Putting It Together:

AMD and Compatibility

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Introduction: AMD's Commitment to Quality

In support of the broad goal of overall product quality, AMD puts a great deal of time and energy into analyzing the compatibility of its products. Compatibility is an extremely complex issue in the microprocessor industry. Testing each processor model on every combination of application software, operating system, and system configuration is a relative impossibility. In order to serve best the needs of its customers and partners, AMD focuses great attention at the very first stages of the development process. The earlier a compatibility issue can be identified the better for everyone involved. AMD engineers are constantly developing newer, better, and more rigorous tests for products to help ensure that by the time an AMD processor-based system reaches the end user, it is compatible with industry x86 standards and ready to go.

Compatibility by Design

AMD processors are designed according to industry standard specifications for x86 instruction sets, which allows for universal compatibility with x86 application software and operating systems. The x86 standards are rigid specifications to which AMD adheres throughout the design and testing of its products.

AMD's primary responsibility during the design phase of processor development is to help ensure compatibility through millions of simulations of the instructions that will one day make up the infrastructure of the processor. Before any silicon is involved, before a single wafer or chip is produced, a software version of a processor is created. Thousands of networked computers are then used to host this software model.

The first level of innovation that AMD applies to check the foundation of its processors is the writing of mini-applications to be run on the simulation model. These

mini-applications are directed at specific areas of functionality. They test for some of the same types of executions found in commercially available software.

The second innovation used to make sure that processor code meets established industry standards involves the use of a Golden Model check at every instruction boundary. A Golden Model is essentially the simplest model of a processor that implements the x86 standard instruction set. AMD engineers use this Golden Model by running it in parallel with the real, more complex model. They then check for consistency between these two models at all possible intermediate points in a simulation.

Third in the design compatibility process, AMD engineers utilize an automated system that generates thousands of random tests. The Golden Model is then used to flag problems generated when running these random tests on the software version of the processor. Millions upon millions of unique cycles are able to run each night, which far exceeds the boundaries and limitations of a test engineer manually writing and verifying tests.

The fourth level of innovation used in the design process is subdividing the processor model into ten or more specialized blocks. After the previous tests confirm a level of compatibility with x86 standards, these tests allow the engineer to subdivide the processor's complexity into more manageable chunks and perform focused testing on lower level functions against internal specifications.

Together, these four levels of design testing help assure that AMD processors are more than just compatible; they help assure that the processors are unique, reliable, and more powerful as well.

Compatibility by Test

Once silicon for the processor is delivered from the Fab, mass testing of the physical device begins. Real silicon has orders of magnitude and more throughput than a simulation model, but less controllability of the interfaces and less visibility into the execution details. AMD checks and rechecks the compatibility of its products at all stages of development, so many of the tests from the design phase are repeated on the actual silicon. The added throughput and leverage of the design verification tests offers an opportunity to catch the last few problems or bugs that may not have been as easy to locate before the chip was created.

The testing phase, however, is largely focused on getting the first samples to the Processor Validation Lab. Here chips are run with several different operating systems and applications in order to check for specific types of execution compatibility. Processor validation engineers are constantly designing new ways to check hundreds of applications and scores of operating systems, even versions that are well out of date. Rather than testing each piece of software in depth (which would be a huge task and incredibly impractical at this phase of testing), AMD's processor validation team focuses on taking a thin slice from a vast application/OS pool.

The effectiveness of the testing done in the Processor Validation Lab is not only measured by the sheer quantity of operating systems and applications tested, but more importantly, by the diversity of operating systems and applications tested.

Compatibility by Platform

After the Processor Validation Lab, silicon samples next go to the Platform Validation Lab. Even the most powerful processors in the world are useless if they don't work in a system. This phase of testing relies heavily on the industry standards adhered to

by AMD's "complementors"—manufacturers who build associated components such as chipsets, motherboards, and the various types of cards.

While the initial objective of the Platform Validation Lab is to validate chipsets, it is also necessary to test a broad selection of third-party platform components to determine a processor's compatibility in various system configurations. The lab's purpose is to validate motherboard implementation, to test electrical systems and BIOS, to complete stress and stability tests, and to try out a variety of hardware on ports and interfaces. The lab also covers OEM platform validation as a superset to the third-party testing. This includes extra BIOS testing (mostly in reference to power management issues); tests on AGP, memory, PCI, EIDE, USB ports; and general system tests that include Microsoft® WHQL and boot cycle test suites. During this process, engineers determine which types of critical components (power supplies, heat sinks, memory) work best in conjunction with the AMD processor under evaluation. This is why it is very important that each AMD processor-based system is built using components from the AMD Recommended Parts list for the specific processor used.

AMD platform engineers perform these complex batteries of tests to not only help ensure whole system compatibility of AMD products today, but also in concert with the collective goal of helping to create an Industry Standard Validation System for the future of compatibility assurance methodology on the platform level.

Compatibility by ISV (Independent Software Vendor)

Application software tends to be at the center of most end users' compatibility concerns. The challenge for AMD engineers in this case is how to test the vast multitude of x86 applications for processor compatibility. How can a deep slice of software be tested in a thorough manner without spending years in the process? Part of the work is done in the previously discussed phases of compatibility by design, test, and platform. But AMD doesn't stop there.

Each year, AMD provides numerous systems to developers working on applications for the x86 standard to help ensure compatibility in the ISV community. At the cornerstone of this initiative is AMD's relationship with Microsoft. AMD is committed to working with Microsoft to ensure the highest quality user experience with Windows® on AMD platforms. These practices include the creation of an internal team to ensure support for the features of AMD processors and platforms in all Microsoft product lines, deploying a large number of AMD systems in Microsoft build-and-test labs, and aggressive seeding of early hardware to Microsoft compatibility and development teams.

AMD processors are designed to be compatible with x86 industry-standard software, including the installed base of Microsoft Windows compatible software and operating systems. A company doesn't sell tens of millions of processors and win more than 90 processor and processor-based system awards worldwide without its products being able to run the tools people need every day. The bottom line—today and tomorrow—is that if it's from AMD, it's compatible.

About AMD

AMD is a global supplier of integrated circuits for the personal and networked computer and communications markets with manufacturing facilities in the United States, Europe, Japan, and Asia. AMD, a Fortune 500 and Standard & Poor's 500 company, produces microprocessors, flash memory devices, and support circuitry for communications and networking applications. Founded in 1969 and based in Sunnyvale, California, AMD had revenues of $4.6 billion in 2000. (NYSE: AMD)

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