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Adoption by Intel makes digital controllers mainstream technology, says Petrov Group

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The next generation of Intel's power architecture, VR12, to be introduced in the third quarter of 2011 represents a watershed industry event, according to Boris Petrov, managing director of the Petrov Group. For the first time ever the analog controller is being replaced by a digital controller in Intel's high-end computing point-of-load (POL) applications, that is, in the server power infrastructure.

The benefits of digital power solutions include power supply size reduction (higher power density), a high degree of flexibility in achieving high efficiency under varying operating conditions, design platform reusability across a range of applications, flexibility in changing operating parameters, ease of maintenance and upgrading, and higher system reliability.

Intel's adoption of digital power control represents its "stamp of approval" − a creation of a de facto industry standard in the x86 market segments which Intel dominates. Digital power control is a key enabling technology for the next generation of server power designs. This helps explain the rush of recent acquisitions of digital control power control IC vendors by leading power IC companies.

Intel and AMD are, of course, the dominant suppliers of server processors (about 75% and 20% market share, respectively) representing about 95% of shipped processors worldwide. Both vendors provide server power design specifications for their upcoming generations of processors. From 2011 onward both vendors are converging to very similar power design specifications.

Intel and ARM processor architectures are locked in a mega-battle for market shares in a range of large and fast growing market segments. One of the key determinants of that gigantic battle will be end-equipment's total power consumption − in all segments, from servers to portable/mobile devices.

Major server power supply functions include AC/DC conversion, PFC pre-converter, isolated DC/DC conversion, and server board level POL conversion. POL power conversion converts a power bus voltage (typically 48V, 24V, and 12V) to the voltage required by the load. Hence, POL applications require relatively low voltage power devices (typically in the 25V to 30V range).

Server POL power supplies provide power to the CPU (Vcore power), the supporting CPU chipset and memory, and a range of peripheral functions. CPU Vcore power requirements are the most demanding; server POL applications represent a fertile ground for new power technologies including digital power control and advanced power stage technologies. The main demand drivers are higher efficiency, smaller form factors, and reduced cooling requirements.

The current Intel specification VR11.1 stipulates use of a 6-phase POL power conversion for Vcore power consisting of an analog PWM controller and discrete or integrated power stages. Intel's new VR12 specification is targeted for processors (Romley series) to be available in third-quarter 2011. This specification, for the first time ever, stipulates the use of a digital power controller driving 4-phase power stages (integrated or discrete) for the CPU plus phase (4+1) for the new CPU chipset. Memory power is provided via a separate 1-phase POL solution.

Hence the VR12 specification represents a reduction from six to only four phases, that is, higher current per phase (45A) with total current remaining at 180A. Server board implementations typically feature one to four CPU sockets, each requiring a separate POL solution. Each power stage features a synchronous rectification requiring two high-performance power transistors-high side and low-side devices optimized for this application.

From the power supply system viewpoint power conversion ICs are analog power devices − regardless of how they are internally implemented. Digital power conversion devices use digital design techniques to implement the feedback control loop and the associated power management functions. However, the power stages used to deliver power to loads remain the same as in analog power conversion devices. Two major new elements are product-level oriented: (1) A smaller number of configurable products is required to support a broader range of applications versus a large number of standard analog products. However, the number of digital design implementations remains extensive. (2) A higher degree of design flexibility and parameter control Implications. Digital power IC vendors must possess extensive analog business know-how in addition to digital design know-how.

There are a number of IC vendors that are targeting server POL applications and that will be affected by the Intel adoption of digital control. They include ON Semiconductor (an entire platform solution for enterprise computing), Maxim (digital power control plus power stages), Intersil (Zilker labs digital power plus power stages), Infineon (Primarion digital power plus OptiMOS 5 disretes), Chil Semiconductor (digital power control), TI (digital power control and power stages), IDT (digital power control and power stages), Volterra (digital power control and power stages), Linear Technology (power stages), and many others. The Petrov Group analyzed 22 vendors of digital power management ICs.

Standardized power buses directly drive the need for digital power management and indirectly drive the need for digital power control. The main reason for digital power control is the natural fit for integrating digital power management and control. For example, Power-One has licensed its technology to a range of IC vendors, including Linear Technology, TI, Infineon, and Powervation.

Primary applications of digital power solutions are high complexity and performance power supply systems in computing, networking/telecom, and storage end-equipment. However, new applications have also emerged, including motor control in consumer appliances, in addition to traditional industrial and aerospace applications, Power-over-Ethernet in premises equipment applications, high-end digital consumer applications (digital TV, notebooks, battery-powered handheld equipment), and lighting and renewable energy (solar, wind) applications.

Intel's adoption of digital control will likely accelerate the evolution of power management techniques and technologies. Some of the major forthcoming changes are fairly obvious and easy to predict, some far less so. However, it is obvious that the year 2011 represents an entry into a new era in system power architectures and is led by Intel's well defined new industry standard, said Boris Petrov.

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