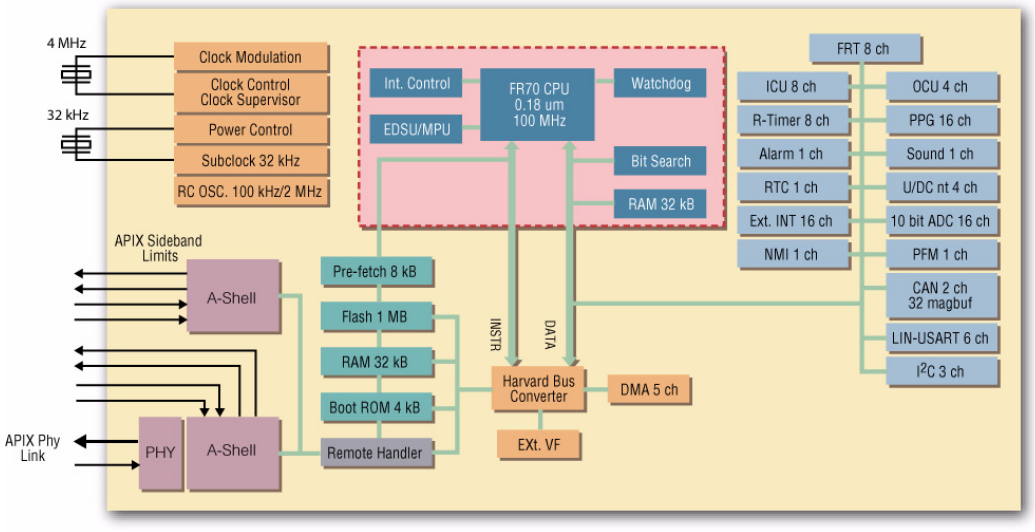

Figure 3 — MB91F47S Block Diagram

The APIX IP: High-Speed Serial Link Interface

APIX is notable partially because it allows the wiring that supports a remote TFT display to be significantly simplified. The interface can pass command and control data to and from the remote module. Data returning from the remote LCD travels through the APIX backchannel, which is significantly faster than even the fastest CAN standard. The backchannel function eliminates the need to connect the LCD to an existing CAN or LIN network. The function is also key to enabling a modular subsystem design that allows display systems to be mixed and matched to meet different performance needs.

Besides reducing the number of lines and possibly eliminating a dedicated power supply, the APIX configuration can declassify an Electronic Control Unit (ECU) subsystem into a dumb terminal or slave system.

In this new configuration, the controlling software would be located in the main ECU, and the pixel (video) and control data would be pumped through APIX to the slave system. (The presence of controlling software defines a system as an ECU.) In the automotive world this translates into significant savings as the non-ECU system is no longer subject to the same rigorous qualification requirements that apply to an ECU. With the lower BOM and qualification costs associated with the slave subsystem, it is feasible to have multiple configurations of slave units that can be easily switched out for different models.

The connectors and cables required for APIX are standard high-speed serial connectors, which are readily available from many companies like Honda Connectors, Hirose and Molex. APIX uses Shielded Twisted Pair (STP) cabling, and can offer cable lengths up to 12 meters.

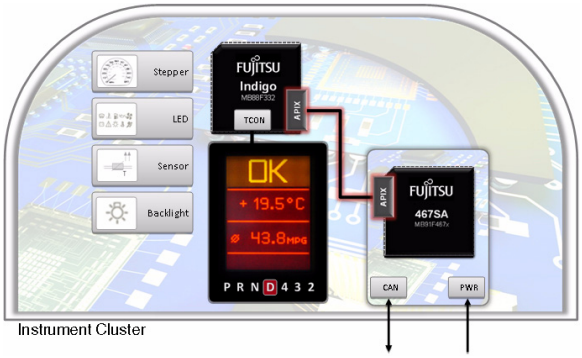

Figure 4 — Entry-Level Cluster Variant – Modular Architecture

Representative Applications: System Architectures

The combination of the Fujitsu devices with APIX provides many benefits, which help car manufacturers and suppliers meet the space, cost and performance challenges of sophisticated graphics. The integrated technology lowers costs and space requirements by reducing the number of connectors and wiring harnesses needed to connect to remote displays. Integrating the programmable TCON into the GDC means the TCON unit can be removed from the LCD, saving money. The Fujitsu-Inova technology easily integrates with other bus standards such as CAN or MOST.

More importantly, the integration of the two technologies increases flexibility, allowing for system architectures that were not feasible in the past.

Here is an example.

The MB88F332 “Indigo” graphics controller can be placed directly on the instrument cluster PCB. The controller can be connected to several stepper motors, a central LCD, indicators, and all the other devices and peripherals located in the cluster. This architecture does not require a local MCU in the cluster, nor a CAN link to the cluster. The controlling processor or SoC is located elsewhere and communicates to Indigo, which operates as a slave, over the APIX link.

The MB88F332 “Indigo” controller is unique in that it can display basic splash-screen information at start-up before the operating system loads. In a distributed system, the ability to display information reassures the driver that the display system is functioning.

The display also serves an important diagnostic function. Often, when there is a problem in the ECU or with the cabling system between the ECU and the display, the technician has no way to isolate the problem. The typical course of action is to replace everything, including the expensive display subsystem. However, the Indigo device located on the display system will display a diagnostic message such as “No Pixel Data received from ECU.” The technician would not then replace the display. This can save thousands of dollars in unnecessary replacement costs.

