Green ICT: The IoT World Also Needs Ecological Awareness

Options for optimizing the lifecycle assessment of IoT devices.

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Microelectronics support the fight against climate change and for a better environment; for example, by intelligently controlling drive units, ensuring optimal operation of energy systems, and monitoring the resource requirements of production processes.

Unfortunately, however, the ICT sector itself is one of the fastest-growing emitters of greenhouse gases and consumes a great deal of resources [1].

- ICT is responsible for as much as 4% of global electricity consumption, while 1.4% of global emissions result from the use of ICT.
- A single semiconductor fab can consume up to 99 million liters of water – every day.
- Electronics is the fastest-growing category of waste.

Trends such as the comprehensive digitalization of our everyday lives through the Internet of Things and the use of artificial intelligence, which requires the construction and operation of power-hungry data centers, illustrate the growing challenge.

In Europe, regulatory requirements for the lifecycle assessment of industrial production and supply chains have been in place for some time, meaning that there is an acute need for companies to take action. However, such an assessment includes a holistic view of the entire life cycle, including the use of resources for materials and production, the energy required for operation, transportation to the customer, service costs, and disposal.

In the following, the focus will be on the IoT. Major leverage can be expected here: a single component in an IoT device, such as a MEMS sensor, is responsible for only 80g of CO2 [2], but one manufacturer alone can produce several billion sensors over many years [3].

So what options are there for optimizing the lifecycle assessment of IoT devices in particular? Here are some examples:

Shifting the implementation of algorithms from the cloud to the device reduces the energy required for communication. This obviously increases the energy consumption of the device itself, though.

Simplifying the design may result in less material being used, but it will reduce the device's repairability and therefore its potential service life.

Batteries are used in many wireless and mobile devices and often contain materials that are harmful to the environment. Energy harvesting (e.g., with solar cells or motion generators) means batteries can be smaller or even excluded altogether – however, this makes the device's design more complex and often bulkier, and entails the use of other materials that are difficult to dispose of.

Economic factors also need to be taken into account, as the products must be brought to market at an acceptable price and must be user-friendly.

It shouldn't be forgotten that some optimizations of the lifecycle assessment also offer collateral benefits and can make the IoT system more attractive to users:

- Lower energy consumption reduces the need for inconvenient battery changes.
- Repairable products have a longer life, which makes them more economical for users.
- The ability to update software extends the useful life of products and avoids electronic waste, while also greatly enhancing users’ IT security.

So there is no simple, general solution. Rather, it’s necessary to take a concrete and comprehensive look at the respective system.

The “Green ICT @ FMD” competence center [4] is investigating standard components such as inertial measurement units (IMUs), millions of which are used in smartphones, robots, drones, cars, and bridge structures. The sensor variables they record (rotation rate and acceleration) form the basis for motion control, navigation, and condition monitoring.

The center uses specific application profiles to investigate which sensor types represent the optimum solution in lifecycle assessment terms with regard to the carbon footprint of the materials used, their accuracy, and their energy requirements. It also considers the effects of the sensor technology’s operating regime, especially in combination with frequently energy-hungry global navigation satellite systems (GNSSs).

References:

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