Holding the Line

Using cellular IoT geofencing to fight global deforestation and conserve biodiversity
Fighting the COVID-19 pandemic is still the global priority and it’s a battle in which Nordic’s customers are playing a critical role. But Nordic is also starting to look to a future where SARS-CoV-2, the virus behind the disease, has been eradicated and the world returns to normal – albeit a normal that’s different from before.

Post pandemic, the world’s most pressing problem will be the one with which it was grappling before: finding new ways to build a sustainable lifestyle.

Post pandemic, the world’s most pressing problem will be the one with which it was grappling before: finding new ways to build a sustainable lifestyle.

Looking at how the tech sector can contribute, Nordic and Qorvo have established a partnership to develop a new technology that utilizes both Bluetooth LE and UWB. The combination of these two technologies promises to offer a new level of precision and accuracy.

“With UWB added to Qorvo’s product line, all the major barriers are broken, and the rules have changed;" says Geir Langeland, Director of Sales & Marketing with Nordic. “What’s often missed about cellular IoT is that its range far exceeds what was previously made such a solution cost prohibitive. “Now, with the Nordic-nRF9160 SiP, all the major barriers are broken, and the rules have changed;” he says.

“The heart data can then be remotely viewed in an app they can review their data. "Real time" at the device. The data is then transmitted to the cloud and can be analyzed by healthcare professionals. “With UWB added to Qorvo’s product range, our collaboration now covers three complementary technologies across a wide range of applications," says Geir Langeland, Director of Sales & Marketing with Nordic.

Welcome
Geir Langeland
Director of Sales & Marketing

Smart Agriculture
Cellular IoT-powered farm storage tank tracks fuel levels

An agricultural storage tank that eliminates the common problem of farms running out of either fuel or fertilizer has been introduced by Arizona-based scalable hardware design and manufacturing specialist CoreKinect.

The CoreKinect TankTrack wireless gauge reader is based on Nordic’s nRF9160 low power multimode NB-IoT/LTE-M SiP, and securely attaches to any storage tank using four permanent magnets.

Deforestation of natural wilderness such as the Amazon rainforest robs the world of major carbon stores. Brazil’s National Institute of Space Research estimates nearly 20 percent of the region has been cleared compared to the forest’s area in 1970.

Some of this deforestation is officially sanctioned for agriculture and commercial logging, but much of it is illegal and damaging. Just as it has gone down the coronavirus, wireless tech and IoT can help turn the tide of illegal deforestation and in this edition (pg10) we highlight one example. In a pilot project, Nordic’s nRF9160 low power cellular SiP forms the heart and brain of a device that monitors the location of heavy machinery in the Amazon. While the equipment operates in legal forest zones no action is taken, but should the earthmovers and trucks wander, Nordic’s technology immediately informs the authorities. It’s a real-life demonstration of how to best manage the planet’s natural resources and a pointer to a brighter future.

Nordic and Qorvo collaboration extends to Ultra Wideband

Following Qorvo’s acquisition of Ultra Wideband (UWB) pioneer Decawave, Nordic Semiconductor and Qorvo are reaching out to include dual UWB and Bluetooth LE connectivity in their future product development. Bluetooth LE and UWB are complementary technologies suited to a wide range of consumer and industrial IoT applications, particularly those demanding precision location measurement and proximity awareness.

Both Bluetooth LE and UWB are low-power wireless technologies that can communicate over short distances, which makes them ideal for applications requiring a high level of security and privacy.

Keith Kozlica explains that the lack of coverage and power requirements previously made such a solution cost prohibitive. “Now, with the Nordic-nRF9160 SiP, all the major barriers are broken, and the rules have changed;” says Geir Langeland, Director of Sales & Marketing with Nordic.

“With UWB added to Qorvo’s product range, our collaboration now covers three complementary technologies across a wide range of applications," says Geir Langeland, Director of Sales & Marketing with Nordic.

Smart Health
ECG monitor detects heart arrhythmia

Healthcare manufacturer, MEZOO, has launched a wireless, wearable electrocardiogram (ECG) monitoring system, employing Nordic’s nRF9160 SiP, to help patients live in place of an ECG Holter.

The wearable measures vital signs including one-channel ECG, heart rate, body temperature, respiration rate and body posture, and detects arrhythmia "real time" at the device. The data is then wirelessly relayed by the Nordic SoC to the user’s smartphone, where from the HICard app they can review their data. The heart data can then be remotely viewed and analyzed by healthcare professionals.

The latest developments from Nordic Semiconductor

The company explains that the cost of avoiding even a single 100m3 of deforestation could be as high as $200. It adds that to date, industries have contributed to the forest’s area in 1970.

The benefits of dual-core SoCs

The benefits of dual-core SoCs

Following Qorvo’s acquisition of Ultra Wideband (UWB) pioneer Decawave, Nordic Semiconductor and Qorvo are expanding their partnership to include dual UWB and Bluetooth LE connectivity in their future product development. Bluetooth LE and UWB are complementary technologies suited to a wide range of consumer and industrial IoT applications, particularly those demanding precision location measurement and proximity awareness.

“With UWB added to Qorvo’s product range, our collaboration now covers three complementary technologies across a wide range of applications," says Geir Langeland, Director of Sales & Marketing with Nordic.
Smart Home

Xiaomi ecosystem company launches Nordic Bluetooth LE smart lock

Shenzhen, China-based Lumi United Technology, a member of smartphone and electronics giant Xiaomi’s ecosystem of companies, has released its Aqara Door Lock N200. The smart lock enables instant keyless door entry for multiple authorized users in domestic security applications. Once installed, the lock can be paired to the user’s smartphone or tablet and set up and operated from either the Xiaomi Home app or the Apple Home app. A Nordic nRF52840 SoC provides the Bluetooth LE connectivity between the smart phone and door lock. From the app user can configure the lock settings and remote alarms, and add, delete or update user information. The user can also remotely monitor the status of the lock, review history of when the lock has been opened, and receive push notifications in the event the lock is tampered with. The door has not been properly locked.

The Nordic SoC incorporates an Arm TrustZone Crypticle™ 130 cryptographic module and an AES 128-bit hardware accelerator, supporting a wide range of asymmetric, symmetric and hashing cryptographic services for secure applications, and underpinning the security of the Aqara Door Lock N200 update process. In addition, the smart lock supports NFC, fingerprint, password and temporary password, and emergency key unlocking. Xiaomi Mijia and Apple HomeKit compatibility allows the user to connect the smart lock to other Xiaomi and Apple devices, as well as third party smart home devices, and then perform linked events. For example, turning off the lights and activating the security camera as soon as the door is locked.

“Bluetooth LE was the preferred wireless protocol for the Aqara Door Lock N200 because it provides fast, stable configuration for users without the need for Wi-Fi connectivity,” says Dachuan Zhou, Senior Product Manager with Lumi United.

“We selected the nRF52840 SoC because of its ability to run Bluetooth LE and its Apple HomeKit compatibility,” continues Zhou. “The software architecture is also an advantage because it allowed us to significantly reduce the size of the device’s firmware.”

Industrial IoT

‘World first’ cellular IoT predictive maintenance product for toolheads

German IoT design house, InnBlue, has partnered with Italian automatic toolholder manufacturer, M.T., to develop the world’s first predictive maintenance and continuous usage-based warranty monitoring solution. The product monitors high-speed pitched toolheads by using Nordic’s nRF9160 low power LTE-M/NB-IoT SiP.

A small, retractible battery–powered metal box with an external antenna, developed by InnBlue, is attached to an M.T. toolholder. Internal sensors collect data on toolhead spin speed, temperature, vibration and collisions. The toolhead location is also recorded using GPS. All data is processed using the NRF9160’s edge computing capability and key changes are then wirelessly sent to the Cloud.

“If any abnormalities are detected the customer is alerted via a Cloud dashboard,” says Oleh Lazynsky, the Founder of InnBlue. “For example, an alarm is raised if the toolhead reaches an unusual temperature, or if we sense abnormal vibration that would typically indicate something is going wrong with a critical internal component.

“We also use the accelerometer to detect collisions that will physically damage the toolhead and potentially anything it’s used in, even if the toolhead isn’t broken.”

