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CREATIVE WIRELESS ELECTRONICS

# The 5 keys to maximising your battery life

# Introduction

Smart devices and wireless networks have evolved rapidly but they are still beholden to more humble battery technology. Unlike some other technologies, the evolution of battery technology is linked to a proportionate rise in cost, so any developments in extending battery capacity are likely to be expensive.

Happily, there are ways to extend the useable life of battery powered wireless devices by designing systems that embrace the necessary complexity needed to achieve this. Wireless system designers can use a number of innovative design approaches to low-power communications which optimise battery life. Here are our 5 design secrets to help you maximise your battery life.

# Overview

# Key 1: Duty cycle

The amount of communication activity a device needs is a key design issue. The first approach to minimising battery usage is to look closely at the required activity and to minimise it. Duty cycle refers to the percentage of a period of time that a signal is active. This distils into two key areas: maximising sleep time and minimising awake time.

## Sleep time

Whilst sleep time minimises communication activity the device still needs to be responsive when required by the user. Generally devices will communicate wirelessly at set periods to maintain contact, but this will vary per application. For some applications this may not need to be as regular as for an 'on-call' device. Therefore, it's vital to understand the specific needs of the application when this is designed.

## Awake time

The key issue with awake time is to assess the processing that actually needs to be done by the device. With a wireless network it is also essential to confirm the vital transmissions as this will be a key user of battery resources. The ideal solution is often to aim for high bit rate transmissions as these send data rapidly before the device goes into sleep mode to preserve power.

# Key 2: Micro-scheduling

Micro-scheduling revolves around the amount of 'listening' a device will do in responding to signals from the network. This technique helps minimise wasted transmissions (with the corresponding power usage) and can offer substantial power savings.

Ideally micro-scheduling will be hidden from users, a sub-system design element that should be as unobtrusive as possible. The best design is one that appears to offer 'always on' performance but that reduces the amount of communication activity through smarter use of resources. One technique is to check for the presence of a signal before attempting to respond to it, rather than fruitlessly trying to connect and using valuable resources to do so. Micro-scheduling is already a standard feature in many battery powered devices (such as smartphones and tablets) and can achieve significant power usage savings within wireless system design.

# Key 3: Sleep current

A power-conservative wireless network will spend as much time in sleep mode as possible. If the sleep current dominates the average current drain in the system then batteries last longer whilst still enabling optimum system performance.

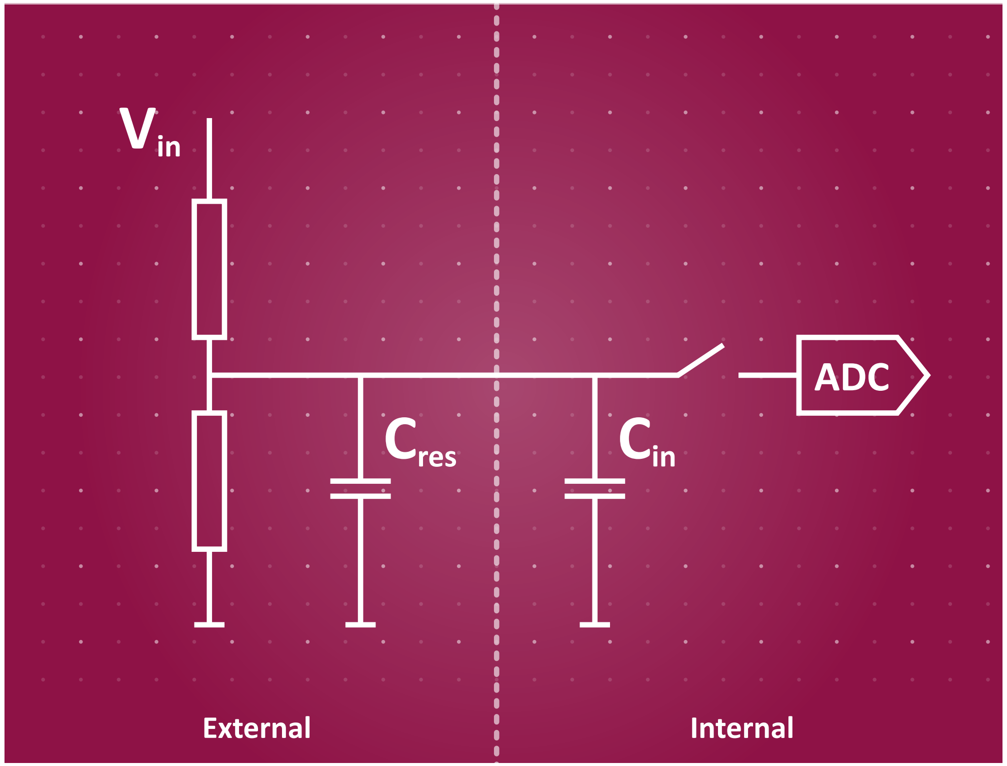
Being such an obvious energy saving function it's easy to see why an effective sleep current facility becomes an important factor when choosing the right devices for the design. This can be further extended by the use of low power controllers to ensure the transition into an awake mode is not power-hungry either.

# Key 4: Low power support circuits

It's important to take an overall view of the system design and to remember that all the key parts of a circuit could affect the drain of current from the battery. With a duty cycle in place, low power support circuits can add additional power saving benefits.

Using voltage regulators can offer energy-saving benefits. Their low ground current is a critical factor which can vary by many micro-amps (µA) and can be sub-µA as well.

Another support circuit resource is avaliable through voltage sensing networks, shown in the diagram. When designing voltage sensing networks care is needed on the ADC (analog-to-digital converter) inputs. A high resistor value is needed to limit the current, usually a few megaohms. It is crucial that the $C_{res}$ value is greater than $C_{in}$ to avoid a false low reading. This limits the bandwidth of the sensing to tens of hertz.




Schematic of a microprocesser voltage sensing circuit

# Key 5: Battery choice

Obviously, battery choice is absolutely critical. From a systems design point of view there will always be a trade-off between the need for wireless devices to be small (and therefore have a small battery) and the ability to have a high current pulse to send signals effectively.

It's also important to understand battery characteristics. When it comes to capacity, fairly straightforward sums are involved. For example, a 1Ah (Amp hour) battery will supply 1mA for 1000 hours (41 days), or 1uA for 1 million hours (114 years). However, you should be aware that shelf-life and self-discharge issues often limit a modern battery to a 10-20 year lifecycle. Another factor is pulse capability – literally, how much current can be taken without ruining the output voltage or capacity of the battery.

Common sense and experience show that small batteries and a high power current do not work well together. Complex devices in particular take pulses of current which can adversely drain a battery quickly. For example, a 2.4GHz 802.15.4 transceiver takes 16mA or more to receive or transmit. In this case, small alkaline batteries are better at pulses than coin-cell lithium ones (which are often rated at less than 10mA). A possible solution is to use reservoir storage such as capacitors and super-capacitors to help make energy efficiencies. However, large capacitances can also be problematic with wireless systems.

# The secret recipe

In practise, the best way to achieve battery power savings is to find the ideal blend of several or all of these key approaches. Finding intelligent power-savings across the board will enable wireless systems to provide the required performance levels with greatly enlarged battery life.

Using key techniques such as low duty-cycle, micro-scheduling, sleep currents, low power support circuits and the right battery can all help to greatly extend the usable time period from a battery. More importantly, a combination of two or more of these can offer remarkable increases in performance when intelligently applied.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Having had many years of experience helping clients make the most of their battery-dependent systems why not call one of our wireless system designers to talk through your current needs, wherever you are on the product development cycle.

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