WQ Special Report

How the IoT Can Help Save the World

Wireless tech supports major carbon saving initiatives aimed at limiting global warming
Welcome
Kjetil Holstad
EVP Product Management

The Wi-Fi Alliance says there are 18 billion Wi-Fi devices in use. A glance around the home or workplace shows Wi-Fi is integral to the way we work, rest and play.

With the introduction of Wi-Fi 6, the technology is set to become even more widespread. The latest specification brings features that make Wi-Fi even better suited to the IoT. Examples include an advanced power saving mode and the capability to support many more devices on a single channel without coexistence challenges.

Together with Bluetooth LE and cellular IoT, Wi-Fi is a foundation technology of the IoT. Nordic is the leader in Bluetooth LE and is disrupting the cellular IoT sector with its low power cellular IoT. However, until now, the company didn’t offer a Wi-Fi solution. That’s changed with the availability of the nRF7002, a Wi-Fi 6 companion IC.

The introduction is accompanied by the nRF7002 DK and software development support is through the nRF Connect SDK, helping developers get started on nRF7002 Wi-Fi IoT projects immediately.

The nRF7002 operates alongside Nordic’s nRF52 and nRF53 Series SoCs to bring Internet Protocol (IP) connectivity to Bluetooth LE networks where it will enhance existing applications and enable new ones. The nRF7002 will form a key part of Nordic’s Matter standard solutions which bring interoperability to smart home ecosystems.

The IC also works well with the nRF9160 SiP where it supplements cell-based and GPS-based location services with the SSID-based Wi-Fi location service offered in nRF Cloud.

This is an exciting time for Nordic. The company is now one of very few suppliers with wireless IoT solutions for all three key technologies. And this is just the start; our R&D roadmap details major advances in our Bluetooth LE, Wi-Fi and cellular IoT products which I’m looking forward to telling you about soon.

Unifying the smart home market

LEARN MORE
nordicsemi.com/matter
Nordic introduces nRF7002 companion IC for Wi-Fi 6 IoT applications

Nordic Semiconductor has announced the availability of its nRF7002 Wi-Fi 6 companion IC and the associated nRF7002 DK. The IC is the first in Nordic’s Wi-Fi product family and is a low power device providing dual band (2.4 and 5 GHz) connectivity. By using the IC, developers can take advantage of Wi-Fi’s higher throughput compared with, for example, Bluetooth LE, and ubiquitous infrastructure. The nRF7002 IC can be used together with Nordic’s award-winning nRF52 and nRF53 Series multi-protocol SoCs and the nRF9160 cellular IoT SiP, but can equally be used in conjunction with non-Nordic host devices. The IC makes it easy for developers to get started on nRF7002-based IoT projects. Wi-Fi 6 brings significant benefits to IoT applications—such as smart home products, industrial sensors, asset trackers, and wearables—including power efficiency gains for battery powered-Wi-Fi operation, and management of large IoT networks comprising hundreds of devices.

“The nRF7002 Wi-Fi 6 companion IC is a testament to Nordic’s leadership in low-power wireless technology,” says Svein-Egil Nielsen, CTO/EVP of R&D and Strategy at Nordic. “Supported with the nRF7002 DK and the award-winning NRF Connect SDK, combined with Nordic’s best-in-class technical support, low power has never been easier to develop great Wi-Fi products.”

The nRF7002 is a perfect fit for Matter, a smart home standard backed by Amazon, Apple, Google, Nordic, Samsung, and others,” says Finn Boetius, Product Marketing Engineer with Nordic. “The nRF7002 makes it easy for developers to get started on Matter over Wi-Fi applications.” Matter uses Thread, Wi-Fi, and Ethernet for data transport, and Bluetooth LE for commissioning. The nRF7002 is the ideal choice for implementing low power SSD-based Wi-Fi locationing when used together with Nordic’s nRF9160 SiP and the company’s nRF Cloud Location Services. The nRF7002 companion IC and nRF7002 DK are available now from Nordic’s distribution partners.

Asset Tracking

Samsung keeps track of consumer valuables with Nordic technology

Nordic’s nRF9160 SoC is being used to power the Galaxy SmartTag from global IT and mobile company Samsung Electronics. The Galaxy SmartTag provides a simple and effective way to keep track of commonly misplaced items, such as keys or bags. Nordic’s SoC provides Bluetooth LE wireless connectivity, which Galaxy SmartTags use to pair with the SmartThings app on Galaxy smartphones.

“The demand for consumer asset tracking solutions has witnessed substantial growth in our increasingly mobile world, and Samsung is a technology leader in this area,” says Nordic’s Bjørn Åge “Bob” Brandal, VP of Sales and Marketing, Asia Pacific. “Nordic is delighted to be working closely with Samsung Electronics on the new Galaxy SmartTag.”

