# Holding the line

Innovative, wireless tech solutions can help reduce global deforestation and conserve biodiversity

### In Short

As global demands for food, materials and energy increase, the world's forests are increasingly subject to threats like illegal logging

Protected land zones in rainforests are critical for biodiversity conservation, but restrictions in these areas are difficult to enforce

The Nordic-backed 'Code of Conscience' initiative aims to help NGOs, governments and communities monitor and restrict heavy vehicles in protected areas

Other innovative wireless conservation technologies including remote monitoring systems help reduce deforestation

Around a third of the Earth's land surface is covered by forest. Across the globe, forests provide food and habitats for wildlife and indigenous populations, protect vulnerable ecosystems, stabilize weather patterns and play an ever more vital role in reducing the impact of climate change. In a 2018 joint statement, the United Nations' environment, development and agriculture chiefs asserted "forests are a major, requisite front of action in the global fight against catastrophic climate change — thanks to their unparalleled capacity to absorb and store carbon."

Unfortunately, these same forests are experiencing a consistently alarming decline. Increasing global demands for food, materials and energy is leading to damaging levels of deforestation and forest degradation. The harsh reality is that human-driven threats including farming, livestock grazing, mining, drilling, logging and urbanization, as well as natural events like drought and wildfires, combine to decimate forests and harm terrestrial biodiversity. According to a landmark report by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), approximately 2.9 million square kilometers ($km^2$) of native forest cover was lost from 1990 to 2015 due to clearing and wood harvesting, 50 percent of agricultural expansion occurs at the expense of forests and ten to 15 percent of global timber supplies are provided by illegal forestry. The report notes there was a seven percent reduction of intact forests from 2000 to 2013 alone in developed and developing countries.

The problem is becoming chronic; between 1990 and 2016, the world lost 1.3 million $km^2$ of forest—an area larger than the size of South Africa—according to the World Bank's 'World Development Indicators' database. In 2018 alone, global tropical tree cover shrank by 120,000 $km^2$ – the fourth-highest annual decline since records began in 2001, according to data provided by Global Forest Watch (GFW), an initiative of the World Resources Institute. The GFW open source web application monitors tree cover losses from Brazil to Ghana in real time using satellite imagery and remote sensing technology. Meanwhile, the World Wildlife Fund (WWF) claims on average, the world loses 75,700 $km^2$ of forests annually — the equivalent of 27 soccer pitches every minute.

Attempts to arrest deforestation rest in major part on protected land areas, particularly within tropical rainforests. These are proving critical for biodiversity conservation as well as the continued existence of culturally rich local communities. But borders, regulations and restrictions don't entirely guarantee the health and safety of a forest.

For example, despite the presence of conservation programmes and dedicated efforts on the ground, about 17 percent of the world's largest intact forest, the Amazon, has been lost in the last five decades, according to WWF. Satellite data released by the Brazilian Space Agency's deforestation monitoring system shows deforestation of the Brazilian Amazon (which makes up 64 percent of the 6.9 million $km^2$ Amazon basin) has accelerated drastically following a spike of invasions to exploit natural resources amid the COVID-19 pandemic. Our forests need help.

## CODE OF CONSCIENCE

Thankfully, innovations in environmental conservation-related technology may offer some light at the end of the canopy. One promising initiative aims to help NGOs, governments and communities around the world monitor and restrict the use of heavy-duty vehicles—the kind that are used to rip through the forest in both legal and banned logging operations—in protected areas. Launched in September 2019 by a collective of designers, engineers and content creators led by global agency AKQA, Code of Conscience is a proof-of-concept (PoC) to protect against illegal deforestation. Open source software uses publicly available, regularly updated, cached and compressed mapping data, in conjunction with existing GPS tracking technology installed in construction vehicles, to autonomously restrict crews from entering protected zones (determined by the UN World Database on Protected Areas). The open source software provides the GPS-based geofence capabilities which interlock with the fuel pump systems of the machinery, enabling automatic shutdown if the equipment moves into a restricted area.

Integrated cellular connectivity enables notifications and audits of the machinery's position during normal operation and also provides a method of updating map data. A small, low-cost chip has also been developed to equip older, non-GPS vehicle models with the same code. With a vision for all new machines to leave the factory with Code of Conscience technology pre-installed, the collaborative sent the CEOs of the world's top-ten construction equipment manufacturers an invitation to participate in the iniative along with the Code of Conscience chip embedded in a wooden sculpture of an endangered animal.

