Integrated Digital Isolation Delivers Enterprise Energy Efficiency Benefits

The cumulative effect of efficiency improvements can be quite substantial

Power over Ethernet (PoE) standards have made it possible to deliver power to network devices along the same Ethernet cable used for data, eliminating the need to provide a 'wall wart' power cube for each device. Network power is thereby consolidated at the Power Sourcing Equipment (PSE) in the data-center, which has tremendous benefits of lowering cost, simplifying infrastructure and providing backup power management. Overall power management has been crudely addressed in previous-generation PoE clients via power classification, but these have largely been limited and static solutions.

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To reduce energy consumption in the enterprise, it's critical to focus on all aspects of energy: usage, allocation and management. With advent of the new PoE Plus (IEEE 802.3at) compatible PSEs, there is the added control functionality that allows for dynamic allocation of per-port Power Device (PD) power by the PSE. Using this approach, power can now be allocated and managed much as data bandwidth is today.

A new PoE System-on-a-Chip (SoC) that integrates an isolation barrier has been specifically developed to affect significant energy savings in the enterprise. The device's integrated isolation increases the power-conversion efficiency of individual PDs in a simple and cost effective way, while also enabling network software to reduce enterprise energy consumption with better allocation and management of power. The overall energy saved by using this device can offer considerable benefits in an enterprise setting where thousands of IP phones, WAPs, thin-client PCs and security cameras all draw power from more efficiently-loaded power supplies at the network center.

PD Efficiency Improvements

The cumulative effect of efficiency improvements at each of the PD nodes can be quite substantial across the enterprise. For example, if on average a PoE Class 2 IP phone draws an average power of 5.2W from the PSE, improving the PD power conversion efficiency by 5% (example from 86% to 91%) will provide over 500mW of savings at the PD, and approximately 700mW of savings referred back to the PSE input. Similarly a 20W IP camera can save 1.3W at the PD and over 1.6W referred to PSE input. Table 1 below shows savings for different types of appliance, assuming average power consumption based on the device PoE Class.

In a simple model of 1,000-employee enterprise that consists of 1100 IP phones, 60 wireless access point nodes, and 40 IP cameras, power savings at each PD node due to efficiency improvements will lead to over 860 Watts of power saving, and over 16.6kWH of energy saving per year when reflected to the PSE input, including savings from less heat dissipation in the data-center.

Intelligent Power Allocation

Allocation of PSE power in a traditional PoE environment consists of setting aside the maximum power that each port will be expected to deliver to a PD at any phase of its operation. In addition, maximum cable power losses must also be set aside. Generally there is a significant margin between the maximum advertised power and the actual power consumed. These maximums force the significant over-design of PSE power supplies. In addition, power supplies are much more efficient when used near their peak capacity, rather than under light loading.

For example, a traditional PSE will budget 7.7W of power for a Class 2 IP phone (6.95W for PD, 0.71W for 100m cable loss), and 30W of power for a Class 4 IP camera (25.5W for PD, 4.5W for cable loss). If the PSE could determine a PD's dynamic power consumption and the cable distance between the PSE and the PD, the PSE could substantially optimize its power allocation and hence reduce total required power at the PSE. Assuming average power drawn by the PDs, as in Table 1, and average Ethernet cable length of 50m between the PSE and the PD, intelligent allocation will reduce the power budget at the PSE by over 35% (7.3kW vs. 11.2kW for static allocation) in our 1,000-employee enterprise model.

PD Efficiency Improvement (91% vs. 86%)	Used Power (W)	Savings at PD (W)	Savings at PSE A/C Main (W)
IP Phone (average usage)	5.2	0.54	0.69
WAP (13W)	10.7	0.68	0.88
IP Camera / IP PTZ Camera (13W / 25W)	10.7 / 20.0	0.68 / 1.28	0.88 / 1.64

Table 1 – Average Power Savings per PD Node

This not only reduces the power supply size needed at the PSE, delivering direct cost savings, but it also allows the PSE power supplies to operate near full load conditions for higher efficiency, reducing power wastage and conversion to heat in the data-center. Energy savings for the 1,000-employee enterprise example can be over 11.8kWH, including the savings from reduced cooling requirements.