By using cellular IoT, InnBlue says the need for a gateway is eliminated. Encrypted data is sent periodically to summarise how a toolhead has been used, and automatically in the event of an alarm.

“For spotting problems early they can be fixed more cost effectively instead of developing expensive failures,” says Lazynsky. “If a warranty claim is made it can quickly be determined if it was caused by the toolhead being used outside normal parameters, or a genuine warranty or parts failure. And it keeps driving toolhead operating costs.”

In Brief

KEEPING TRACK OF MISSING KEYS

Chinese wearable electronics firm, Beijing Zical Technology, has released a range of wireless trackers that help users prevent the loss of personal items. The Nut Grey Finder can be attached to key fobs or other personal items and once paired with a smartphone using Nordic-powered wireless connectivity, the user carrying the device, sets alerts if the tag, and the smartphone become separated by losing signal. The user is also alerted to the location where the device was disconnected.

NB-IOT PILOT PROJECT FOR UK WATER

U.K. water utility, Yorkshire Water, is in the final stages of an NB-IoT and Alzip connected trial of almost 400 acoustic, flow, pressure and water quality monitors to manage leaks and interruptions in the water network in the north of England. Billed as the U.K.’s largest water network pilot, the project is expected to deliver significant improvements in data quality and utility life, enabling the utility to identify and prevent leaks and water loss more accurately. The platform will also allow customers to remotely monitor their water usage and, by using the self-service portal, helps customers to manage their accounts more effectively and accurately inform asset and operational decision-making.

CELLULAR IoT MODULE SHIPMENTS ON THE RISE

According to analyst, Berg Insight, global cellular IoT module shipments increased 22 percent in 2019 to 384 million units. The research said LTE-M and NB-IoT would continue to substantially grow in the coming five years. In addition that cars equipped with 5G cellular IoT modules, video surveillance, as well as other multimedia applications would drive growth over existing wired communications solutions.

INDUSTRIAL IOT – THE LIMIT OF THE SENSING TOOLS

IoT connections driven by early industrial deployment and pandemic-driven telemedicine telemonitoring applications are projected to reach 93 billion by 2024, with a 310 percent growth rate, as IoT platform revenue jumps an estimated 18 percent over the year to $56 billion, according to estimates by analyst Juxin Research. Despite security and data protection challenges, the market to embrace IoT deployments will be largely unaffected by the economic downturn created by COVID-19.

By the Numbers

$8.68 billion in revenue

Nordic Semiconductor has reported Q2 2020 revenue of $88.5 million and a gross profit of $45.9 million, a 27 percent increase in profit over the same quarter in 2019. The company continued to see strong demand in several verticals including healthcare, consumer electronics and home office equipment. Cellular IoT, which is in the early stages of commercialization, generated revenues of 5.2 million. The company also ended the second quarter with a record order backlog of $20.9 million, which offers support for continued revenue growth in Q3.

Data suggests a significant portion of the 6.9 million hospital appointments missed in the U.K. each year are as a result of navigation problems in overcrowded hospitals. With each appointment costing an average of £108 ($140), that’s nearly a billion dollars in lost productivity. Bluetooth LE beacon-equipped technologies can help solve the problem, allowing for seamless connectivity with smartphones and patient and visitors view the hospital map on their device and navigate to their destination in the hospital in real time. Associated smartphone apps can also share helpful details such as contact information and hours of operation, descriptions and websites.

Smart Health

pH monitor aids oral health strategies

U.S.-based health tech company, Lura Health is developing an oral pH monitoring strategy that enables continuous monitoring of salivary pH (acidity) levels. The information can be used to create oral health strategies. A Nordic nRF51822 SoC-powered 100 tooth sensor monitoring the patient’s tooth and features a pH sensor and compensatory temperature sensor. The pH data is sent over the Bluetooth LE link to the phone at 15 minute intervals. From a smartphone app, the user can view their current oral pH data and trends, as well as receive recommendations for products that can improve managing oral health such as mouthwash.

Sport & Fitness

Gym management platform analyzes equipment and zone use

A wireless gym management sensor platform that allows facility operators to monitor and record what equipment is being used and how, has been launched by technology startup D-Fetch.

The Gymplanner gym management platform comprises D-Fetch’s MultiTracker device which integrates accelerometer, temperature, humidity, air pressure and magnetic contact sensors to track a range of data. The information can be used by operators of health and fitness clubs to determine which equipment in the facility is being under- or over-utilized and plan gym layouts accordingly.

The solution is powered by a Nordic nRF51822 SoC. The platform also features a Nordic nRF52810 SoC-powered detection sensor which performs as a discrete device for monitoring occupancy, and how, has been launched by technology startup D-Fetch.

The Aqara Door Lock N200 is compatible with Xiaomi Mijia and Apple HomeKit and allows perform linked events when conditions such as turning on the lights.
Bluetooth LE fuel level sensor helps fleet managers track usage

Escort, a Russia-based technology company, has released the Escort TD-BLE fuel sensor, a platform designed for the transport telematics market. The device is claimed to be the world’s first wireless, capacitive fuel level sensor integrating Bluetooth LE technology.

Once installed into a vehicle the device is configured and commissioned via a smartphone app, and then enables fleet managers to remotely monitor the amount of fuel being used by that vehicle.

The device employs a Nordic nRF52832 SoC. To wirelessly send the collected fuel level information via Bluetooth LE connectivity to a Bluetooth- and GPS-enabled tracking device.

Alternatively, the fuel level sensor can be connected to trackers that don’t offer Bluetooth LE connectivity via the company’s proprietary BLE-BASE wireless adapter.

The fuel level sensor relays data to the BLE-BASE—which also integrates a Nordic SoC—which in turn can send the data to a tracker via its UART interface.

Once the data is transmitted from the fuel level sensor to the tracker, the data can then be transferred to the Cloud—typically via the GSM channel, or in rare cases via satellite—where the detailed information and insights can be viewed through a web-based dashboard. This information allows fleet managers, for example, to closely monitor the fuel consumption of individual vehicles, track a whole fleet more efficiently, reduce operating costs by optimizing routes, and assess breaches of protocol by drivers.

Escort TD-BLE uses a Lithium-thionyl chloride 2400mAh battery to provide approximately seven years of continuous operation before replacement, thanks in part to the ultra-low power characteristics of the Nordic SoC.

Bluetooth LE robot camera takes a ride on beetle backs

Researchers at the University of Washington (UW) have developed a tiny robot camera that can also ride aboard an insect. The camera, which streams video to a smartphone at 1 to 5 frames per second, is on a mechanical arm that can pivot 60 degrees.

This allows a viewer to capture a high-resolution, panoramic shot or track a moving object while expending a minimal amount of energy. To demonstrate the versatility of this system, which weighs about 250 mg, the team mounted it on top of live beetles and insect-sized robots.

The researchers used a tiny, ultra-low power black and white camera that can sweep across a field of view with the help of a mechanical arm. The camera and arm are controlled via Bluetooth LE from a smartphone with an accuracy of 120 meters away.

“The [to save power] we added a small accelerometer to our system to be able to detect when the beetle moves,” says co-lead author Venkatesh Jayaram, a UW doctoral student.

“The study is significant because it is the first to use Bluetooth technology to comprehensively monitor transplant patients,” says Felicia Schenkel, MSN, lung transplant manager and lead author of the study.

Twenty-eight lung transplant patients received the two year remote tracking, and 28 matched control patients did not. With the exception of remote monitoring, all patients received the same level of post-transplant medical care. Monitored patients used computer tablets to report symptoms, track appointments and medication compliance, conduct videoconferences with staff and access educational videos along with other materials. According to Schenkel, the at-home tracking worked for two reasons. “With constant monitoring, we were able to react to data sooner and take intervening steps before a patient’s condition worsened,” she explained.

Lung transplant patients benefit from remote monitoring

To provide another layer of support for lung transplant recipients, the Kidney Medicine of University of Southern California’s (USC) lung transplant team launched a two year observational pilot study to monitor patients post discharge using Bluetooth LE-enabled devices and computer tablets.

Lung transplant patients have a reasonable option to extend lives and improve quality of life. However, once lung transplant recipients post discharge using Bluetooth LE-enabled devices and computer tablets.