"We made the Code of Conscience open source because we wanted to be transparent about how simple this initiative is from a technology standpoint," says Tim Devine, Executive Creative Director at AKQA (Australia and New Zealand). "The sociopolitical challenges of implementing this at scale are the most urgent to solve. Many of the regions where the Code of Conscience will be useful have complex sociopolitical conditions with extreme environmental variation."

The collaborative began by working with NGOs, governments and local communities to pilot a project in the Amazon using Nordic Semiconductor's Nordic Thingy:91 multisensor cellular IoT prototyping platform to demonstrate its PoC design for tracking forestry and agriculture vehicles, both on land and water. Looking ahead, the goal is to establish more key partnerships to help accelerate the Code's transition from PoC to adoption.

"Telematics exists in hundreds of millions of vehicles worldwide, many of which are heavy vehicles used in forestry and agriculture. If there were the will, we might be able to effectively 'switch it on', potentially saving millions of hectares of protected forests," says Devine.

It's a sentiment shared by Matthew Adams, Lead Engineer at Tekt Industries, the Australia-based technology company responsible for developing the original hardware

### By the Numbers

**THE GLOBAL IMPACT OF DEFORESTATION**

It is estimated that over

**15 billion**

trees are cut down each year

*Source: Tree density projections from a 2015 'Nature' journal study*

**75%**

of the land-based environment has been severely altered by human actions

*Source: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)*

Up to

**90%**

of logging in tropical rainforests is illegal

*Source: UNESCO*

Forest loss contributes to around

**15%**

of all harmful greenhouse gas emissions

*Source: World Wildlife Fund (WWF)*

for Code of Conscience based on Thingy:91. "Citizens are beginning to look at intentionality in the design of products, and companies manufacturing these machines have the opportunity and the power to shape the future of our planet through the responsible design of their machinery," says Adams. "Long-term we hope to see greater accountability and transparency for all machinery which works around protected sites worldwide."

The Nordic Thingy:91 proved an ideal 'out-of-the-box' solution forming the foundations for a future custom device, according to Adams. "Given the remote installation and potential support issues with the hardware, the Thingy:91 was a natural choice as a proven low-risk technology which could easily be taken up by OEM partners and effortlessly integrated into their machinery," he says.

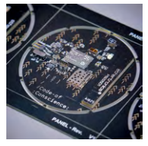
## SHOWING INITIATIVE

Wireless tech is also being embraced by innovators as a potential solution to other global forest environmental conservation challenges.

For example, inspired by the UN Global Goals initiative, the not-for-profit Micro:bit Educational Foundation invited children and teens to design sustainable development solutions using the Nordic-powered micro:bit, a tiny yet powerful pocket computer with wireless capability. (*See* WQ *Issue 4, 2019, pg8.*)

Young coders around the world responded to the "do your:bit" BBC micro:bit challenge by creating an impressive variety of tech-based sustainability solutions, including a number designed to help protect life on land.

The North America winner, Lynn, created a unique device for highlighting the dangers of deforestation to local communities by detecting loud sounds in forests. Using a Raspberry Pi ultra-compact computer with a connected camera and a microphone that communicates with the micro:bit, the system wirelessly relays an audio signal then automatically takes a photo and posts it to a public Twitter account. A local park ranger can then review the picture to determine the source of the noise—which could be the crack of lighting or something more sinister, for example, the buzz of a chainsaw—and respond accordingly.



### Tech Check

The Code of Conscience PoC uses the Nordic Thingy:91 to support an initiative to restrict heavy vehicles from entering protected land areas. Built around the nRF9160 SiP, the Nordic Thingy:91 is a prototyping platform for cellular IoT using LTE-M, NB-IoT and GPS, ideal for creating PoC demos and prototypes. Cellular connectivity alongside GPS makes it suitable for sophisticated asset tracking solutions.

The Middle East winner, Zayd, created the Z Palm Tree, a complex device enabling a tree to 'communicate' its needs. The system uses multiple sensors including a vibration sensor to detect the tree being cut down, a flame sensor to detect the tree being burned down, a moisture sensor in the ground to detect water level and a temperature sensor to approximate the air temperature. All the collected sensor data is sent to a bespoke smartphone app using either Bluetooth LE or Wi-Fi connectivity, providing the user with updates on the tree's status and warning of any impending or immediate dangers.

At the 2019 Zoo Hackathon event in Bogota, Colombia, teams proposed a number of technical solutions for controlling the production chain to combat illegal logging and deforestation. The solutions needed to be inexpensive, scalable, interoperable with the Colombian Ministry of the Environment and Sustainable Development's information system, and exclusively based on open source development services. The winning team presented a solution to track logging from extraction to manufacturer using an IoT device installed in trucks. The device detects anomalies, for example a deviation from an established route, and sends suspicious activity alerts to authorities.

