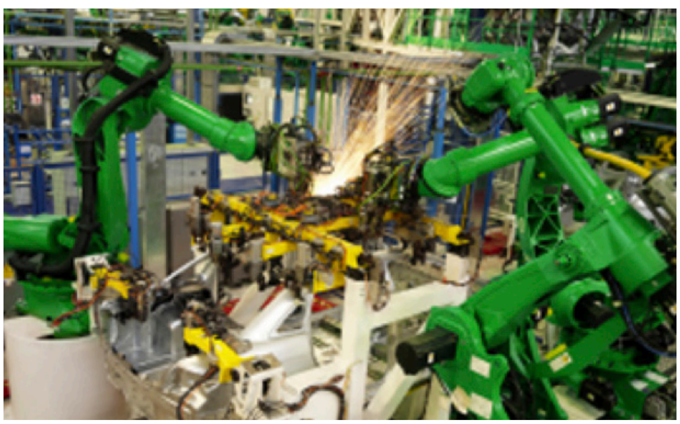
Power Management and Power Efficiency Can Differentiate Your Product

Bob Blumenscheid, Senior Product Marketing Manager, Digi International

If you are designing products for industrial applications, both power management and power efficiency can be differentiators. Power efficiency, one of the key parameters in any system design and integration, is the simple means of being able to do more with less. It could mean having more power available for more components or boards within the product. Or, it could mean designing a smaller system without having to compromise performance.



Industrial applications must balance performance versus power efficiency.

Power management, which should never be confused with power efficiency, is the means by which you can control the power usage within the system. That could mean that certain subsystems or components can be dynamically shut down or throttled back. The power within the system can be managed in a number of ways. For example, it could be controlled by custom firmware or it could be handled by the real-time operating system (RTOS).

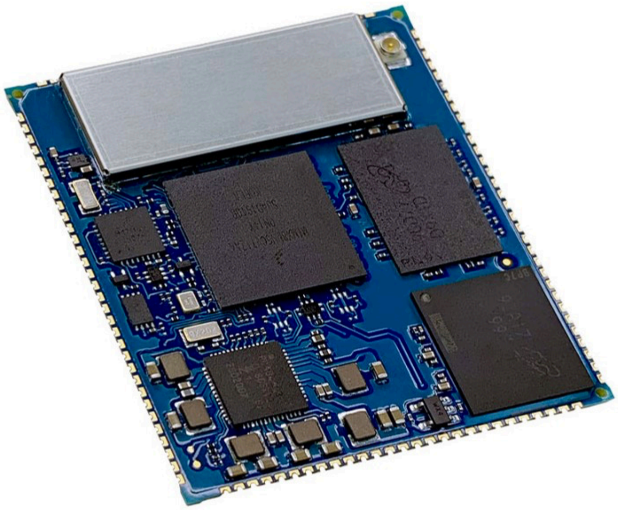
While the shutting on and off of devices is fairly straightforward, it's the power efficiency that's more of an art and not nearly as well known, but frankly, can be the "game changer" in your system.

Power Efficiency Is a Boon to Medical, Industrial, and Transportation Applications

Most applications have a definite need for power efficiency. The need arises for different reasons, but the need is still there. For instance, in an industrial application, the OEM may have a fixed power budget. By maximizing the efficiency of that system, more compute power can be integrated in. For example, more processors can be deployed, but only run at the highest frequencies when needed.

Alternatively, in a medical or transportation application, size may be the most limiting factor. Hence, by running the system more efficiently, you can reduce the number of heat sinks and fans because less heat is being generated. At the same time, a smaller power subsystem would be required.

In a hospital setting, you may have an array of systems connected through a secure IoT network. While power may be plentiful, it's certainly not unlimited. Hence, the need for power efficiency. In an untethered medical application, such as a cart-based product, mobility of a system may be required, which would necessitate a smaller, more agile platform. This choice is far simpler if the system is lighter weight, or designed for extended operation on battery power.



Developers are turning to SOMs for their industrial applications, thanks to extensive features, including easy upgradability and power efficiency.

Take Advantage of SOMs

System-on-modules (SOMs) are one recognized way to increase system performance while greatly simplifying the overall design. Deploying SOMs is not a new technique. It generally consists of a mezzanine approach with a CPU, memory, and basic I/O interfaces residing on the module, which is mounted to a single carrier board or a stack of boards to complete the I/O and system requirements. Using this approach, the most complicated part of the design can be separated from the unique I/O requirements of different carrier board solutions.

The SOM approach allows for simple scalability within a family of products by deploying a different CPU and different memory configurations on each SOM. Other than the SOM, the baseboard can be the same. That also permits an easier upgrade path for the systems integrator — just plug in a higher performing SOM. Assuming the CPU comes from the same family, the software upgrade process should be seamless as well.