The key to ShipSafe’s remarkable battery life is the nRF9160’s 64 MHz Arm Cortex-M33 processor backed by 1 MB Flash and 256 KB RAM provides sufficient computational power to not only run the LTE-M cellular connectivity but also all other ShipSafe functionality. “The combination of features like the processor and memory, speed of operation and low power consumption makes the nRF9160 a winning product.”

The combination of features like the processor and memory, speed of operation and low power consumption makes the nRF9160 a winning product.
Bluetooth LE becomes the new market standard

The low power version of Bluetooth short range wireless continues to drive significant growth across key sectors

For more than two decades, Bluetooth has consistently adapted to meet the increasing demands of wireless developers. Today, the technology supports countless applications across a broad range of industries on the journey towards a connected world. In the process, Bluetooth technology has boomed – anticipated to continue well into the future.

Bluetooth enabled device shipments will continue to increase with no sign of slowing down, according to the Bluetooth Market Update 2020, a Bluetooth SIG report supported by updated forecasts from industry analyst ABI Research along with insights from several other analyst firms. In 2015, three billion Bluetooth enabled devices were shipped, with the annual total rising to 4.2 billion shipments in 2019. The report predicts a CAGR of eight percent until 2024 when the annual total will hit 6.2 billion.

While classic Bluetooth proved a good solution for consumer applications, Bluetooth LE has emerged as the preferred wireless protocol because its capabilities have evolved to support the original protocol but with much lower power consumption. Bluetooth LE tech is expanding at a rapid rate and remains the fastest growing wireless protocol – it supports commercial and enterprise IoT solutions aimed at increasing workplace safety and security, reducing costs and enhancing operational efficiency. The latest Bluetooth innovations in range, speed and advertising channels provide data for a more informed decision making and support predictive maintenance across a variety of industrial and commercial environments.

For example, smart industry solutions such as the ABB Ability Smart Sensor, fans, temperature and vibration sensor, and National Instruments’ M0N-10411 Wireless Vibration Sensor all employ Nordic Bluetooth LE connectivity allowing plant maintenance personnel to remotely monitor the diagnostic health data of critical assets in the field for preventative maintenance purposes. By 2024 there are expected to be 451 million annual Bluetooth smart building device shipments.

Location services including indoor wayfinding, asset management and space utilization solutions form the majority of this market. Bluetooth mesh networking is also powering a surge in connected lighting and asset tagging.

Today, almost all mobile devices support both Bluetooth classic and LE radios, but it’s Bluetooth LE alone that’s responsible for driving the majority of the growth

By the Numbers

7.5 billion devices containing Bluetooth LE will be shipped in the next five years

1.4 billion connected device annual shipments in 2024

95 million in 2019

1.8 billion connected lighting devices by 2028

Need to Know

A Helsinki based for-profit Bluetooth Specialinterest Group (SIG) was formed to oversee Bluetooth technology—a simple, flexible and secure wireless communication solution—and serve industry leading member companies around the globe. By the turn of the century, the first mobile phone equipped with Bluetooth capability had entered the market. In 2020, the total number of annual Bluetooth device shipments is set to hit 4.6 billion.

Colgate, also employs a Nordic SoC in its Colgate Electronic Toothbrush, which is paired using Bluetooth LE to the free Colgate Connect app allowing the user to track how well they brush through mouth zones.

Annual Bluetooth smart industry device shipments are expected to reach 3.15 million in 2024, up from 8.8 million in 2019 and just 5.1 million the year prior. This anticipated growth is due in part to the improved location accuracy and robustness of Bluetooth technology, which supports commercial and industrial IoT solutions aimed at increasing workplace safety and security, reducing costs and enhancing operational efficiency. The latest Bluetooth innovations in range, speed and advertising channels provide data for a more informed decision making and support predictive maintenance across a variety of industrial and commercial environments.

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Today, almost all mobile devices support both Bluetooth classic and LE radios, but it’s Bluetooth LE alone that’s responsible for driving the majority of the growth in Bluetooth connectivity.

Live market prospects

Bluetooth technology is a driving force behind the emergence and future prospects of markets including connected devices, smart industry, smart building, smart home and smart city.

Every day, millions of connected devices including tools, toys, toothbrushes and more turn raw data into a meaningful information and insights for users thanks to the power of Bluetooth technology—a simple, flexible, secure wireless communication solution and serve industry leading member companies around the globe.

The number of annual Bluetooth device shipments in the smart building market jumped from 48 million in 2018 to 106 million in 2019, while the connected lighting market is expected to grow from 4 million in 2018 to 1.8 billion by 2028.

One of the biggest debates at CES earlier this year was why consumers don’t want to risk personal information captured by smart home devices being hacked. Embarrassing security breaches go some way to answering that question. For example, in mid-2019, Forbes magazine reported that two billion records in an online database had been exposed in a single smart home – device security breach and included “everything from user passwords to account reset codes and even a smart camera recorded conversation”.

Elsewhere a shadow of doubt was cast over the popular Amazon Ring smart doorbells. Wired magazine described “a lot of creepy and concerning news” about how these cameras were being used. Privacy advocates are worried about surveillance to suburbs andUnlike Amazon which securely transfers data—sharing relationships between smartphones and other devices, the tech magazine added: “the situation with Ring is far from unique. At the beginning of the year, for example, hackers launched similar attacks with Ring cameras, complete with incidents where hackers were creepily talking to children through smart speakers. The industry is coming to realize that success in the smart home won’t come from trying to share information about consumers that they don’t want. Consumers have seen what can happen and they don’t want to take the risk.

It’s a risk that’s only set to escalate as voice and other biometric data becomes ever more valuable in the future. In many cases that data could be turned into a unique digital key used to identify the consumer in all kinds of transactions. There is precedent in how Amazon has used this information: the fingerprint or face Cuscles opened to open its smartphone is only ever saved locally on a highly secure and encrypted part of the phone and is never sent to the Cloud.

Next generation smart devices will need secure data outside the home. In the future data processing will happen at the edge of the home network using the powerful embedded processor so supported by lots of memory and Cloud connection will keep to a minimum,

What happens at home stays at home

Consumers won’t tolerate smart home tech that spies on them

Keep it in the family

The only way to prevent hacking today is to disconnect a device from the Internet. Devices like smart speakers need to connect to the Internet sometimes, for example, to look up information when asked a question. But private data like voice and video should never be exposed to prying eyes.

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Holding the Line

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

A round 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 are 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 the Earth’s terrestrial biodiversity. According to a landmark report by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), approximately 2.9 km² 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 in the capacity to absorb and store carbon.

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 programs and dedicated efforts on the ground, about 20 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 km² Amazon basin) has accelerated drastically following a spike of invasions to exploit natural resources amid the COVID-19 pandemic. Our forests need help.

Wildlife Fund (WWF) claims on average, the world loses 7,570 km² of forests annually — the equivalent of 27 soccer pitches every minute.

The problem is becoming chronic; between 1990 and 2016, the world lost 1.3 million km² 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 km², 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) estimates that are helping to reduce catastrophic climate change — thanks to their unparalleled capacity to absorb and store carbon.”

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By the Numbers

THE GLOBAL IMPACT OF DEFORESTATION

It is estimated that over 15 billion trees are cut down each year.

75% of the land-based environment has been severely altered by human actions.

Up to 90% of logging in tropical rainforests is illegal.

Forest loss contributes to around 15% of all harmful greenhouse gas emissions.

The Nordic-backing Code of Conscience initiative aims to help NGOs, governments and local communities monitor and restrict heavy vehicles in protected areas. Other innovative wireless conservation technologies, including remote monitoring systems, are helping to reduce degradation.
for Code of Conscience based on Thingy:91. “Citizens are beginning to look at intentionally 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 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.”

**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). Young coders across the world responded to the “Micro: bit BBC micro:bit challenge” by creating an impressive variety of tech-based sustainability solution ideas.

Young innovators from 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 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 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.

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 felled, 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 measure 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 production using an AI 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. Brazil-based startup TrevasTech 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 customised web-based system. The information is then combined with satellite images and analyzed by machine-learning algorithms to detect early signs of deforestation in pest attacks or 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 assists with negotiations for greater protection 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 initiative 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 the AI to detect human activity in forest. 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 much faster rates.