For tagged items lost but still within Bluetooth LE range, the SmartThings “search nearby” feature lets users see the approximate location of the tag, while the “ring” feature allows users to play a sound on the tag to help locate it. Within range, the user will receive a smartphone or smartwatch notification letting them know the item has been left behind. Any nearby Galaxy smartphone or tablet that has opted in can alert the Samsung server, which in turn alerts the owner. The user data is encrypted and securely protected, ensuring the location is only revealed to the owner.

With Nordic’s Bluetooth LE wireless connectivity, Galaxy SmartTags can do more than locate valuables. They can also be programed to perform automated tasks such as activating a home security system, dimming the lights, or controlling a smart TV.

Internet of Things

Nordic becomes full member of DECT Forum and joins board

Nordic Semiconductor has announced its full membership of the DECT Forum, the organization responsible for fostering the development of the DECT (Digital Enhanced Cordless Telecommunications) Industry standard, and the adoption of the DECT New Radio (NR1) standard. The European Telecommunications Standards Institute’s (ETSI) DECT NR1 is the first non-cellular 5G wireless standard and is designed to support massive IoT at densities of million devices per square kilometer.

Nordic has been a key contributor to the development of the DECT NR1 standard since the initial specification was published in July 2020. The standard promises 99.99 percent reliability due to features built into the lower layers of its RF stack. Nordic became the main contributor for the stack’s physical (PHY) layer and a key contributor for the Media Access (MAC) layer at the launch of the specification. The company continues to serve as we the editor for the PHY layer.

As part of its membership, Kristian Sæther, Nordic’s Product Director of Cellular IoT and NRC, will join the DECT Forum Board. Nordic has also joined several key working groups. “Nordic is a believer in bringing the IoT to the widest audience,” says Sæther. “Our strategy is to support the IoT technologies that cater to the widest range of applications while being based on open standards and built to exacting technical specifications. DECT NR1 fits the bill perfectly,” he adds. “We joined the DECT Forum due to its proven track record for establishing DECT in the market.”

Wearable technology

Wearable provides seniors healthcare metrics

Yardarw Electronics has launched two wearables for patient use in hospitals and aged care facilities. The wearables offer a wide range of features including patient location monitoring, health data acquisition as well as automated alerts and emergency calling. For example, staff in an aged care facility could use the products to not only monitor an individual’s key health data, but also their location in the building.

The YH-WR6 smart watch and YH-WR7 smart bracelet both employ Nordic’s nRF52832 SoC to provide Bluetooth LE wireless connectivity to send data to a gateway. From the gateway, the data is relayed to the Cloud where hospital or facility staff can review it via a web-based platform. The IR56 waterproof-rated devices integrate sensors including an accelerometer for activity monitoring; an optical sensor for blood heart rate and blood oxygen measurement; an air pressure sensor; a temperature sensor; a gyroscope; and an ambient light sensor to adjust the screen brightness and save power. The SoC’s Arm Cortex-M4 processor acts as the main microcontroller and helps oversee the infrared sensors. The IR52832 also enables the devices’ location monitoring functionality.

In Brief

IMPROVING AIR QUALITY

Nordic has added technical expertise to an international air quality monitoring initiative. The South African Consortium of Air Quality Monitoring (SACAOQM) is a consortium with the goal of bringing together the private sector, and other institutions to promote and develop IoT-powered air quality monitoring and prediction technology. Due to the cost and complexity associated with deploying traditional air quality monitoring systems, countries are forced to allocate their limited resources to monitor priority sites which necessitates the omission of others. As such, SACAOQM is developing an AI-powered IoT system envisioned to address shortcomings in currently available commercial systems.

A SCENT FOR VIRTUAL REALITY EXPERIENCE

Scent might soon become part of the multi-sensory enhanced reality experience. At CES 2023, U.S. startup OVR Technology presented IGN, a wearable featuring a cartridge filled with unique digital aromas. The company says the sense of smell influences emotions and behavior. The device, which connects wirelessly over Bluetooth, fits a smartphone, PC or VR headset and could open up a new realm of possibilities for gamers, retailers and healthcare providers, the company claims. Adding scent to a virtual reality retail exhibit or therapeutic VR environment, for example, could influence the way people respond to it.