## REMOTE FOREST MONITORING

A number of other environmental innovators see the ability to remotely monitor activity in forests as the key to reducing global deforestation and conserving biodiversity. Brazilian startup Treevia has developed SmartForest, a wireless sensor-based monitoring system that enables the remote tracking of forest growth rates in real time. Once fixed around trees, the sensors capture changes in tree diameter at regular intervals. The collected data is relayed via a wireless network to the company's customized web-based system. The information is then combined with satellite images and analyzed by machine-learning algorithms to detect early signs of infection or pest attacks on plantations and provide researchers and technicians with reliable estimates on how well the forest is developing.

San Francisco-based not-for-profit Rainforest Connection (RFCx) has developed a solar-powered, wireless acoustic monitoring system using modified recycled smartphones fitted with an extra microphone to continuously monitor the sounds of the forest. Using the standard local cellular network, all the audio is relayed from the canopy-mounted 'Guardian' devices to Cloud-based servers. Google's TensorFlow machine learning framework then uses AI techniques to continually monitor and detect the telltale indicators of illegal deforestation activity, such as the specific sounds made by heavy machinery. Text alerts can be automatically sent to local authorities for further investigation, while the comprehensive ecosystem data also aids negotiations for greater protections in these areas. Various partners on the ground are using the RFCx system in projects to protect rainforests across Brazil, Peru, Ecuador, Costa Rica, Romania, Cameroon, South Africa and Sumatra.

Meanwhile a joint venture between the International Institute for Applied Systems Analysis (IIASA) and business intelligence tools company, SAS, has launched an initiative to combat deforestation by engaging crowdsourced 'citizen scientists' to examine satellite images of the Amazon rainforest for signs of human impact, such as roads and forest clearances. At the same time, the system uses the human input as a method of training AI to detect the human activity in future. As the volunteers carry out the work using a Cloud platform, an AI engine is continually learning how to accurately perform the same task at a much faster rate.

Whether it's customized cellular IoT devices installed on construction vehicles to prevent illegal logging activity, machine learning systems tracking data on forest growth, smartphone-based acoustic monitoring devices reporting sounds of destruction or earth-imaging satellites mapping changes to land use for review by volunteers, technology is now at the forefront of the fight against deforestation and the battle for biodiversity. Wireless and non-wireless surveillance solutions may not be able to 'save the forests' on their own, but remote access to actionable information and real-time alerts could effectively support the individuals, organizations and communities prepared to make a difference.

> "Long-term we hope to see greater accountability and transparency for all machinery which works around protected sites worldwide

## Mixed results for corporate biodiversity targets

Many everyday consumer goods directly or indirectly contribute to the issue of deforestation. For example, tropical rainforests are often illegally logged or cleared to grow plantations of commodity crops such as palm oil, which is found in around half of all packaged products. Palm oil is cheap and versatile, making it a popular choice for manufacturers and retailers everywhere. These days, buyers and users are strongly encouraged to only purchase products containing Certified Sustainable Palm Oil. When a company continues to purchase unsustainable commodity crops like palm oil sourced through deforestation, it is effectively funding forest destruction and biodiversity loss.

The good news is that corporate attitudes to these challenges are changing to reflect consumer sentiment. A 2018 study led by Oxford University's Department of Zoology revealed that 49 of the top 100 companies from the 2016 Fortune 500 acknowledged biodiversity in their reports, with 31 making clear commitments to the cause. However, only five of these could be considered "specific, measurable and time bound", according to the study. Moreover, only nine companies provided quantitative indicators to verify the extent of their biodiversity activities, while no companies reported quantitative biodiversity outcomes.

Elsewhere, ambitious biodiversity and sustainability goal-setting has not always proved a reliable indicator of success. Industry trade group, the Consumer Goods Forum (CGF), recently suggested that hundreds of member companies that made 2020 zero net deforestation pledges had underestimated the scope of the task and would fail to meet their own deadlines. For example, Nestlé and Procter & Gamble—the world's two largest consumer goods companies—announced in September 2019 that they will fall short of self-imposed targets for their products to use no ingredients that contribute to deforestation by the end of this year.

Some corporations in the technology space are at least demonstrating a willingness to adjust their approaches. A September 2019 report by IoT specialist, Libelium, explored the IoT's contribution to the United Nations' Sustainable Development Goals and explained how the company's technology is supporting the achievement of these goals. Last year, multinational manufacturer, Siemens, declared: "Environmental efficiency is just as important as productivity, flexibility and time-to-market." It is now, for example, using IoT and technology to help a chocolate maker reduce primary energy consumption by 20 percent.