While other projects include 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 technology 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.**
As the world grapples with the health implications of COVID-19, the wellness technology industry is quietly booming.

The Business of Wellness

As the world adjusts to the new normal in the midst of the COVID-19 pandemic, the importance of our health and of those who help us maintain it has never been in sharper focus. More than the absence of disease or infirmity, health is now about physical, mental and social wellbeing, and for most, all three have been tested in 2020.

But while staying healthy is naturally top of everyone’s priorities, the business of wellness is often viewed with more suspicion. Whether it conjures up images of organic probiotic juices, relaxing inside a yurt on a mindfulness retreat, or aContributed by non-profit organization, the Global Wellness Institute (GWI), consumer opinions is shifting. “Once upon a time, our contact with wellness was occasional ... but this is changing fast,” says Katherine Johnston, Senior Research Fellow at GWI. “Wellness, for more people, is evolving from rarely to daily, from episodic to essential, and to a personal lifestyle.”

Rebalancing power

According to GWI, the wellness industry has become big business worth an estimated $4.5 trillion in 2018, and is expected to continue to grow as populations age and lifestyles become more sedentary. Not to be outdone, in 2018 the global wellness economy was worth an estimated $4.5 trillion, more than half the size of health expenditure, and it too is growing.

The long-term aim is to transfer the outlay on healthcare products and services to those of Wellness. Spending money to stay healthy, rather than to just get healthy, promises greater return on investment. According to non-profit organization, the Global Wellness Institute (GWI), consumer opinions is shifting. “Once upon a time, our contact with wellness was occasional ... but this is changing fast,” says Katherine Johnston, Senior Research Fellow at GWI. “Wellness, for more people, is evolving from rarely to daily, from episodic to essential, and to a personal lifestyle.”

In Short

The wellness industry has become big business worth an estimated $4.5 trillion in 2018 example aims to stay healthy rather than just get healthy. Exercise, nutrition, sleep and social connection are key to wellness and the technological solutions that not only monitor their activity levels, but also monitor their health.

Many factors are driving growth in the wellness industry, but according to the GWI, four in particular stand out. Firstly, consumers are increasingly focused on nutrition, and are prepared to pay extra for “free-from” and organic food. At the same time, “wellness tourism” is generally on the rise (although it has taken more of a backseat during the pandemic as international travel remains off-limits). As of 2017, the GWI claims the sector was worth $53.9 billion, with 830 million wellness trips made that year. And when the pandemic abates, wellness seekers will surely get back on the road.

Then there are the trends powered by technology. A byproduct of the rise of consumer monolith Amazon – not least during the pandemic when consumers prefer their “wellness” delivered to their door – has been the e-commerce giant’s ability to position itself as the preferred channel for nutritional supplements and skincare products. The average consumer is spending $1300 a year on supplements, sport nutrition and skincare, and Amazon has established itself as the number one provider. Wearable devices have also proliferated in the wellness industry ushering in the personalization of wellness rather than a one-size-fits-all approach with its inherent limitations. After all, your grandmother and a Tour De France cyclist have rather different metrics when it comes to determining their fitness for their stage in life. According to a 2019 survey by business news website, The Manifest, 56 percent of the population of the U.S.—about 183 million people—now own a connected wearable, and demand, as well as the sophistication of these devices, has increased dramatically. The days of mechanical pedometers and社科ial connection are key to wellness and the technological solutions that not only monitor their activity levels, but also monitor their health.

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their fitness, heart rate and it’s variability, blood oxygen saturation, muscle oxygen, sleep as well as emotional and mental health. The demands on wearables and their makers by consumer is unprecedented. A 2018 Pricewaterhouse Coopers’ (PwC) report claims health-conscious consumers expect their wearable devices to help them live longer (70 percent), maintain a healthy weight (61 percent) and reduce their health insurance premium (62 percent). That’s quite an ask but does explain why the wearable market is expected to grow to $27 billion by 2022.

Wellness Wearables

Smart healthcare solutions have grabbed all the headlines in 2020 as we reinvent the delivery of health services in a socially distant world.

While avowery of Bluetooth LE - and other wireless-based technologies have eased the burden on overstretched health services and enabled good hygiene practice, contact tracing, social distancing, and home and remote patient monitoring (see WQ Issue 2, 2020, pg5), technology that allows individuals to practice wellness can, in theory, go one better. Wireless tech that helps prevent you getting sick rather than helping you recover after you’ve been ill, allows healthcare services to focus their attention on treatment for non-preventable conditions.

If one of the key trends powering the wellness industry are clean eating and wearable technology, then it is hardly surprising that solutions have already been developed that successfully marry the two. Last late year, London, U.K.-based DnaNudge launched a wearable device that uses a combination of the user’s DNA and wireless technology to help people make healthier food choices. After a one-time use cheek swab test that analyses and maps the user’s genetic profile to key traits, the results are loaded onto an app that can be used as digital DNA on the wrist, fittedinside the Nordic Semiconductort–powered DnaNudge wearable. The user can then scan the barcodes of approximately half a million food products and instantly have the device determine if the food is suitable for them based on their unique genetic traits.

In the barcode is scanned, the device’s LED display flashes either green, to indicate a suitable food choice, or red, to indicate a choice less well-matched to their DNA profile. Why? The device is also used to monitor the user’s activity, an amber LED indicates a scanned product that might usually be suitable is not recommended because of the wearer’s lack of activity. So, for example, if a person has a high sensitivity to sugar, saturated fat or salt, and scans the barcode of a product with high levels of these ingredients they can be offered healthier alternative.

According to DnaNudge CEO and Co-Founder, Professor Chris Tousmazou, the technology has the ability to transform both shopping behavior and an individual’s long-term health. “Quite simply, [short term] diets don’t really work, and the visual guidelines about healthy eating are too easily ignored,” says Tousmazou.

“By using genetic insight into well-understood health risks and combining this with lifestyle nudges based on your inactivity levels, we can all make better to-day–day

The DnaNudge wearable device that uses a combination of the user’s DNA and wireless technology to help people make healthier food choices.

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While the gains to be had from good nutrition, sleeping well and managing stress are becoming better understood, the benefits of exercise to our health and wellness are fully established.

EXERCISE AND RECOVERY

While the gains to be had from good nutrition, sleeping well and managing stress are becoming better understood, the benefits of exercise to our health and wellness are fully established. Wristwatch fitness trackers can reasonably lay claim to being one of the foundation stones of the wearable technology revolution that exploded into life over a decade ago and fitness monitoring remains the primary use case of wearable tech.

Whether you are a professional athlete or a Sunday striver, exercise trackers are designed to motivate the user to keep going and achieve a greater level of fitness. They don’t all do it well when they are overtraining, at risk of injury or chronically paired need to focus on recovery.

“High-impact sports take a toll on your body, and endurance sports wear you down. It is increasingly important to be proactive about taking care of yourself to prevent injury or chronic pain or need to focus on recovery.” — Dan Evans, Co-Founder and CTO of RecoveX. A U.S.-based technology startup taking a different approach to wellness wearables.

Earlier this year the company released Contrast Knee, a Nordic-powered Bluetooth LE knee brace that provides electric-powered alternating heating and cooling therapy. Once strapped around the user’s knee the product employs built-in temperature sensors that regulate and sustain precise temperature therapy, controlled via the user’s smartphone. The varied phases of recovery help the user successfully manage inflammation, relieve pain and return to an active lifestyle.

Pain relief hinges on how effectively the system cools and warms the knee, giving scientists, developers and entrepreneurs unlimited possibilities to create products that could change people’s lives for the better in many ways,” says Kadunc. “Once the product is launched... that’s only the beginning. It’s an ongoing journey and improvement never really ends.”

The breadth of wellness products powered by wireless technology today is stunning. There are rings that promote general wellbeing, head-arm solutions to improve sleep and manage our weight. Compression leggings that tell you how hard your muscles are working, wearables that change your heart rate for you, devices that stick to your fingernail and coordinate with your smartphone to alert you if you are being exposed to too much light. And many more. Wireless sensors can already help determine a host of measurements that directly or indirectly impact our wellness, including: Blood pressure, blood sugar, body composition, galvanic skin response, fitness, posture and balance, sleep duration and quality, weight, and where it’s all going, steps. Combined with machine learning algorithms this sensor data can be transformed into actionable health data.