Enterprise Energy Efficiency Benefits

Using the 1,000-employee model, , if each PD saves an average of 0.5-1.3Watts, the total savings for the enterprise would be nearly 16.6kWh or €3,500 annually, assuming average European commercial energy rates. With typically-rising energy costs, this factors into a 5-year savings of over €20,000. The total savings approaches €35,000 over five years (Table 2 below) after adding in savings effect of intelligent power allocation between the PSE and PDs. Considering a five-year average life span of a PD, this translates to close to €29 in recurring cost savings per PD node, a substantial direct monetary benefit. It also helps enterprises achieve their energy efficiency objectives.

Energy savings from PD node efficiency, including cooling	16,626 kWh
Yearly savings from PD node efficiency	€3,500
Energy savings from Live Monitoring	11,836 kWh
Yearly savings from Live Monitoring	€2,500
Total yearly savings (PD efficiency and Live Monitoring)	**€6,000**
Total Lifetime Savings (5 Yr)	**€34,600 (€28.84 per node)**

Table 2 – 1000-Employee Enterprise Model Energy Saving Benefits

PoE Device with Integrated Digital Isolation

A new device by Akros Silicon called the AS1854 integrates Akros GreenEdge™ 2kV digital isolation technology with next-generation PoE PD and power conversion technology. This combination delivers groundbreaking power integration, and enables a new range of Digital Power PoE PD capabilities and solutions. A Type 1 (IEEE® 802.3af) and Type 2 (IEEE® pre-802.3at) compliant PD is integrated into the device with high-voltage isolation and quad-output digital power DC-DC converters – resulting in a complete PoE and power management solution in a single device with minimal external components.

The number of required voltage sources in a PoE-PD platform is similar to many embedded platforms that include a processor, DRAM/SRAM, Flash memory and I/O, each with different voltage and power requirements. For a VoIP

phone, there is often a display that may demand a unique voltage, whereas a pan-tilt-zoom (PTZ) camera will have multiple motors as well as low-voltage electronic power needs. By integrating four flexible dc-dc outputs in one power SoC, including digital isolation, the AS1854 simplifies PoE PD system design and delivers the benefits of power-system efficiency and intelligent management (Figure 1)

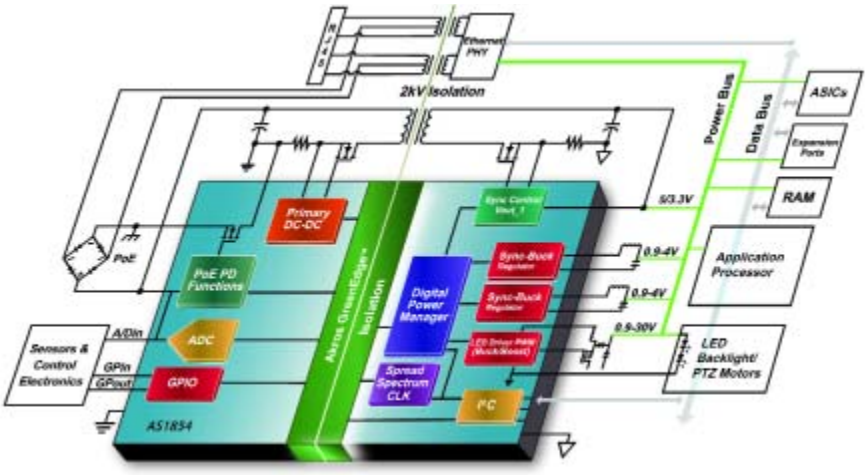

Figure 1: Akros Silicon's AS1854 in PoE Powered Device System

Integrated digital isolation offers a breakthrough for improving power system efficiency and dramatic cost savings. Using a built-in isolated synchronous driver for secondary side rectification, the AS1854 not only eliminates the need for external pulse transformers to create the sync drive, it allows the device to intelligently manage timing of the primary and secondary drives. This optimizes "Sync delay" and "Overlap delay" parameters, practically eliminating PWM timing related energy losses (Figure 2). Figure 3 shows the improvements in PoE power system efficiency delivered by the AS18x4 series products – which improves both light-load and full-load efficiency compared to traditional designs. The GreenEdge technology delivers efficiency improvements of over 8% in PoE Class 2 range, the one most commonly used for VoIP phones, over typical traditional designs.

