Do electronics need a winter rest too?

Mach technology (NL), Roland van Straten, 12-10-2025

Disclaimer: This article will not solve world problems but show how (even small) design choices can make a difference by using nature as one of your engineers!

Hibernation

Hibernation is a biological rest, but also part of a life cycle. A period of activity is followed by a period of rest. It can be short like day/night and could be longer like when the winter season is there, but essentially it is a time to conserve energy and regeneration. If one does not rest ultimately one will burn up itself.

For us, hyperactive humans, a digital rest like a hibernation would do wonders, time to recalibrate, check perspective, etc. Likewise in electronics, and especially IoT, hibernation, or sleeping helps to save energy, to recalibrate, to adjust to change. As such, conserving power is not a discipline that power electronics owns, but it involves multiple disciplines and is dynamic by nature.

Turn off

Let's try to conserve power. Less battery waste and minimise energy use, that is good for everyone. But if we truly want to save power, it should be turned off. As said, always on, 24/7, will just waste energy. The battery is emptied not by its use, but its idle time. When something is not responding, would that be a problem? Suppose it starts working a few hours later? The question for the system should be: I get no answer, but was the product scheduled to be operational at this time? Power off is no option, so let's go through some steps that help to lower the consumption.

Context is important

Consider the user interface. Suppose you have a display that is aways on, it "burns up" the backlight over time, uses energy at times no one is using it and ultimately shortens the life cycle of the product, a waste on all accounts. Adding a movement sensor, detect a keypress or switch off after office hours, are all ways to conserve energy. Turn down the intensity of the screen by the amount of ambient light.
To implement this efficiently context is important. Understanding how the product is used is essential to make it efficient and smart software saves energy

Nature – Nurture

We all know about nature (when you are born) and nurture [1] (what you experience after that). We are born with skills, and we learn how to put them into use. If such is applied on electronics you could say that core elements (nature) are hardware constraints, operation limits, boot states, watchdog, etc. and the way it can adapt (nurture) is by using sensors, change duty cycles to conserve energy, decide on the context and change behaviour though software updates. Even more so, with machine learning it becomes increasingly easier to make autonomous decisions.

Immune System

A Battery Management System (BMS) can be seen as the immune system of the energy storage to keep everything healthy and safe. Then consider power management as muscles of a system, with new heavy weights like GaN and SiC materials that are more efficient, more compact, and cooler.

Brains

The brain in nature is different in size, modular organised and has a hierarchical structure.
A microcontroller together with the software to drive it is similar as the brain. It has tasks, drivers, it has memory, it coordinates actions, uses interrupts to perform tasks in background, keep a tap on timing, handles events. And now we move into areas where a system will self-adapt, use feedback loops and neuron networks to make decisions.

Central Nerve System

In nature connectivity the physical layer is hormones, pheromones, electrical impulses, sound, vibration but these do not function without metabolism. Nature is quite clever. We have the world-wide web, but trees were earlier in designing the wood-wide web [2]. Tiny threads of fungi, mycelium, form a vast underground mesh network. Resources are shared like sugar, chemical reactions as warning signals.
We have low-bandwidth mesh networks (mycelium) that are resilient. We build networks that route data through the network (pheromones).

Emergent Behaviour

Where it becomes interesting is emergent behaviour like 1+1=3. You can bring things together that bring unforeseen results. Think about these analogies:

Nature	Technology	Emergent outcome
Ant colonies	Network routing	Optimal paths without central planning
Neurons	Neural Networks	Pattern recognition
Immune systems	Intrusion detection	Anomaly detection and mitigation
Bird flocks or school of fish	Swarm drones	Self-organising
Fireflies [3]	Oscillators	Synchronisation and phase adjustment

Endnote

In an embedded design many different disciplines come together: user interface, embedded software, positioning, sensing and control, connectivity, motor control and power management. The weight of these disciplines in a product depends on its intended use. Thinking about nature is thinking in systems, not in only one discipline.
Use your hibernation time to see what you can learn from nature, capture its ideas, use the patterns and implement behaviour [4][5][6]. They are already tested for hundreds of years. Drop me a message at nature@machtechnology.nl to further discuss how we can bring nature into your products!

[1] “No Two Alike” by Judith Rich Harris.

[2] The wood-wide web explained: https://youtu.be/yWOqeyPIVRo?si=LqiCP5FHlDG1bipx

[3] “SYNC” by Steven Strogatz on “How Order Emerges from Chaos in the Universe, Nature and Daily Life.”

[4] “From bacteria to Bach and Back” by Daniel C. Dennett on the evolution of minds.

[5] “ The Invention of Nature” by Andrea Wulf on the adventures of Alexander Humboldt.

[6] “I Am a Strange Loop” by Douglas Hofstadter on self-awareness.