While wearable wellness technology has in the past largely focused on devices that capture physical and biometric information, technology either still subject to research or at the cutting-edge is investigating, for example, how we can track and analyze emotional states using voice patterns, brainwaves and electrodermal activity, even by breath analysis. Also under development are wearables that track physiological and performance and dysfunction from an analysis of the molecular biomarkers in our sweat, while brain-computer interfaces will allow our brain signals to be directly merged with computers. At some point in the not too distant future some of these devices will be wearable and implantable. No different to microwrapping the family pet, this will—once we have provided our initial consent—offer the ability to reliably capture biometric data and monitor our wellness passively and continuously.

Dr Pedro Lopes of the University of Chicago is already working on a wearable that uses electrical stimulation to help a user’s muscles perform tasks they didn’t otherwise know how to do, offering a raft of potential wellness possibilities. According to author and futurist, Bernard Marr, this seamless blending of us and technology will give rise to ‘augmented humans’ or ‘humans 2.0’, or as Elon Musk predicted, a future in which people can directly merge with computers.

Today’s solutions show what’s next for wellness tech

U.S. computer scientist and inventor of the overlapping windows GUI, Alan Kay, once observed: “The only way to really know what we’re doing is to make it. In other words, the best place to look for today’s solutions is to look at today’s solutions.” The breadth of wellness products powered by wireless technology today is stunning. There are rings that promote general wellbeing, head-arm solutions to improve sleep and manage our weight. Compression leggings that tell you how hard your muscles are working, wearables that change your heart rate for you, devices that stick to your fingernail and coordinate with your smartphone to alert you if you are being exposed to too much light. And many more. Wireless sensors can already help determine a host of measurements that directly or indirectly impact our wellness, including: Blood pressure, blood sugar, body composition, galvanic skin response, fitness, posture and balance, sleep duration and quality, weight, and where it’s all going, steps. Combined with machine learning algorithms this sensor data can be transformed into actionable health data.

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Guiding Lights

Street lighting offers a go-to platform for interconnected smart cities and dual-mode IoT connectivity is smoothing the transition to human activity. It is the forward way as a platform for smart cities in a wider context. Over two-thirds of new street light installations will be tied in with central management platforms as early as next year, says ABI, to integrate data from multiple smart city sensors.

But the smart city question is also about the choice of technology. Different applications make different demands on the technology of their systems – of traffic flow and mobility, noise and air pollution, and of new commercial opportunities. Even parking sensors, traditionally buried in tarmac, can be hooked up cheaply and effectively to lighting infrastructure. Whole cities can be networked and optimized, suddenly, without digging streets or rerouting space or resolving abstract calculations about healthier living and safer streets.

The logic says smart cities are hard, so do the skeptics. Think about garbage bins and parking lots, made smart with sensors, and run-through with analytics. ROI in such cases is difficult to calculate and standardize, especially when government is so fragmented – between public authorities and private services, towns, cities, regions and countries. Think about air quality monitoring; how does a city easily calculate the impact of clean-air on health services? The logic says smart cities are hard, so do the skeptics.

But there is a light on the murky horizon of digital change. Street lighting, of all municipal services, affords a platform for cities to get smart and unite multiple applications for the first time. Consider the varied smart street-lighting projects in San Diego in the U.S. and Copenhagen in Denmark, among an increasing number. These combine an array of sensors in modular hardware units affixed to light poles, enabling remote control of the luminaires themselves, plus an engine to run other functions, such as traffic counters, air quality monitors and even gun-shot detectors.

From up high, on light poles, cities have started to get a handle on the livability of their streets – of traffic flow and mobility, noise and air pollution, and of new commercial demand. In Short

Smart cities are hard to fund and complex to build. The concept of digital pyrotechnics.

Street lighting offers a platform for cities to get smart and unite multiple applications for the first time.

- PI GG YBACKING ON LED SAVINGS

The rule-of-thumb, presented by lighting and sensor solutions cost-effectively at scale.”

- Maintenance costs can be slashed dramatically just with centralized tweaks and insights. The ways are multiple and ad hoc. PRojects that have started to flow in the smart city space

- There are additional opportunities to be had by smart city suppliers leveraging street pole infrastructure by hosting wireless connectivity, environmental sensors and even intelligent cameras,” says Adarsh Krishnan, principal analyst at ABI Research. “The challenge is finding a feasible business model that encourages deployment of multi-sensor solutions cost-effectively at scale.”

- The question is no longer whether to connect – but how to connect – and how much to connect from the start. This is partly about business models, as Krishnan observes, but funding has started to flow in the smart city space via cooperative public-private partnership (PPP) vehicles, where the financial risk is shouldn’t be shouldered by the private enterprise in return for a stake in the venture’s success. Subscription-based ‘as-a-service’ contracts, spreading investments into the payback period, have also stimulated activity.

- But the smart city question is also about the choice of technology. Different applications make different demands in terms of coverage, throughput and security. Street lighting has developed along different technologies in tarmac, can be hooked up cheaply and effectively to lighting infrastructure. Whole cities can be networked and optimized, suddenly, without digging streets or rerouting space or resolving abstract calculations about healthier living and safer streets.

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- From up high, on light poles, cities have started to get a handle on the livability of their streets – of traffic flow and mobility, noise and air pollution, and of new commercial demand.
Street lights date back to ancient Rome, when oil lamps were used to illuminate paths and deter thieves; slaves were employed to watch over and maintain the lamps. Silk lamps were used in the Middle Ages. In 1477, the city of London introduced alewa that residents should hang, and light lanterns outside their homes. It marked the introduction of organized public street lighting. Paris did the same in 1324.

By then, candles were being used, and continued to be used for almost three centuries. By the 1800s, coal- and gas-fed lights were in place, on poles along main streets. London was first, followed by Baltimore and Paris. London and Paris introduced electric street—carbon arc—lamps, from Russian design—in 1878. These were modified Thomas Edison as carbon-thread vacuum bulbs.

They lasted into the 1930s, when low-pressure sodium lamps were introduced, holding sway until the advent of the semiconductors—based LED. LED—based street lighting has grown in the past ten years, encouraging a focus among utilities and cities on energy maintenance and cost savings. Milan was the first city to switch entirely to LEDs.

Meanwhile, the idea of smart street-lighting dates back to the late millennium, just. Texas-based firm Intelilite filed a patent in 1999 for a “outdoor lighting system network” to provide automated “sensing, conveying, and recording” of data... so that both control and maintenance can be performed more efficiently. For the connect third part, the system used the power line itself, itself of “additional separate wires.”

The take up scale implementation of a control network for street lighting did not appear until 2007, when Oslo commissioned the installation of 55,000 connected street light lamps, also using power-line communications. Energy savings were calculated at 50 percent, plus maintenance efficiencies.

The Oslo project was important because it formed the basis for Europe’s “6-Gstreet” (a shortening of “European-SmartStreet”) initiative to reduce energy in lighting systems and guide policy on outdoor lighting; it also inspired interest from other cities. Smart platforms are now being deployed with two thirds of new street lighting deployments.

**Street lights: A brief history of street lights**

**By the Numbers**

90% of streetlights – out of 363 million, globally — would use LEDs by 2027

10x growth in global smart-lighting revenues by 2026 to $1.7 billion

50-70% energy savings from smart street-lighting

230 million Bluetooth LE shipments into the smart city in the next five years

DIFFERENT MARKETS. For instance, the U.S., Zigbee—based short range mesh networks are a majority of smart metering with an 80 percent share, according to ABI; all the same titles own most of the public lighting network as well and Zigbee’s utility—focused SFP (Smart Energy Profile) 2.0 profile is being remarked for RNK NY.

In Europe, by contrast, street lighting is being connected with traditional cellular (2G through LTE (4G), commonly), as well as the new cellular IoT LTE-M standard; Proprietary ultra—narrowband (UNB) technologies are also in play. Along with Zigbee, smart meters of Bluetooth LE and IEEE 802.15.4—sophists.