Additionally, the device's integrated isolation technology enables direct digital management of both isolated primary power and secondary system power. Primary-side isolated ADC in the AS1854 device allows for direct power usage monitoring by the PD's µController across the isolation barrier. This "Live Monitoring" feature collects real-time power usage to pass to the PSE's Network Management software via standards based LLDP messaging. This enables the PSEs to deduce cable power loss and true PSE power allocation needed per PD port, eliminating blind allocation of maximum power to each PD.

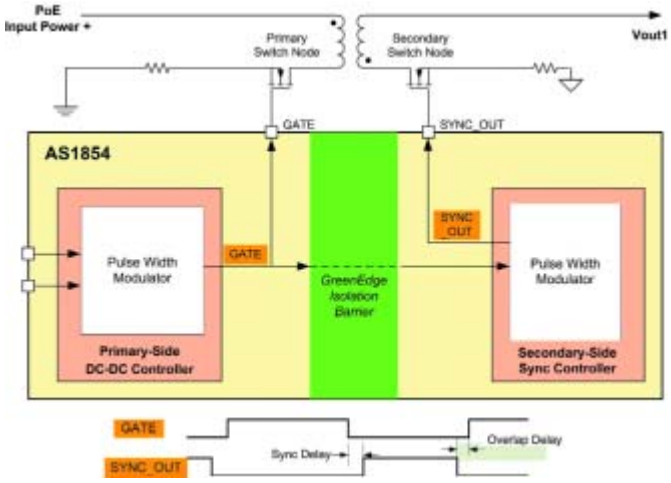

Figure 2: Primary and Secondary PWM timing management across integrated isolation

This approach for the first time enables PSEs to serve the same number of PDs with a much lower power and efficiently operating power supply. In addition, savings can be augmented upstream using a live monitoring capability, which allows for better power allocation and higher-efficiency PSE power supply utilization. Although isolated communication channels can be accomplished using discrete components such as opto-couplers, this approach tends to be slow, bulky and expensive, making the design more costly, much larger and sometimes even impractical.

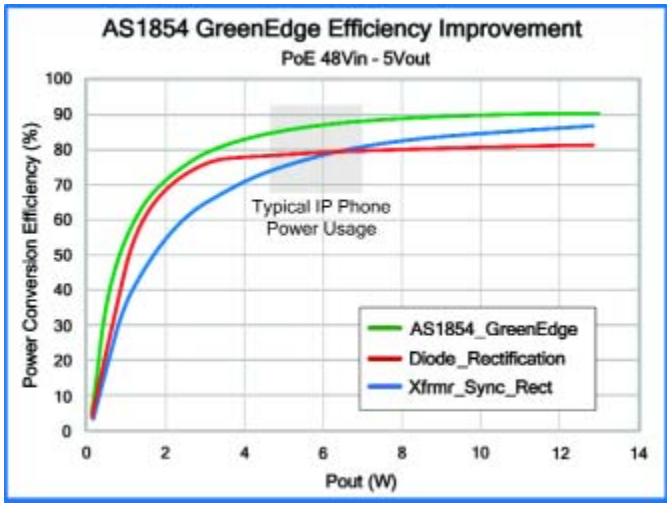

Figure 3 – GreenEdge™ Efficiency Improvement

Summary

PD efficiency improvements and intelligent allocation capabilities can deliver significant monetary benefits to the enterprise with lower energy usage and lower cost of power supplies in the data-center. A new device using Akros' GreenEdge™ integrated isolation facilitates energy-saving design improvements on the PD, reducing device power consumption with efficient power conversion across a wide loading range. This new approach to integrated high-voltage power management provides a unique opportunity for cost-effective, end-to-end "green power" applications. By employing the AS18x4 product family, designers now can create value-added and differentiated feature sets in a cost-effective manner, passing on recurring energy-saving benefits to their end customers.

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