Moving to System on Chip (SoC) Integration

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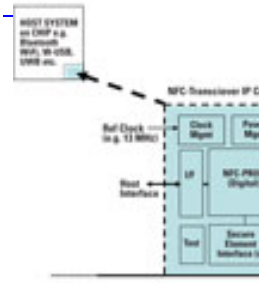
The success of Near Field Communication (NFC) across a range of applications depends on its large-scale adoption. This means simple, low-cost implementation of the technology in mass-market electronic devices, from mobile phones and laptops to point-of-sale terminals and ticket machines.

One way NFC can be integrated cost-effectively is through System on Chip (SoC) implementation in other common chipsets. In high-volume products, SoC



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implementation of NFC offers significant unit cost savings and very efficient integration, with lower overall space, processing and power requirements. This article outlines the business case for NFC integration, highlighting the key considerations when implementing custom NFC design.

Integration is Natural

Integration is an established ‘fact of life’ in the consumer electronics product lifecycle. Usually, the first products to market are built from discrete components, and their typically high sale price reflects high production costs and small production volumes. As a product becomes more popular, manufacturers invest in progressively greater integration of components to drive down costs as volumes increase.

For consumer electronic devices, integration of a new technology follows a well-trodden path. When a new technology comes along, the first products might be external devices connected via a cable, for example. Next, may be card accessories that can be plugged into the device, followed by a chipset that sits on the motherboard. Finally, closer integration of the technology with other functionality on the motherboard.

Technologies undergo a similar process of integration within the devices themselves. A good example is the development of the GSM mobile phone from single-band only operation, through multi-band GSM operation to multi-mode operation. As these new capabilities were introduced, multi-band and multi-mode

blocks were typically added for the digital logic and signal processing parts.

Initially, however, the different RF parts were implemented as separate blocks, as digital logic and RF technology were developing at different rates, and market demand for the different combinations of RF bands was not well established. Today, RF design and market acceptance have moved to the point where the RF part is common for all frequencies.

Over time, it has become possible and desirable to move commonality further down the mobile phone functionality stack.

The key issue facing electronic product designers and manufacturers today is where, and how closely, NFC should be integrated into their products.

The NFC Integration Story

Key considerations include: When to integrate NFC with other technologies, and which interfaces to provide to the host system. Integrate too early and you could have an expensive ‘white elephant’ that proves difficult to update inline with changing market demands. Integrate too late and you could be left behind in the race to meet volume demand from a mass market cost-effectively.

The choice of interface point is a key market success factor, especially when different technologies are developing at different speeds. If integration is performed with interfaces at the wrong point &#151 with stable technologies integrated with less mature ones &#151 adding or developing capabilities on the ‘integrated’ side of the divide could become much more costly than if they had been left on the other side of the interface. The integration point shifts with time and changing market conditions. The trick is to know when to move to the next level of integration.

NFC is going through the classic integration process. The first prototype implementations in mobile phones were as cover units that clipped on to the back. While useful for accessing and testing the market for NFC-enabled phones, they were unlikely to take off as a mass-market product &#151 the NFC covers cost about the same for 10,000 units as complete phones cost for 10 million units.

As NFC moves to the next level of integration, designers have the choice of developing NFC chipsets to sit on electronic device motherboards, or moving to SoC implementations.

The benefit of greater integration is a significant cost benefit in high-volume production, which should more than cover up-front design and development costs. But before jumping in, designers and engineers should consider what role NFC will play in the device, and whether there are ‘overlap’ areas with other circuitry on the host device’s existing silicon.

The SoC Opportunity

Like any RF-based technology today, NFC requires a certain amount of analogue circuitry for transmitting and receiving analogue radio waves. Around 99% of silicon is purely digital (mostly memory), and there is little scope for building extra

processes on this. But there are several areas of combined digital/analogue circuitry in mobile devices &#151 including Bluetooth, WiFi and UWB chipsets &#151 which provide ideal hosts for NFC processes.

Using such hosts for SoC implementations of NFC makes sense financially. The additional cost of including a stand-alone NFC chipset on the typical electronic device motherboard can be US$3 to $5 per unit, and requires 25 to 30 connector pins. Implementing the same NFC functionality as a custom IP block on a Bluetooth chipset typically adds less than US$1 per unit, requires 6 to 8 connector pins (including test pins) and needs no separate chip. The NFC IP block can be placed in the corner of the Bluetooth chipset using on-chip connections.

The financial attractions of SoC are clear when addressing a mass market. There are up-front costs for developing custom IP for SoC implementations, but these will be repaid quickly through production savings in high volumes. With 300 million Bluetooth chipsets sold annually, it would be very quick to recoup even a US$1 million development investment if the manufacturer can charge an extra US$0.50 per unit for built-in NFC capability. The reduction in pin connectors is also significant, because motherboard ‘real estate’ in devices like mobile phones and digital cameras is limited and expensive. Integrating NFC with existing chipsets also makes sense technically. Many of the processes and components needed by these RF-based technologies are the same: antenna, power, clock, data bus, etc. Having the NFC IP block on-chip also avoids the need for it to have its own ESD protection and drivers to ensure it works over the distances involved.

The choice between a custom IP block for SoC and a custom chip implementation is determined by the project emphasis &#151 whether memory, size, power requirement, for example &#151 or if additional functionality is required for an existing SoC. For example, to add NFC capability to a Bluetooth SoC, the challenges stem from the fact that different semiconductor vendors use different SoC design procedures. Some emphasize memory optimization; others focus on size, layout or power consumption. Providing an NFC IP block that is optimized for use across these different environments requires extensive experience of the fab industry tools, individual vendors’ procedures, an in-depth understanding of customers’ requirements and design-flow.

Summary

Assuming there is sufficient volume to justify the development costs, custom IC design &#151 whether for stand-alone or SoC implementations &#151 offers the advantage of enabling a designer to focus on meeting customer requirements in a way that cannot be achieved using standard products.

In a nutshell, custom IC design optimizes the cost of IP ownership and contains exclusively non-recurrent engineering. This means that for a given application, power usage, silicon area and memory can be optimized to a specific requirement. Using custom IC design for NFC SoC implementations also means the host chipset designers do not need to become experts in a new area.

As NFC becomes more widely adopted as a mass-market technology; the

advantages of SoC implementations become more compelling. Bluetooth chipset manufacturers have shown that Bluetooth/FM integration is a successful business model in the mobile phone market, and the potential for NFC integration in consumer electronic devices is potentially huge.

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