The Bluetooth Special Interest Group (SIG) in particular is serious about smart cities. It predicts five—times growth of Bluetooth LE shipments in the space in the next five years (to 230 million annually). Most is linked to access tracking in public venues, for example airports, stadiums, hospitals, malls and museums. But Bluetooth LE is pitched for outdoor networking too. “Asset management solutions increase utilization of smart city resources to help lower operational costs,” says the Bluetooth SIG.

**TWO TECHNOLOGIES ARE BETTER**

There are arguments for each, although certain of them underdeveloped. Interference, UNB, for example, imposes tighter limits on payloads and delivery schedules, precluding parallel support for multiple sensor applications or for more size like cameras. Short—range technologies are cheaper and offer greater throughput for developing “lighting as—a—platform” setups. Importantly they also bring redundancy, in case the WAN signal fails out and a means for technicians to get direct access to sensors for commissioning and diagnostics. Bluetooth LE, for example, is interoperable with almost all smart phones on the market.

But while a denser mesh creates robustness, it also brings and architectural complexity and places higher energy demands on interconnected point—to—point sensors. There is an issue with range too; coverage tops—out at a couple of hundred meters with Zigbee and Bluetooth LE. And while short—range technologies are clearly contenders and well—suited for meshing neighborhood-wide sensors, they are closed networks that require a gateway to get the signal back to the Cloud.

In the end, a cellular connection is usually integrated into the mesh. The trend among smart lighting providers is to go with point—to—Cloud cellular, offering coverage of five— to—15 kilometers from gateways or sensor devices. Cellular brings range and simplicity; it also provides ready—built networks and higher—grade security, according to the cellular community. “Cellular operators...possess total coverage over urban areas, [so] no additional infrastructure is necessary to connect city lights and sensors,” says Neil Young, IoT Verticals Lead at the GSMA, the industry organization that represents the interests of mobile network operators. “The security and reliability of [cellular] networks is increased spectrum (unlicensed) operators are best—placed to support large numbers of low cost devices requiring long battery lives, minimal maintenance and long term costs. Abi says, cellular out of all the connectivity technologies in play, will see most growth in the next few years. The clamor for 5G networks, and the struggle to host 5G infrastructure, has seen operators—to eager to light fields for—small cell in urban environments. In the U.S., Las Vegas and Sacramento are rolling out LTE and SIG, plus smart city sensors, on street lights with carriers AT&T and Verizon. And Hong Kong has just unveiled a plan to install 400 SIG—ready lamp posts as part of some smart city drive. But LTE and SIG are geared for more far—reached smart city cases, requiring high throughput and lower latency, such as high— definition camera surveillance. The IoT sector at large is propped up by low—power—use systems in the form of short—range technologies like Bluetooth LE and Zigbee, and cellular IoT LPWAN technologies NB—IoT and LTE—M. These can be combined to powerful effect in street lighting platforms, and elsewhere in smart cities, as part of lower—rate sensors bringing intelligence about city functions and environmental conditions.

“The solution is to team inexpensive but range— and resource—limited short—range wireless with cellular IoT so they complement each other. That way the data...about traffic flow and footfall, air quality and temperature, vibration and noise, or whatever else...can go from the sensor network to the Cloud via a secure and robust cellular network,” says Sven—Egil Nielsen, CTO with Nordic Semiconductor. “A short range wireless and low power cellular IoT solution provider.”

**TIGHT INTEGRATION IN HARDWARE**

Nordic provides multitude short— and long—range products. Its NRF24L01 SoC supports Bluetooth LE, Bluetooth mesh and Zigbee, as well as Thread and proprietary 2.4 GHz systems. Nordic’s—cellular based NRF9160 SLP offers both LTE—M and NB—IoT. “the combination of the two technologies brings advantages in terms of performance and cost,” adds Nielsen.

Frequency separation allows these systems to coexist, with the former running in the unlicensed 2.4 GHz band and the latter going wherever LTE goes. There is a trade—off between wider area coverage and larger—capacity throughput at lower and higher frequencies. But lighting platforms, short—range wireless is being commonly deployed to inter connect sensors, edge—based compute power is being charged to direct insights and cellular IoT is being used for backup to the Cloud, and for higher— maintenance sensor control.

As yet, short— and long—range radios are being added separately, but they are not embedded into the same silicon in the factory, and there is a case on hand to keep components smart, as luminaires, sensors and radios all fall differently. At the same time, embedding two radios into a single system will bring “tighter technological integration and lower acquisition costs,” and thus are already being studied.

**The security and reliability of LPWANs in licensed spectrum means operators are best—placed to support large numbers of low cost devices.**

**Need to Know**

Cellular IoT networks are already deployed with denser cell tower coverage over most cities in the world NB—IoT and LTE—M gigabit uses will feature low latency making it possible to connect sensors to a single base station. Moreover, cellular IoT networks will also deploy deployment density and promote massive scale.
The market for RTLS is potentially huge—imagine the market from
CAGR of RTLS

The US Defense Advanced Research Projects Agency (DARPA) coined the term ‘ultra wideband’ in the 1990s and defined it as a system with a ‘fractional bandwidth’ greater than 25 percent where fractional bandwidth is the ratio of signal bandwidth over the center frequency. The U.S. Federal Communication Commission (FCC) defines UWB as ‘an intentional radiator that has a fractional bandwidth equal or greater than 20 percent’ or has ‘a bandwidth equal or greater than 500 MHz’. Conventional short range RF technologies use narrowband technology, Bluetooth LE, for example, transmits on a one megahertz channel and carries information using Gaussian frequency shift keying (GFSK) modulation. In contrast, UWB spreads the radio energy across a wide bandwidth. The low power spectral density provides immunity to multipath fading and interferes. Several modulation techniques are used, and the IEEE802.15.4 standard calls for a Burst Position Modulation - Binary Phase Shift Keying (BPM-BPSK) scheme. (See sidebar. An alternative PHY: Pulse Radio.) Information is sent using precisely timed pulses, and it’s this timing that makes UWB a good solution for RTLS applications. By timing how long it takes for a pulse to reach the receiver and for a response to come back (and subtracting the processing latency of the receiver), dividing by two and multiplying by the speed of light, the distance between two UWB radios can be accurately measured. Because the measurement is based on timing rather than signal strength, attenuation due to multipath fading and other forms of signal degradation do not compromise distance measurement accuracy. In addition, UWB supports measurement of Angle of Arrival (AoA) of an incoming signal by using multiple antennas and a technique also favored by Bluetooth Direction Finding (DF) to determine the direction of the transmitter. Combining distance and direction data enables the system to determine precisely where, in three dimensions, the transmitter is located. Combining UWB with Bluetooth LE creates a technology with excellent position-measuring capabilities but with a power consumption close to that of Bluetooth LE alone. By using the ultra-low power Bluetooth LE radio to approximate the target object’s position—a process which requires a relatively large amount of RF activity—and then switching from the native radio to the UWB radio for the shorter precision location operation, the on-air time for the higher power UWB radio is kept to a minimum. This helps to extend battery life. The Bluetooth LE SoC’s processor is used to control radio switching. Another advantage of the Bluetooth LE/UWB combination is that it allows for RSSI to be used as a fallback position-measuring technique should a non-UWB target device be encountered.

EARLY TO MARKET
Decawave (now part of Qorvo) offers a commercial UWB solution, the DW1000. The chip is targeted at RTLS applications and is compliant with the IEEE802.15.4-2011 standard. The DW1000 is designed for a distance measurement precision of 10 cm, supports six channels in the 3.5 to 6.5 GHz spectrum allocation and features data throughputs from 110 kbps up to 6.8 Mbps. In June, Nordic’s Semiconductor and Qorvo extended their partnership to include dual UWB and Bluetooth LE products. Previous collaboration focused on Nordic’s ultra-low-power nRF52832 SoC featuring Bluetooth technology, BLE and Wi-Fi, and its edge computing support, by combining Decawave’s DWM1001C module—which combines the DW1000 with an nRF52832— into a UWB and Bluetooth wearable social distancing tracker that was developed specifically to combat COVID-19. The Distancer is a wearable that can work around the neck like an employee ID card and produces accurate face-to-face separation measurements with what the company claims is greater certainty and accuracy than other COVID-19 wearables—avoiding unnecessary testing.

