ANSYS

Technical Paper

Early Power Budgeting with PowerArtist™ for Live Applications Using Streaming Interface with Emulators

Power and energy efficiency are at the forefront of SOC design. Functional activity has a first-order impact on power. Increasing functional integration requires a comprehensive analysis of power consumption across complex modes of operation. Power inefficiency in any one mode can have a significant impact on the competitiveness of a product or time to market. Early visibility into the power profiles of live applications, such as operating system and firmware boot-up, ultra-high definition video frames, etc., is necessary to avoid costly surprises late in the product development cycle. This technical brief describes a high-performance and high-capacity approach to gaining early power visibility at RTL for such applications.

Products Used
ANSYS PowerArtist, PowerArtist VEctor Streaming (PAVES)

Keywords
activity, API, capacitance, cell selection, clock-tree, Design-for-Power™, emulator, FSDB, power accuracy, power analysis, power integrity, power debug, power reduction, RTL, streaming

Early Power Budgeting
ANSYS PowerArtist is an RTL Design-for-Power (DFP™) platform enabling high-impact power-related decisions to be made early in the design flow. Analysis of design data and clock activity, power efficiency metrics and a complete breakdown of power early at RTL enables architectural decisions with high impact. PowerArtist proprietary models deliver predictable power accuracy at RTL by accounting for physical effects including wire capacitance, clock trees and cell selection. (Fig. 1)

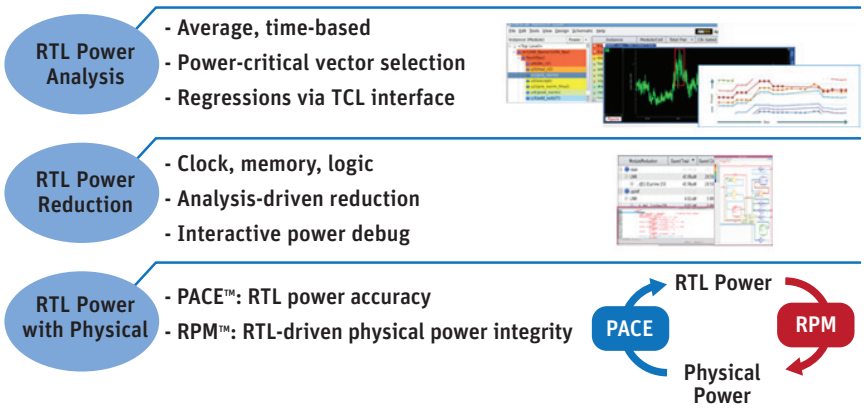


Fig 1. PowerArtist: RTL Design-For-Power Platform

Replacing File-based Activity Transfer with a Streaming Interface

PowerArtist typically consumes data acquired from a simulation test bench in order to compute power. Standard file formats used to store activity data include SAIF, VCD and FSDB. However, these formats are limited either in terms of capacity or accuracy, which makes them non-viable for power budgeting of live applications. SAIF does not include temporal information, thus compromising on accuracy. VCD is temporal but inefficient since it is a textual format. FSDB is temporal and a binary format, but the generation of this file can slow down emulators and simulators by more than an order of magnitude. Methodologies that employ power roll-ups and projections based on shorter-duration simulation activity data for sub-hierarchies are prone to inaccuracy.

An emulator-based activity streaming flow for power analysis allows RTL designers to compute power profiles of live applications by consuming switching data directly from the emulator without converting to FSDB/VCD formats. Emulators run real application-level test benches, execute long verification cycles, and can collect relevant temporal design activity. By replacing file-based activity transfer with a streaming interface, both the emulator hardware and power analysis software tools can run faster. More importantly, the flow provides early RTL power visibility for live applications otherwise not possible with a conventional file-based activity transfer methodology.

Early Power Budgeting for Live Applications

PowerArtist VEctor Streaming (PAVES™) is a new RTL power "socket" that can connect with emulators and simulators enabling streaming activity transfer. The PAVES socket interface with Mentor Veloce® emulator's Dynamic Read Waveform™ (DRW) API demonstrates the first delivery of such an integration, enabling early power budgeting for live applications. PAVES processes activity in parallel while Veloce is running. The high-performance integration enables early RTL power budgeting and gate-level power verification of live applications. This enables early power decisions and power budgeting for derivative designs.

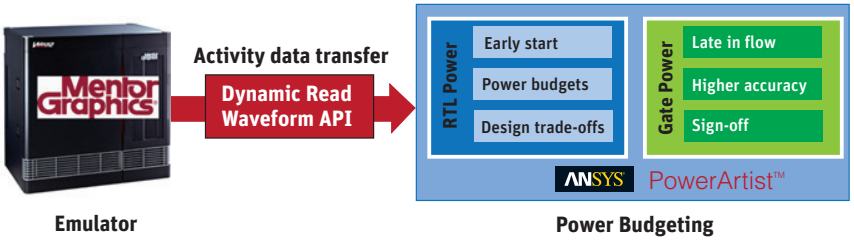
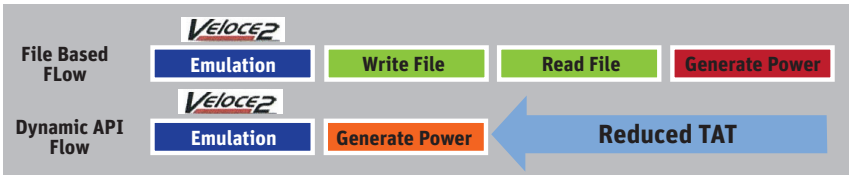


Fig. 2. PowerArtist PAVES streaming activity flow integration with Veloce emulator

Results for Speed Improvement of PAVES versus File-based Activity Transfer
Current early access partners and customers have seen runtime performance improvements up to 4.5X without compromising RTL-to-gate power accuracy. The table (Fig. 3, Courtesy: Mentor Graphics) compares the speed improvements observed for various design applications using the dynamic API flow against the file-based flow.



Design Description	Design Size	Number of Cycles	File Based Flow	Dynamic Read Waveform API Flow	Speed Improvements
GPU	13M	24M	20 hours	7 hours	2.85x
CPU Core	45M	3M	27 hours	12 hours	2.25x
Processor	65M	15M	51 hours	12 hours	4.25x
PCI subsystem	42M	11M	40 hours	10 hours	4x
Video Enc-Dec block	25M	0.3M	2.1 hours	0.9 hours	2.3x
Video Enc-Dec block	25M	72M	61 hours	30 hours	2x

Fig. 3. Performance results. TAT is turn-around time. *(Courtesy Mentor Graphics ©2015)*

Summary
PowerArtist with its emulator activity streaming interface PAVES reads switching data directly from an emulator enabling early RTL visibility and gate-level verification of the power profiles of live applications which was not practical with the conventional file-based interface for activity transfer. The user benefits from an overall turnaround speedup of 4.5X by replacing the file-based activity transfer with the streaming interface.

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