NORDIC THINGY'53 WINS AWARDS

The Nordic Thingy-53 has been named the winner of two important industry awards. The IoT prototyping platform won the ‘Best IoT Innovation of the Year’ category of the Electronics Maker (EM) Best Awards 2022. India’s most prestigious electronics industry awards. The Thingy-53 was recognized as the ideal platform for building advanced wireless products of concept with M. capabilities on short schedules. It then won the WF/ Wireless/Microwave’ category of the 2022 World Electronics Achievement Awards (WEA), which honors products, companies and individuals that have made outstanding contributions to innovation and development.
Livestock tracking solution offers remote health and location alerts

U.S.-based HerdDogg has released a suite of livestock tracking solutions to provide ranch operators with remote health and location data for their herd of cattle. The range includes three DoggTag smart tags—TraceTag, YardTag and WelfareTag—as well as the DoggBone gateway which relays the smart tag data to a Cloud platform for review by ranch management.

The smart tags are applied to the ear of an animal, using a standard tag applicator and the tag then records its proximity to the gateway at specific times. Ranchers can then use the data to determine, for example, if or when an animal visits a feed trough or a watering location, as well as maintain vaccination-inventory of their herd. If an animal falls to visit a feed trough it could be a sign that the animal is unwell or of potential theft.

The WelfareTag also includes temperature and light sensors as well as an MEMS accelerometer to record data about animal behavior. This data is gathered several times an hour and is stored on the tag’s Flash memory. In this manner it can relay this data to the Cloud when the animal is near within range of the DoggBone gateway. The data can also be used for estrus detection—identifying when a female animal is ready for breeding—as well as for health alerts for apparent lameness, fever or Respiratory Disease.

The TraceTag and YardTag smart tags are provided by Nordic’s nRF52833 SoC and the WelfareTag device employs the advanced nRF52840 SoC. The Nordic SoCs provide Bluetooth LE wireless connectivity between the tags and the gateway at a distance of up to 90 meters in standard operation. The DoggBone gateway employs two U-Blox BM1319 modules—which integrate the nRF52832 40 SoC—to provide long range wireless connectivity between the gateway and the smart tags. From the gateway, the data is relayed to the Cloud using cellular or Wi-Fi.

Wildlife telemetry solutions provider, Cellular Tracking Technologies, has developed a lightweight and low-powered device for monitoring the migration patterns of species weighing as little as 75 grams. The company has already deployed trackers on species that are previously too small to carry trackers—such as the American Robin and Green Jay.

Both versions of the animal tracker, FleckrGPS and FleckrCL (CellLocate), come in a compact form factor—the smallest version weighs approximately 2.5 grams—with the transmitter generally weighing below 3 percent of a tracked bird’s weight so as not to impact its natural behavior.

The products use Nordic’s nRF9160 low power SiP for the GNSS positioning and cellular IoT connectivity that allows the animal data to be relayed to the Cloud. The battery and solar-powered devices feature a three-axis accelerometer for detecting mortality, providing a general level of activity (not moving or moving significantly), and standard 0.1, 0.2 and 0.4 Hz measurements. Algorithms can also be deployed to identify specific animal behaviors like roosting, flight and foraging, for example.

“The FleckrGPS and FleckrCL leverage a whole new suite of tools enabling the study of animal movement and behavior at a spatial and temporal scale previously unattainable for a wide range of smaller species,” says Sheldon Blackshire, the firm’s CEO. FleckrGPS and FleckrCL use Nordic’s nRF9160 Cloud/Loc Services for power-efficient and accurate positioning. From the web platform researchers can see where the animals are on a map, view sensor data and update device configurations over-the-air.

Location & Tracking

Cellular IoT animal tracker monitors small species

Resort management solution tracks skier location on mountains

Flak, a ski management firm, has upgraded its workforce management solution to include IoT network capabilities. The network indicates the location of thousands of guests and instructors in real time over the mountain in near real time. The Flak SnowSports Workforce Management solution with GPS Tracking platform comprises the Flak tag wearable device using Nordic’s nRF5180 ISD and the associated Mountain View web-based dashboard.

The ISD provides the GNSS positioning and cellular IoT connectivity that allows the skier’s location data to be relayed from the Flak tag to a smartphone or tablet via the Cloud. The nRF5180 ISD combines cellular location data with GNSS triellation for precise location.

The location of individuals is continually relayed to the Flak servers for a comprehensive understanding of what’s happening on the ski fields. The system allows, for example, ski management to direct late students to a classroom in minutes or track any class late to return at the end of the day. At the same time, data-driven feedback helps instructors set level-appropriate lessons. At the biggest resort at which it’s deployed in Whistler, Canada, flak can scan and associate up to 3,500 devices to guests and instructors.

Connected rowing machines provide performance insights

Rowing machine maker, WaterRower, is using Nordic Bluetooth LE connectivity in its rowing machine performance monitors to provide users with real time access to programs to help them train smarter.