The standard continues to evolve, but under the most recent version, complete UWB PHYs must support three independent bands of operations: A sub-3-gigahertz band (channel 0, 245.6 to 749.6 MHz) a low band (split into channels 1 to 4, 3.1 to 4.8 GHz) and a high band (split into channels 5 to 15, 5.8 to 10.6 GHz). Some channels support over one gigahertz of bandwidth (for example, channel 15 offers 1.35 GHz). Each channel supports four data rates, 150 and 890 kilobits per second, plus 6.8 and 23.74 megabits per second. The standard defines a Burst Position Modulation - Binary Phase Shift Keying (BPM-BPSK) modulation scheme whereby a UWB symbol is capable of carrying two bits of information—one to determine the position of a pulse burst, and one to modulate the phase of the burst.
Nordic Inside

Sports & Fitness

Fliteboard

This Bluetooth LE-controlled electric board allows watersport enthusiasts to 'surf' above water.

The global sports and leisure equipment market is expected to witness a surge in growth to 2025 on the back of an increase in health and fitness awareness and higher disposable incomes, according to analyst Grand View Research. The sports technology market meanwhile will grow to in excess of $30.9 billion at a CAGR of 20.1 percent.

While the Fliteboard can reach speeds of up to 45 kph, the fastest speed recorded on a surfboard has been clocked at 78.26 kph by South African Josh Enslin. However, Enslin didn’t reach the speed thanks to wave propulsion, but rather by being towed behind a car. He described the dangerous stunt as “calculated fun.”

A customized high-capacity battery management system enables the e-foil to travel up to 30 km before recharge, although the longest wave ever surfed was a 66 km ride behind a wave-creating boat on the Panama Canal by Panamanian surfing champion, Gary Saavedra. The marathon surf took Saavedra almost four hours.

The Fliteboard system comprises a 6 kW brushless electric motor-powered hydrofoil board, as well as the remote-controlled handset. The handset relays control data to the board via low latency Bluetooth LE connectivity, enabling the rider to wirelessly control the speed of the motor, even when the devices are submerged in water.

The exact origins of surfing are not certain, but it was first observed by Europeans from a ship in Tahiti back in 1767. Research suggests that surfing dates back to early Polynesian cultures, although the practice of riding a vessel on a wave was practiced since the pre-Incan civilization around 2000 years ago.

The Fliteboard’s fully sealed subassembly is embedded directly into the carbon fiber shell and provides GPS data recording, motion measurement, telemetry transport and data transfer hardwired to the main eFoil module. As well as connecting the board to the handset, the Bluetooth LE link enables the board to communicate with the accompanying iOS-compatible Flite App.

The Fliteboard and the Flite Controller remote handset integrate a Ligado BMR-350 Bluetooth LE module based on Nordic’s nRF52832 SOC. Bluetooth Low Energy allows the handset to receive key data from the board itself—such as telemetry and battery status—and display the information on the integrated screen.
Case Study

Sports & Fitness

‘World’s first’ NB-IoT cycle security tracker protects and locates bikes

Using built-in smart sensor technology, GPS and NB-IoT cellular connectivity, See.Sense AIR notifies cyclists when their bike is moved, damaged or stolen.

For avid cyclists, the passion for riding is high, yet it comes with inherent risks and concerns. Their favorite two-wheeled pride and joy is vulnerable to theft, vandalism and neglect. And while the best locks and chains can help prevent a determined thief, there’s also the fear of being unable to recall a beloved bicycle following an accident in a remote location.

To break this cycle of uncertainty, Northern Ireland-based cycling sensor technology startup, See.Sense, developed what it claims is the world’s first NB-IoT cellular bike security tracker. Perforning like an electronic tag for a bicycle, the compact (85 x 50 mm), lightweight (80 g) See.Sense AIR protects and locates bikes anywhere, anywhere. Once mounted discreetly under the saddle or below the bottle cage, the bike- and for-get device uses See.Sense’s advanced sensor technology and GPS functionality to quickly and accurately detect whether the bike has been involved in a crash. Moved or stolen, riders are notified via an associated app on the user’s smartphone either via short range Bluetooth LE if they are within 50 meters or via the NB-IoT network in case of cellular IoT.

AIR was developed after listening to what the cycling community wanted. It’s a smart device, reacting automatically to its situation.

The NB-IoT advantage

A smart sensor solution like See.Sense AIR can only be as effective as the network coverage supporting it. Described by the company as the first bike tracking device to operate across an NB-IoT network—which trumps peer-to-peer throughput for decent battery life—AIR allows users to locate and track their bikes from their smartphone for up to three months on a single charge of the device’s battery.

While See.Sense considered a number of competitive LPWAN wireless technologies, including NB-IoT’s sister cellular technology, LTE-M, the company settled on NB-IoT due to its coverage, ability to operate across an NB-IoT network—which trumps peer-to-peer throughput for decent battery life—and its ability to provide superb power consumption capability when idle. Described by the company as the first bike tracking device to operate across an NB-IoT network—which trumps peer-to-peer throughput for decent battery life—AIR allows users to locate and track their bikes from their smartphone for up to three months on a single charge of the device’s battery. AIR is designed to run on four AA batteries for up to three months, giving the device a range of up to 50 miles on a single charge.

The NB-IoT platform was chosen because it allowsSeeSense to work with a wide variety of hardware and software vendors, giving the company flexibility in selecting the best components for its product. AIR is a low-power device that consumes very little energy, making it ideal for use in the sports and fitness market.

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The road ahead

While AIR is a powerful tool for tracking and locating a bike, it may not be able to prevent theft or vandalism. However, it can help cyclists avoid expensive repairs and replacement costs. By providing real-time location information, AIR can help cyclists avoid leaving their bike unattended in a high-crime area or in a vulnerable position. AIR can also alert cyclists to potential theft or vandalism, allowing them to take immediate action to prevent further damage.

In conclusion, AIR is a valuable tool for cyclists who want to protect their beloved two-wheeled rides. It provides peace of mind and can help prevent theft or vandalism, making it an essential component of any cyclist’s toolkit.

Industry Viewpoint

Juan Pablo Viera, Co-Founder and CTO, Unlimited

Sports and Bluetooth LE prove the perfect match

As wireless tech has become more sophisticated, so has the imagination of developers. Bluetooth LE, for example, offers several benefits over traditional Bluetooth technology, making it an ideal choice for a variety of applications.

Bluetooth LE is essential to maximize battery life and improve the user experience

We could have chosen a closed RF protocol to connect our e-skate, but it did not give us the flexibility to connect our devices to other platforms or devices. Bluetooth LE offers a simple, secure, and reliable protocol for connecting devices, making it the perfect choice for our e-skate.

Bluetooth LE is essential to maximize battery life and improve the user experience. It provides low-power consumption and long battery life, allowing our users to enjoy their e-skate for longer periods of time. Bluetooth LE also provides a secure and reliable connection, ensuring that our users can trust their data and privacy.

Beyond battery life and smartphone connectivity, Bluetooth LE also offers a secure and reliable connection, ensuring that our users can trust their data and privacy. Bluetooth LE is also more efficient than traditional Bluetooth technology, making it ideal for use in the sports and fitness market.

The Bluetooth LE protocol is also easy to integrate into existing devices, making it a popular choice for developers. Bluetooth LE is also more efficient than traditional Bluetooth technology, making it ideal for use in the sports and fitness market.

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Plug-and-play IoT and Microsoft Azure IoT Cloud connectivity

IoT solutions company, Cloud of Things, has released DeviceConnect Genie, a plug-and-play module designed to integrate any electronic product where the manufacturer wishes to introduce ‘production-grade’ IoT capabilities and Microsoft Azure IoT Cloud support. Integrating Nordic’s nRF51822 Bluetooth LE Advanced multiprotocol SoC, the module could, for example, be used in lighting systems for buildings, where LED or OLED illumination needs to be made dimmable or set to a ‘human centric’ temperature range. The module also supports multiple encryption and network protocols, including Wi-Fi, Bluetooth LE, Zigbee, and Thread. The module can be configured to work with a variety of applications, including remote control, security, and home automation.