In the low-end variant of this architecture, a remote MB91F467SA MCU controls the cluster using the PCB-mounted Indigo device through the APIX interface. The sprite engine side of Indigo generates the relatively simple bitmapped-based 2D graphics. This can be seen in Figure 4 on the previous page.

An important advantage of the architecture shown in Figure 4 is that there is no software in the cluster because all software runs on the external MB91F467S. Modifications or improvements to the cluster subsystem can be done without concern for software requalification costs.

The MB88F332 “Indigo” controller, which includes an advanced sound generator, can also directly control up to six stepper motors. These features eliminate the need for a local microcontroller, making the GDC extremely useful in distributed cluster configurations. All control information is passed to the Indigo unit via APIX. While fast, the APIX link still introduces some latency, and stepper-motor and sound-generation functions must run constantly. Indigo’s remote handler features a sophisticated FIFO management system that neutralizes the effects of jitter and other latencies associated with serial transmissions.

Changing to the higher-end cluster variant in the same architecture requires only a swap to a larger, higher-resolution LCD panel and a change in the remote module driving the cluster. In such a case, the Fujitsu MB86R02 “Jade-D” SOC would be added to the remote module to perform more sophisticated 2D and 3D graphics for both the cluster and added HUD. Being able to easily swap panels and modules in this way increases flexibility and modularity.

Just as in the low-end architecture, all command and control are done over the APIX link. The automotive peripherals in Indigo are controlled by the MB91F467S connected to the Fujitsu MB86R02 “Jade-D,” and the graphics are sent over the APIX links. In addition, the GDC’s dual APIX channels can support two independent displays that can feature different content. This is illustrated in Figure 5.

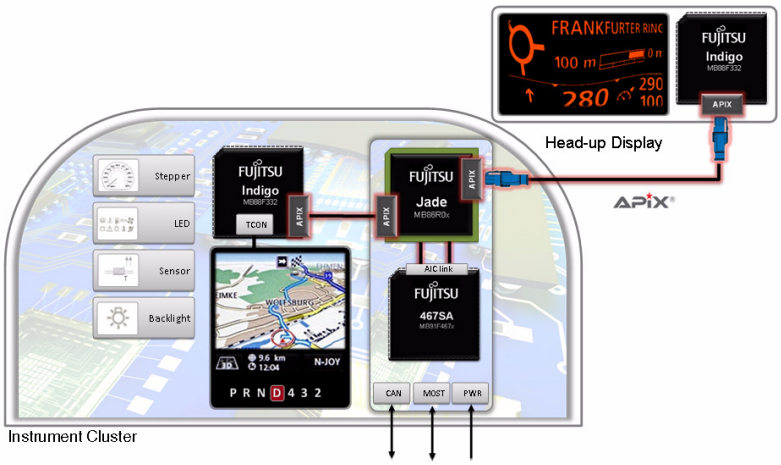

Figure 5 — Jade’s dual APIX channels, supporting two independent displays

As in the lower-end variant of this architecture, there is no software in the cluster or even in the HUD module. All software resides in the remotely mounted MB86R02 “Jade-D”-based graphics processing module. Besides creating vibrant and detailed graphics, the unit can produce some much-needed special effects. For example, the GDC can manipulate the polygons of the HUD unit to eliminate the appearance of warping produced by curves in the windscreen. (Fujitsu provides the algorithm.)

In the display module on the other side of system, the Indigo device is much more than an APIX-enabled display controller. This GDC can control the mechanical gauges (if any), produce a variety of warning sounds, manage the backlight and even support the touch screen. Also, Indigo can offload some of the graphics support from the main controller. For example, the GDC can instantly display a splash screen at boot time while the operating system is loading. (The main control unit cannot begin graphics rendering until the OS has booted.) The device can also display a message on the HUD or cluster if the APIX link is dropped. This capability eliminates the display subsystems(s) as the cause of a problem.

Many other variants using APIX are possible. For example, a rear backup camera can be input into the MB86R02 “Jade-D” graphics processing module using APIX. The MB86R02 “Jade-D” SOC can process the video, removing any fisheye distortion, and send the video to the display in the cluster via APIX.

In another use, the remote graphics processing module can drive a center stack information display instead of a HUD while still driving the graphics to the cluster. In a different architecture, the MB86R02 “Jade-D” SOC can be located on the cluster PCB and drive a remote HUD or center display via APIX.

And these scenarios only consider using the APIX outputs of the MB86R02 “Jade-D.” This GDC also supports dual display through dedicated ports. This makes it possible to support four separate displays — two via APIX and two directly.

Summary

The integration of the Fujitsu graphics display controllers and the APIX high-speed serial interface is meeting the significant space, cost and performance challenges brought about by the demand for more graphics content in vehicles.

The integrated technology is enabling car manufacturers and tier-one suppliers to provide flexible, high-quality, cost-effective displays. The Fujitsu GDC-APIX technology enables less expensive and more modular architectures, providing car companies more options for their high-performance graphics subsystems.

The result is that car manufacturers and suppliers can provide the rich graphics experience today’s car buyers expect. At the same time, manufacturers enjoy more stable development, dramatically reduced costs, and more flexibility—all desirable in today’s challenging automotive environment.

For More Information

For more information on the Fujitsu GDCs, please go to http://us.fujitsu.com/micro/gdc or address e-mail to inquiry@fma.fujitsu.com

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