The WaterRower rowing machines provide smooth and even resistance and a realistic rowing experience. The company’s S4 Parformance Monitor can be mounted to the machine and displays a range of time, distance and intensity metrics. It integrates Insight SiP’s ISP1907-LL module based on Nordic’s nRF52831 SoC. The module provides Bluetooth LE connectivity to the WaterRower Connect iOS and Android app. From the app the user can review their workout history.

Haptic skin VR system provides vivid touch experience

A hand-worn wireless haptic interface system that collects personalized tactile sensation data to provide a vivid touch experience in the virtual world has been developed by researchers in Hong Kong. The ultra thin, ultra flexible, wireless skin-integrated electronic haptic technology is designed to enhance the immersive experience of VR and AR users.

Users can feel virtual objects at varying degrees of force proportional to actions in the metaverse—such as a mouse running along the hand, or grasping a tennis ball. Based on personalized threshold data, electrotactile feedback can be delivered to any part of the hand on demand and within an intensity range that is strong enough to be noticed but will not cause any pain. Unlike typically cumbersome haptic gloves which tend to rely on bulky pumps and air ducts powered through cables, the WaterFrac system, developed at the City University of Hong Kong, employs Bluetooth LE connectivity provided by a soft driver unit worn on the wrist. This enables configuration from a smartphone to drive the actuator in multiple configurations over-the-air.

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A wireless soundproof microphone that straps over the user’s mouth to create a seal can prevent ambient noise from leaking out while simultaneously suppresses the user’s voice to make it less audible to the outside world. Developed by Japanese company Shifu, the Mutalk device is designed for various applications in environments where external noise might hinder communication, such as VR, online gaming and conference call while using Songkran technology to harness the Helmholtz resonator principle to achieve a significant sound deadening effect. It operates as a wireless headset when linked to a smartphone via Bluetooth LE connectivity.
News

Smart City

Speeding up a rapid transit system

The rapid transit system of one of China’s most populous cities is employing Nordic Bluetooth LE wireless technology to help the 10 million people who use the network each day get to their trains and destinations faster.

The point of sale (POS) machines at Shanghai Metro’s entry and exit gates uses Shanghai Dito Information Technology’s (Dito) QR Code Bluetooth Security Signature Verification Module. The module employs Nordic’s nRF52832 multiprotocol SoC. The SoC enables secure, offline signature verification to authorize customer payments in the event of network loss.

To access Shanghai Metro, commuters can download the Shanghai Qihao app to their smartphone. From the app, users can generate a QR code that is scanned on approach to the entry or exit gates. In addition to Shanghai Metro, the POS systems have been rolled out across a number of other smart transportation facilities across China. The system is used up to 150 million times each day, accounting for more than 35 percent of transportation payment transactions in China, according to the firm.

Bruce Xie, CEO of Dito, said, “With Nordic’s in-depth cooperation and support, Dito’s offline verification module is not only improving travel convenience of citizens’ travel, but also greatly reducing the use of physical cards and tickets, and the resources required to make them.”

To oversee the sensors and collate data, the nRF9030 SiP enables the collected sensor data to be securely transmitted to the proprietary Cloud portal, Prylada Cloud, via a cellular IoT network.

Wireless sensor networks predict environmental changes

Three wireless sensor networks that supervise square kilometers of land and water to predict environmental changes are being developed by a team of researchers in the U.S. led by Supratik Guha, Professor at the University of Chicago Pritzker School of Molecular Engineering, the team is creating a sensory network capable of tracking pollution, moisture levels and chemical composition to generate data about the rapidly shifting composition of the planet.

“We want to see how rivers are being polluted, how much fertilizer is washing out of the soil,” said Prof. Guha. “With better data, terrestrial ecologists can develop better nitrogen and carbon dioxide cycling models. [And farmers can use exactly the right amount of water at exactly the right time.]”

Under the project name Thoreau (after the famous naturalist Henry David Thoreau), Guha’s team have created a network that monitors customer payments should the entry or exit gates suffer a loss of network signal. The nRF52832 SoC ensures secure Bluetooth LE connectivity between the entry and exit gates and the user’s smartphone.

Cellular IoT

Cellular IoT gateway enables sensor data collection

An IoT gateway solution developed by German company TYMOQ sits at the heart of its asset monitoring and data acquisition platform. The Prylada IoT Gateway (ADH-02) provides a set of connection interfaces for gathering telemetry data from a variety of sensors including temperature, humidity, light, liquid leak, air quality and movement detection.

The device employs the computational power of Nordic’s nRF9030 SiP’s Arm Cortex-M4-L3 application processor to oversee the sensors and collate data. The nRF9030 SiP enables the collected sensor data to be securely transmitted to the proprietary Cloud portal, Prylada Cloud, via a cellular IoT network.