Tech Briefing

The advantages of a dual-core Bluetooth LE SoC

Nordic Semiconductor has announced its nRF5340 SoC, which is designed to support developers in building more complex applications with long battery life. The nRF5340 SoC is equipped with two user-accessible processors allowing developers to build more complex applications with long battery life.

Industriall IoT

Module suits harsh environments

 Laird Connectivity has unveiled its BL633 module, based on Nordic’s nRF52832 Bluetooth LE Advanced multiprotocol SoC, designed for OEMs developing wireless products for harsh operating environments. The BL633 module comes in a 15 by 10 by 2.2 mm form factor and is qualified over an extended –40º to 105ºC operating temperature range. The extended temperature range, memory and dynamic multi-threaded CPU support makes the module suitable for a range of IoT applications. Full Speed USB operation allows the BL633 module to be used for USB-compatible wired peripheral applications. The connectivity enables device firmware updates (DFU) over USB. The module also supports multiple programming options including the Nordic nRF5SDK, Zephyr RTOS, AT command set as well as Laird Connectivity’s own smartBASE environment, offering maximum flexibility to developers.
Tech Perspective

Using a blockchain for secure asset tracking

IoTeX is combining the security built into Nordic’s nRF9160 and its blockchain technology to protect the integrity of critical asset tracking data.

The commercialization of cellular IoT asset tracking solutions such as IoTeX’s Pebble Tracker has the potential to revolutionize supply chain applications. The product, powered by Nordic Semiconductor’s nRF9160 SiP, uses mature, secure cellular infrastructure to provide location, environment and motion tracking data for global asset tracking.

But more than that, Pebble Tracker promises to address problems such as the more than $400 billion in annual losses that result from supply chain errors such as temperature excursions. Each year compensation for these losses and many others are sought, and payouts from penalty clauses and insurance claims rely heavily on asset tracking data. (See WQ Issue 3, 2020, pg25)

It should be any surprise that asset tracking information has somehow been tampered with or falsified, claims could drag on for years. And worse, litigation could follow.

IoTeX is tackling the challenge by combining the Pebble Tracker’s nRF9160 SiP’s Arm TrustZone (for trusted execution) and Arm CryptoCell 310 (for application-layer security) protection features with the company’s blockchain for large scale, decentralized and trusted asset tracking applications.

Trust built on hardware and the blockchain

The Arm TrustZone technology built into the nRF9160 forms a Trusted Execution Environment (TEE). The TEE is a secure area inside the Arm processor that runs in parallel but is isolated from (and often invisible to) the main operating system. Code and data inside the TEE are maintained with the highest level of integrity and confidentiality. Such a system protects the valuable code and data while enabling less valuable code and data to run unencumbered on the main operating system. (See WQ Issue 3, 2020, pg25)

But a truly secure IoT device requires more than a TEE—additional roots of trust (RoTs) and security mechanisms are demanded. That’s the role of Arm’s CryptoCell.

CryptoCell is an embedded security platform for devices using TrustZone, comprising a multilayered architecture combining hardware data path, RoT management and operation control with a layer of security firmware. (See WQ Issue 4, 2019, pg26)

Pebble Tracker sends its data to the IoTeX blockchain-based backend services to orchestrate large-scale, decentralized asset tracking applications. Blockchains are based on the concept of open, openly verifiable ledgers ensuring that all transactions are publicly confirmed and logged with an uncorruptible digital signature. (Only the transaction is visible, not the private data or content that triggered it.) Because of the use of open ledgers, tampering with blockchain data would quickly be exposed.

IoTeX’s blockchain and IoT technology stack, which includes sophisticated middleware to pair with Nordic’s hardware, offers SDDs that developers can use alongside one of Nordic’s preferred operating systems, the open-sourced Zephyr, to build the trusted applications of tomorrow.

Security and privacy by design

Pebble Tracker makes use of built-in environmental and motion sensors from Bosch and TDK to capture real-time metrics, including GPS location, temperature, humidity, volatile organic compound (VOC) level, light, acceleration and orientation.

The product employs “security and privacy by design” methodology, and equipped with the nRF9160 SiP’s powerful security features. It is built to ensure all data the device generates is trustworthy and owned exclusively by the device’s owner.

The nRF9160 SiP enables LTE-M and NB-IoT network connectivity and integrated GPS support for precise, long range tracking of asset data. Via this cellular connectivity, Pebble Tracker continuously records real-time data and transmits the digitally signed information to the Cloud or other backend systems including the IoTeX blockchain.

The combination of hardware security and the blockchain ensures protection of all data points produced and brings end-to-end trust to tracking applications. The trusted data can then be used by backend services to fulfill predeployed smart contracts. For example, if a tracker detects an asset is mishandled, the blockchain contract can automatically penalize the company and compensate the customer without human intervention.

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**Summary**

Full product details at: www.nordicsemi.com/Products

**Radio**

**Peripherals**

**Security**

**Core System**

**Antenna Interface**

- 50 Ω single-ended
- Single-ended
- Single-ended
- Single-ended
- Single-ended
- Single-ended
- Single-ended
- Single-ended
- Single-ended
- Differential
differential
- differential
- differential

**RX Sensitivity**

- -108 dBm (LTE-M), -114 dBm

**Maximum TX Power**

- 23 dBm
- 3 dBm
- 8 dBm
- 8 dBm
- 4 dBm
- 8 dBm
- 4 dBm
- 4 dBm
- 4 dBm

**700-2200 MHz**

**2.4 GHz**

**Timer, RTC**

**Wearables**

**Toys**

**Sports & Fitness**

**Smart Metering**

**Smart Home**

**Smart Buildings**

**PC Peripherals**

**Industrial Systems**

**Healthcare & Medical**

**Consumer Electronics**

**Beacon**

**Automation**

**Automation**

**Networking**

**Consumer Electronics**

**Industrial Systems**

**Medical**

**Network processors**

**Smart Building**

**Smart Home**

**Smart Interiors**

**Sports & Fitness**

**Tops**

**Developers**

**Applications**

**Certifications**

**Operating Temperature**

**Supply Voltage**

**Development Kits**

**Packages**

**Tech Profile**

**nRF52805**

**Description:** The nRF52805 SoC complements the other nRF52 Series SoCs with a Bluetooth 5.2 single-chip solution. The SoC is available in a 2.48 by 2.46 mm WLCSP-optimized for small two-layer PCB designs, making it ideal for cost-constrained applications. The nRF52805 SoC is a good choice for beacons, dispensable medical devices, sensors, switches and presenters. It can also be selected as a network processor providing the wireless connectivity for a companion application processor.

**Hardware:** The nRF52805 features a powerful 64 MHz 32-bit Arm Cortex-M4 processor (144 CoreMark) with excellent efficiency [65 CoreMark/mA] and includes 192 KB Flash plus 24 KB RAM. The multiprotocol radio delivers up to +4 dBm power output and -97 dBm sensitivity (1 Mbps Bluetooth LE throughput). The radio’s peak power draw is only 4.6 mA (TX1 1.41 MHz and the SoC’s current draw is as low as 0.3 µA in System OFF and 1.1 µA in System ON with 24 KB RAM retained and RTC running. The SoC features a range of analog and digital interfaces such as UART, SPI, TWI and QDEC, a two-channel 12-bit ADC and ten GP, and the SoC, which requires only ten external components. The SoC can be powered from a 1.7 to 3.8 V supply and integrates LDO and DC-to-DC voltage regulators.

**Software:** The nRF52805 is supported by the S112 and S113 Soft Devices. These Soft Devices (Bluetooth 5.2-qualified protocol software) are memory-optimized ‘peripheral’ stacks supporting 2 Mbps throughput and CSA x2 features. The stacks support up to four connections as a Peripheral concurrently with a Broadcast. The S112 supports LE Secure Connections, improving security compared to LE Legacy pairing. S113 also supports LE Data Packet Length Extension, resulting in higher throughput.

**Development tools:** The nRF52 DK is the recommended DK for the nRF52805. It emulates the SoC, and can be used as a starting point for development before moving over to a custom board. A guide on how to use nRF52805 with nRF5 SDK is available.