SOMs are available from various vendors. For example, Digi International offers multiple SOMs with wireless on board, including 802.11a/b/g/n/ac and Bluetooth, as well as options to add cellular connectivity. The company's SOMs are designed using the latest microprocessors, such as the NXP® i.MX 8M Nano, i.MX 8X, and i.MX 6UL. In addition, the SOMs provide device security for connected IoT applications and contain support for embedded Android and Linux development environments, including the Yocto Project.

One of the key advantages of using SOMs comes back to power efficiency, in that the SOMs permit the use of "power domains." This means that the SOM can be handling the majority of the processing for the application, thereby allowing most of the remaining components, either on the baseboard or on other SOMs, to be shut down or significantly power reduced. In fact, it's even possible to manage the devices within a SOM, i.e., shutting off I/O that's not being used or memory that's external to the CPU, or even the CPU itself. While each of the power gains may be minimal, when you add them all up, their sum becomes significant. In most cases, the sleep modes can be attained either through a hardware or software shutdown.

Reduced Power Through Sleep Modes

Let's walk through an example using a Digi SOM that adds the 802.11 protocol, which is pretty common for wireless local-area networks. On the SOM, the typical transmit current is 120 mA. In idle mode, that drops to about 31 mA. But when you enter the sleep state, the current draw goes below 1 µA. That's quite a savings. The sleep mode can be entered either manually, by sending a hardware signal to the processor, or automatically, after a certain time interval has passed without any action.

Note that different applications have different needs in terms of how quickly they need the system to wake from its sleep state. Many SOMs can also differentiate between a sleep mode and a hibernate mode, with the latter consuming far less power but requiring more time to wake up. Additional factors include "suspend to disk" mode and "suspend to RAM." The former keeps the power consumption at the absolute minimum, while the latter is used for an ultra-fast wakeup.

SOM vendors like Digi are maximizing power efficiency by deploying multi-core CPUs, such as one with up to four Arm Cortex-A53 cores and one Cortex-M7 core, like the NXP i.MX8 family. That main four-core A53-based processor handles all of the compute-intensive processes associated with the SOM, while the extremely low-power Cortex M7 MCU handles just the power-management functions. So when a wakeup occurs, you're initially waking that very low-power core. The key here is how the M7 MCU meshes so tightly with the main processor for maximum efficiency.

While the obvious benefits from power efficiency come in terms of direct savings of dollars, the longer-terms benefits could be far more substantial, in that less power means less heat, which is directly related to product lifespan and reliability. Simply stated, devices that continually run near their maximum operating temperature will degrade faster, particularly in the case of non-industrial grade SOMs.

NOTE: Digi only selects industrial-rated silicon from NXP, providing lifetime expectation of 10 years in challenging conditions, even in a 24/7/365 duty cycle with temperatures ranging from -40° C to 85° C.

When considering maximum and minimum operating temperatures, it's important to ask whether your end product will be housed in an enclosure, and if so, will it have enough air flow and/or ventilation. If it will be in an enclosure, the power efficiency becomes far more important.

The Digi ConnectCore SOM Family

Digi's ConnectCore® family of SOMs offer all the power-management and power-efficiency features described here. They are designed with the NXP i.MX series of microprocessors that take advantage of the CPU-plus-MCU architecture.

For example, the Digi ConnectCore 8M Nano is designed with an NXP i.MX 8M Nano processor, and focuses on longevity and scalability in industrial IoT applications. It's built to the company's SMTplus form factor (40 by 45 mm) which allows for interchangeability between modules to potentially widen an OEM's product family. In addition to display camera capabilities with hardware acceleration, the SOM is pre-certified for dual-band 802.11a/b/g/n/ac 1x1 and Bluetooth 5 connectivity, as well as an integrated cellular modem and Digi XBee® integration.

For the latest in integrated device security, identity, and privacy features, the Digi ConnectCore 8M Nano maintains compatibility with the Digi TrustFence® security framework. From a high level, Digi TrustFence enables developers to integrate sophisticated device security into the end product, including identity and data privacy capabilities, which are requirements for mission critical applications. It includes secure boot, which means that programs and code running on the device are validated to be from an approved source or manufacturer. It also protects the system's hardware ports. Here, internal and external I/O ports are hardened and access-controlled to prevent unwanted local intrusion.

Digi TrustFence also provides a series of data authentication and device identity management options. It ensures that products are not shipped with default user and password settings. The latest encryption protocols are utilized for data in motion and over-the-air (OTA) transmissions to ensure the integrity of data flowing across a network.

At the end of the day, a host of features will define your end system. Developing with SOMs makes it easier to check off many of those boxes. And with Digi SOMs, you can be assured that you're operating with the highest levels of power management, power efficiency and security.

You can reach a Digi expert for assistance with your next development project at www.digi.com/contactus.

Bob Blumenscheid is a Senior Product Marketing Manager at Digi with over three decades of experience in technology fields. His roles have included sales engineering and sales management as well as product marketing and business development. In his second stint at Digi, Bob plays a key role in driving product marketing for Digi embedded products.