Sports & Fitness

GPS bike computer provides riding data and supports sensors

Magene has launched a multifunctional GPS bike computer that can record over 100 different items of riding data across 13 categories as well as support up to eight peripherals. The C406 Pro uses satellite positioning to accurately record and display a range of medical values, including heart rate monitors, power meters, speed and cadence sensors, as well as electronic shifting systems and the company’s L508 Radar Tail Light.

The nRF52840 SoC’s powerful Arm Cortex-M4 processor provides ample computational resources to supervise the data acquisition, data processing, data saving and GUI display. The SoC’s Bluetooth LE connectivity enables data to be shared with third party devices.

The Fermi farm network (Thoreau 2.0), for example, uses a solar sensor connected to a plastic-encased circuit board. The farm has 23 battery-powered nodes buried beneath the surface where they detect and monitor volumetric water content, temperature and soil electrical conductivity.

The sensors have an operational span of roughly four-and-a-half years, thanks largely to their use of low power wireless tech. The nodes collect data every 30 minutes, relaying it via a cellular IoT network to a solar-powered mini computer in the middle of the field, which in turn transmits the information to a remote laboratory.

Developers delivering solutions for women’s health

Wireless devices that target women’s health are beginning to emerge on the consumer market. CES 2023 in Las Vegas, Movano Health introduced a future iteration of its medical-grade Evie smart ring for women, which will monitor health metrics to help users better understand the timing of their menstrual cycle, including menstruation onset and ovulation windows.

The device also offers support for menstrual symptoms through insights delivered to an app on a paired smartphone. “By monitoring their [women’s] temperature, through the course of the month, as well as their heart rate, we can track and predict when, say, the period is about to start,” John Mastrototaro, Movano Health’s CEO and Director, recently explained to TechCrunch magazine.

Elsewhere at CES 2023, Withings demonstrated a version of its hands-free urine home lab, which sits under the front rim of a toilet bowl. It monitors menstrual cycles by tracking hormone levels. The device can even help screen for bladder and ovarian cancer, says the company.

Information collected by the device is relayed to a smartphone app via low power wireless connectivity.

By the Numbers

Nordic Semiconductor has reported 2022 annual revenue of $777 million, representing growth of 27 percent over the 2021 figure. The result comes on the back of all-time record Q4 revenue of $191 million, an increase of nearly 12 percent in the quarter over 2021. The strong, year-on-year demand reflects a significant growth across all Nordic’s main verticals with Bluetooth LE once again dominating, contributing $569 million to annual revenue.

The global consumer IoT market size is forecast to reach $556 billion by 2030, registering a CAGR of 12 percent from 2023 to 2030, according to Grand View Research. The analyst ascribed this growth to the increasing adoption of IoT devices—including smart wearables, fitness trackers, smart home devices and more—that gather and share data over the network.

The wireless segment held a considerable $1.67 billion market in 2022 and is projected to expand further at a significant CAGR.

The global smart rings market was worth $1.67 billion in 2022, according to a study by market research firm Centive DataInsights. The analyst anticipates the smart rings market will hit $11.44 billion by the end of 2030, with a CAGR of 24 percent over the 2023 to 2030 forecast period. The Asia-Pacific region has the largest market share. Cloud services enable these small devices to provide various functions, the firm says.

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Nordic Bluetooth LE approved for Amazon Sidewalk IoT network applications

Amazon Sidewalk combines Bluetooth LE and sub-6 GHz radio technologies to help wireless devices work better indoors and extend their reach beyond the home.

Building Amazon Sidewalk products

A combination of a Nordic nRF52840 Bluetooth LE SoC and a Semtech SX1262 sub-6 GHz radio transceiver provides the foundation to build an Amazon Sidewalk device. The nRF52840 is the most advanced SoC in the nRF52 Series. It supports Bluetooth 5.3 and Bluetooth 5’s Long Range and high throughput (2 Mbps) modes.

The nRF52840 uses a powerful 64 MHz 32-bit Arm Cortex-M4 processor and includes 1 MB Flash plus 256 KB RAM. The multiprotocol radio offers up to +14 dBm power output and ~95 dBm sensitivity at 1 MHz Bluetooth LE for a link budget of 103 dBm. The nRF52840 includes a full-speed (52 Mbps) USB 3.1 controller on-chip. An extensive range of peripherals are available with a number of high performance digital interfaces such as high speed SPI (32 MHz) and quad SPI (32 MHz) to allow direct interfacing to displays and external memory.

