Automotive Electronics

With all the new features consumers want in the cars they buy today, the number of automotive electronics, which require complex semiconductors, continues to increase.

Q: "How do designers stay within their power budget and still remain competitive?"

By Michael Haight, Freescale

"I want it all" is often the desire for the car buyer. "And I don't want to pay more for it," usually follows soon thereafter. So in the competitive landscape of the vehicle maker, vying for the attention of the consumer and doing so better than everyone else becomes a multi-faceted challenge. Constraints and trade-offs in cost, component availability, system reliability and capability must be balanced to deliver something on-time, within budget and meeting, if not exceeding, the car buyer's expectation.

Nowhere in the vehicle is this more evident than in the information and entertainment systems (infotainment), where rapid progress in consumer electronics products sets the expectation for what should be achieved by the infotainment system in the car. High quality audio, played from whatever source in which it resides, managed by intuitive graphical and voice-controlled means, forms the basis for what was once as simple as the AM/FM/CD radio system. Add hands-free smart-phone calling, text to speech messaging, navigation and access to streaming internet content and we have a sense for the complex systems requiring significant increases in computing performance and communication speeds within the vehicle's center stack.

Opposing the increase in performance and communication speeds is the unwanted increase in power consumption. Additional power consumption poses several challenges to the system designer, the most notable of which is the heat generated from the power dissipation. Build up of heat in the enclosed electronics system can cause the temperature to exceed the rated specifications of the components or it must be dealt with in other costly ways like adding a cooling fan or heat sinks. The heat problem directly and adversely affects system cost and reliability. So what is being done to significantly increase the system performance while maintaining power consumption to operate within a system thermal budget?

In response to the challenge, semiconductor makers are looking to advanced process technologies and higher levels of integration to reduce system power while increasing performance. In the infotainment system, performance is mainly improved by increasing the operating frequency of the central processing unit (CPU) on the applications processor. By running faster, more computational work is done in less time. However, since power consumption and, by extension, heat generation is directly proportional to the switching speed of the transistors, running faster generally means more heat. The need to increase the CPU speed can be mitigated by integration of dedicated processing engines on the applications processor.

Now, computationally intensive tasks can be diverted from the general purpose CPU and onto the more efficient but less flexible task engine. Additionally, the dedicated task engines can be powered off when not needed to reduce power consumption of the device. Examples of dedicated task engines that commonly appear on infotainment applications processors are graphics processing units (GPU) for drawing navigation maps and video processing units for decompressing high-definition video content.

Also contributing to increased power consumption is the size of the capacitive load that must be switched and the voltage levels switched between logical states. At the system level, switching capacitances are higher in the signaling between functional elements that are on different components than if those elements were in the same integrated circuit. Here, component consolidation or integration reduces the communications traffic “off-chip” and, by extension, power is reduced. Advanced semiconductor processes make it feasible to consolidate more of the system functionality onto a single component and smaller circuits typically mean smaller switching capacitance and lower power.

Another benefit of advanced semiconductor process technologies for power consumption is related to the supply voltage and switching voltage thresholds. With each technology advance that shrinks the physical size of the circuits a reduction in voltage is often required. In the case of switching, the power is related to the square of the switching voltage. Small reductions in voltage can have a large impact in reducing power and heat for the system designer.

For the system designer selecting components with state of the art semiconductor process technologies, high levels of functional integration and selective power control (power gating) are key. These attributes come together to simultaneously increase the performance of the semiconductor components while keeping increases to power consumption in check.

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