

Samsung and Cadence

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Tony Gladvin George, Verification Engineer, Samsung

The Customer

Samsung is a market share leader in solid-state drives (SSDs). The SSD is an innovative, nonvolatile storage medium, commonly used in laptops and servers in place of a rotating hard disk drive (HDD). This saves on power, space, and cost while simultaneously increasing product reliability. Because of these advantages, SSDs are being employed more and more in mobile devices such as tablets and smartphones.

In early 2012, Samsung decided to add a PCI Express interface to its SSD controllers to increase the data transfer performance. Samsung expects this innovation to expand market share and to address additional OEM markets.

The Challenge

Traditionally, SSDs have been based on the 12-year-old SATA protocol used for HDDs. This was a good choice for software and hardware compatibility, but it has shortcomings for performance and throughput when used with non-volatile memory (as opposed to use with a spinning hard drive). Using PCI Express as the interface, the SSD storage can be directly attached to the PCI Express bus in the end product. This enables much higher transaction rates and lower latencies relative to SATA-based SSDs.

However, the addition of PCI Express to Samsung’s SSD significantly increased the challenges faced in device and software validation, particularly at the system-on-chip (SoC) level. Adding PCI Express would require a significant performance increase in the validation environment. This performance is needed to:

- Validate PCI Express behavior at the SoC level
- Integrate and debug host driver software
- Validate end-to-end end bulk DMA transfers

Business Challenges

- Deliver new SSD products to market on time
- Expand market share and grow into new applications

Design Challenges

- Complete verification efficiently for new SSD products
- Enable early firmware and driver integration, and debug, prior to FPGA prototype availability

Cadence Solutions

- Palladium XP with simulation acceleration use model
- Accelerated VIP for PCI Express

Results

- Increased validation speed multiple hundreds of times compared to simulation
- Increased validation team productivity by 100%

SSD validation at Samsung involves ensuring the SoC's proper functioning within a wide variety of usage scenarios as well as integrating and debugging firmware and device drivers. Samsung initially attempted to use their traditional approach—a simulated testbench using simulation verification IP (VIP). They quickly found this to be much too slow and inefficient for their needs with the PCI Express interface.

"The main problem in SSD validation is the need to validate a huge amount of data moving between the host to the Flash memory devices and vice versa," explains Tony Gladwin George, a Samsung verification engineer. "Unfortunately in our simulated verification environment, this takes far too much time."

Samsung determined that they needed greater testbench performance—much greater. "We needed performance on the order of hundreds of times faster than what we were achieving using simulation," says Mr. George.

The Solution

Accelerated validation was essential to achieving the required performance and developing the new product on time. Samsung turned to Cadence to provide a PCI Express SSD validation environment that would meet their performance requirements and enable the range of validation capabilities required. Cadence recommended its Palladium® XP-based validation environment using the simulation acceleration use model together with Accelerated VIP (AVIP) for PCI Express. This new environment fit in well with Samsung's existing one, which included simulation and FPGA prototype boards. Acceleration with AVIP provides the level of control and observability available with simulation, but it runs hundreds of times faster and is available months ahead of an FPGA-based platform.

Within three weeks the accelerated validation environment including the PCI Express AVIP was up and running. "As Cadence promised, our validation environment now runs hundreds of times faster than with simulation," Mr. George explains. "AVIP running on the Palladium XP increased my team's productivity by 100% due to the reduced waiting time between simulations. It also enabled us to find bugs we were unable to reach using simulation."

Summary and Future Plans

Samsung's new PCI Express-based SSD needed hundreds of times greater performance than their simulation environment could provide. Using Cadence PCI Express AVIP running on the Palladium XP platform, Samsung was able to close this gap and reach the speed and productivity goals they had established for SSD validation.

Given its effectiveness, the Cadence solution will be deployed on future projects as well. "We are very happy with the support and responsiveness that Cadence has provided" summarizes Taehak Lee, a Samsung verification manager. "Looking to the future, the Palladium-based validation environment with AVIP can now be ported to any of our upcoming PCI Express-based SSDs with minimal effort."



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