The nRF52840 uses the nRF Connect SDK for Amazon Sidewalk software development. The scalable, unified software development kit enables developers to build software optimized for size and performance on devices with limited memory, as well as more sophisticated and feature-rich software for more advanced devices and applications. The SDK can be used by developers to immediately get started on Amazon Sidewalk projects because it integrates the latest version of the Amazon Sidewalk software development repository. In addition, the SDK brings developers a wealth of variables, such as Bluetooth LE profiles and driver support for all peripherals. It supports applications using Bluetooth LE and Bluetooth mesh as well as other popular protocols.

Amazon Sidewalk applications can be evaluated using the nRF52840 DK. This is a versatile single board development kit for Bluetooth LE, Bluetooth mesh, and other low power 2.4 GHz protocol development on the nRF52840 SoC. It facilitates development by exploiting all features of the nRF52840 SoC. All GPIOs are available via edge connectors and, among the applications made more effective through Amazon Sidewalk, and examples for Amazon Sidewalk include smart outdoor lighting, environmental sensors, utility meters, asset trackers, and domestic appliances such as washing machines—that are often kept in basements or garages—as well as healthcare and commercial devices.

Amazon Sidewalk development is supported through Nordic’s nRF52840 DK.
Connectivity a driving force to standardize EV infrastructure

Bluetooth LE, Wi-Fi and cellular IoT connectivity can help electric vehicle charging companies manage the complex EV ecosystem and grow clean transport

As the world transitions away from internal combustion engine (ICE) vehicles to help meet climate targets, the rollout of electric vehicles (EVs) as a viable, more sustainable transport alternative is increasing.

Government mandates and regulatory incentives have been a key driver of the growth in EV adoption. The U.S. Government is aiming to make EVs half of all new vehicles sold by 2030. And the EU’s Green Trucking Directive calls for 50 percent toll discounts for EVs from 2023 and air pollution charges for gas vehicles from 2026.

But deployment schedules around the world are still checkered. According to the Global EV Outlook from the International Energy Agency, Europe’s Nordics — with Norway (96 percent) and Iceland (72 percent) at the top — led the world in global EV market penetration in 2021, while the U.S. barely made the top 20 with 5 percent EV sales as a percentage of overall car sales.

One roadblock to faster EV adoption is that infrastructure and customer experience challenges remain. The drivers of EVs rely on the availability of dedicated EV charging stations to efficiently plan their journeys. While traditional fueling stations for ICE vehicles are readily available, a much smaller network of operational EV charging stations has prevented many people from making the switch to electric. And the charging stations that do exist must be kept reliably up and running. Companies also need to continue to invest in smart charging technologies to generate faster charging options, while also reducing potential grid overload during peak charging times, says analyst ABI Research.

According to a new report, Connected EV Charging, from global telco infrastructure leader Ericsson, “EV charging stations are critical to ensure a steady adoption, and there are significant business opportunities for EV charging companies and the related ecosystem.”

Despite these challenges, there are signs of movement with a recent study by Berg Insight forecasting 9.7 million charging points in Europe by 2024.

The need for connectivity

As in so many other industry sectors, reliable, secure wireless connectivity to EV charging stations enhances their value proposition. Connectivity enables data to be gathered on how customers use the station, as well as the availability and condition of charging sockets. Data can be relayed to a central platform for staff to respond to disruptions or problems remotely. Avoiding potential technical issues can improve maintenance and uptime at the electrical outlet. It can also help charging companies plan when and where to scale their charging network based on demand. Data gathered can even be used to provide real-time visibility of all stations to drivers directly, helping them map out their journey.

Cellular IoT will be a driving force for the fledgling EV charging market, according to the Ericsson report. The report suggests LTE-M/NB-IoT connectivity can help EV charging companies manage the complex ecosystem of stakeholders including drivers, hardware and connectivity providers, utility companies, automotive OEMs, and asset owners like parking operators, cities and homeowners.

“By connecting charging stations with cellular IoT, EV charging companies are better positioned to effectively manage their orchestration, administration and maintenance, offering a smoother driving and customer experience,” the Ericsson report stated.

A flexible approach

Cellular IoT is not the only wireless tech with a role to play in the future of EV charging. “Bluetooth LE, Wi-Fi and cellular connectivity are all needed to enable a flexible approach for EV charging stations,” says Martin Lesund, Technical Marketing Manager – Cellular IoT, Nordic Semiconductor. “With the ability to seamlessly integrate short range, Wi-Fi and cellular devices using the same software development kit (SDK) developers can create innovative and reliable charging solutions that meet the evolving needs of the EV industry.”

An example comes from India-based tech company Intellicar. The firm’s multiprotocol edge intelligence solution has been developed for the EV value chain. The Nordic nRF52833 SoC-powered Flashµ gateway with a cellular is concentrated.

Nordic’s establishment of a base in Denmark builds on the company’s strategy of opening local offices to attract skilled staff.

As the pandemic-induced chip shortage eases, new IoT product development is accelerating. That’s increasing the demand for skilled electronics software and hardware engineers, and created human resource shortages. In response, many countries have implemented educational programs so areas that might have previously not been considered engineering hotspots are now producing thousands of highly skilled practitioners.

Nordic has taken a global perspective to recruitment, underpinned by the establishment of hubs where talent is concentrated.

Examples are India, Turkey, Poland and Nigeria. And today’s highly interconnected world means talent doesn’t have to be restricted to work overseas.

We are working hard to secure global talent because engineers are fundamental to ensuring Nordic designs and builds the products our customers need today and in the future. That’s why we’ve taken a long-term, global perspective to recruitment, underpinned by a local presence in the regions where talent is concentrated.

In recent years, Nordic has expanded into Finland, Poland, the UK, the U.S., Sweden and India. By moving its engineers live, Nordic has not only bolstered its Bluetooth LE team but also built up highly experienced cellular IoT and Wi-Fi groups. These key expansions have enabled the company to significantly strengthen its wireless technology and hardware expertise and become one of the few companies to offer Bluetooth LE, LTE-M/NB-IoT and Wi-Fi solutions. These engineers enhance the company’s credibility and expertise in the foundation technologies of the IoT and increases customer confidence. And now we have continued this approach by opening-up an office in Copenhagen, Denmark. The office houses a team of analog designers, while also serving as a location for attracting other talent in Denmark.

The new office is a further example of Nordic’s dynamic and flexible approach to recruiting. This is helped by a distributed management structure and flat hierarchy dynamics, enabling fast decisions to secure talent.

Engineers are the lifeblood of a tech company, especially one like Nordic which places a heavy emphasis on R&D. Today, the engineering team makes up over 70 percent of the company’s staff. But we’re always looking to strengthen. If you’re interested in seeing what we need to go to nordicsemi.com/About-us/Careers.

Nordic Semiconductor

Calling all engineers – you are in high demand

About us: Career
Sustainability—the ability to live, thrive and advance without depleting the planet’s natural resources—has become something of a catchphrase for the 21st century. But now it’s imperative the word becomes much more than a slogan or convenient rhetoric.

According to Scientific American, over 200 countries have shaped their environmental policies around limiting the planet’s maximum temperature rise to 1.5 degrees centigrade compared to pre-industrial levels. And yet Earth has already warmed by 1.3 degrees and, while they are only whispering it in private, climate experts collectively believe the target will be shot out in as little as ten years.

It has become a leading contributor to the economy of some countries and a major input to total industrial production in many others. And the rate of growth is showing no signs of slowing down; according to analyst Fortune Business Insights, the chip sector alone will expand from $527 billion in 2021 to $1,380 billion in 2029 at a compound annual growth rate (CAGR) of 12.2 percent. In part, this growth is due to an increasing appetite for consumer electronics, but the emergence of the IoT and machine learning (ML) is leading to many new applications that are also boosting semiconductor demand.

Increased accessibility to electronics technology has improved the lives of many, and as it becomes even more environmentally-friendly, modern technology will also improve the health of the planet. New practices are being adopted for material sourcing through processing, manufacture, distribution, retail, repair and recycling. (See analysis pg21 Making greener semiconductors.)

Growth of electronics technology is making the management of e-waste one of the most important issues. Recycling is key. According to the UN, 30 percent of e-waste is successfully recycled today, and the organisation has announced a plan “by 2030 [to] substantially reduce waste generation through prevention, reduction, repair, recycling and reuse.”

“There’s a growing focus on supply chain sustainability in electronics and manufacturing, with an emphasis on responsible sourcing of materials and reducing the environmental impact of production,” says Linda Pettersson, Senior Vice President Legal & Compliance, Nordic Semiconductor. “Additionally, there’s a growing trend toward recycling semiconductor materials to reduce waste and conserve resources.”

**By the Numbers**

<table>
<thead>
<tr>
<th>1.5ºC</th>
<th>Target limit for global average temperature (above pre-industrial levels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7X</td>
<td>Sales growth for sustainably marketed products vs conventional products since 2015</td>
</tr>
<tr>
<td>$8.98 billion</td>
<td>E-waste management market by 2028</td>
</tr>
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**In Short**

There are serious challenges to building a sustainable world, from water constraints to stressed supply chains and climate change impacts.

As the importance of environmental sustainability grows, organizations are increasingly being mandated to be part of achieving net-zero emissions.

The IoT and other smart technology form the basis of sustainable economies.

**How the IoT Can Help Save the World**

As we face up to the challenge of transitioning to a sustainable global economy, the IoT is providing the platform to help countries, communities and companies meet their green responsibilities.
The IoT will soon generate enough savings to pay back the energy cost of its manufacture and deployment and, from then on, will save around eight times the energy it consumes adopting sustainable practices,” says Nordiq’s Pettersson. But thanks to the efforts of farsighted people, there’s a master plan. And it’s a plan that saves electronic chip not as part of the problem, rather as a major part of the solution.

The GREEN ADVANTAGE

In addition to enhancing a company’s image, green policies can boost its competitive advantage and strengthen its bottomline. A 2019 survey by U.S. insurance company Aflac found 77 percent of consumers are more willing to purchase from companies who are serious about environmental practices. According to new NielsenIQ survey data, 46 percent of consumers are looking to brands to take the lead on creating sustainable change, while 93 percent of business leaders believe consumers are likely to hold businesses accountable for their environmental impact, the Environmental Defense Fund claims.

But while an individual company’s action can help towards a sustainable economy, a group of organizations working together can do much more. Industry group the Responsible Business Alliance (RBA) is committed to sustainable global supply chains. The alliance has developed a sustainability code of conduct inspired by international standards, including the Universal Declaration of Human Rights, International Labor Standards, and International Social Accountability Standards. The RBA drives supply chain leaders and customers to meet similar environmental responsibility goals, influencing every part of the process through sustainable practices.

A 2019 report by EY found that 70 percent of the RBA have now also committed to driving sustainable value for workers, the environment and business throughout the global supply chain. Members, including Nordic, are accountable to a Code of Conduct. “For corporations, change begins with enhanced visibility and control of the supply chain itself,” says Pettersson. “RBA members are more likely to require their suppliers, partners and customers to meet similar green goals by following the RBA Code of Conduct, which sets a universal baseline for all relevant aspects of our industry.”

THE CIRCLE OF (PRODUCT) LIFE

Changing how we do business at the corporate level is going to help, and new business models are helping too. The old trend to introduce new products every few years has gone and in the process it has dramatically decreased the volume of e-waste. Seek new products are designed to be instead of being thrown away after just a few years. One example, reported in The New York Times, is the Fairphone 4 made by an Amsterdam company of the same name. The smartphone has a few replaceable parts, which helps it be easily removed to expose the internal components. And those components can be replaced in minutes by removing a few tiny screws.

Other manufacturers are making it easier to fix broken products—meaning trivial faults no longer put expensive devices permanently out of commission—and simplyわない, at the end-of-life to aid recycling. It all helps to build a sustainable economy and the smartphone makers industry, to overcome. But we have to consider how we are going to power it. Replacing or recharging batteries in billions of devices is so impractical it isn’t even an option. Instead, as soon as the battery is empty the device is written off and scrapped, creating further waste. As an industry we have to rewire our investment in harvested solar energy. My company was the first manufacturer to launch a completely solar-powered NB-IoT and eGSM terminal that enables the remote wireless reading of consumption meters. The combination of a supercapacitor, sophisticated firmware and a custom solar cell make it possible for the device to be completely battery free. We have shown that a single 18 by 10 cm solar panel provides more than enough energy to power a gateway or sensor reporting data every hour year round, 24/7, even in winter. Even with only a little daylight, it is already feasible to power IoT devices without disposable batteries. A battery-free future for the IoT is possible, but the responsibility for it doesn’t lie with the end customer. It lies with the hardware developer to design battery-free solutions. Sustainable Due Diligence Directive are proposing, or requiring companies to conduct due diligence on their supply chains, while assessing environmental risks such as pollution, carbon emissions and biodiversity loss. Furthermore, mandatory climate risk reporting has been introduced in the U.K., the U.S., the E.U., Japan, Brazil, Hong Kong, New Zealand, Singapore and Switzerland.

Nordiq is part of a highly-interconnected supply chain where much of the sustainability responsibility lies directly with its suppliers and customers. But with the work towards implementing sustainable practices where we have direct control, and we are committed to engaging with partners to do things in a greener manner. Our sustainability focus is on continuing to develop energy-efficient chips that together with new power management can reduce waste and emissions, and increase the use of renewable energy. And we are committed to helping our customers find ways to use our energy-efficient chip technology in innovative solutions that support and promote sustainability.

There are still challenges for Nordic, our customers and the industry, to overcome. But over time we must create a sustainable future.
The concept aids sustainability through strategies based on the five ‘Rs’—reduce, reuse, repair, recycle and restore—and has the potential to contribute to multiple UN SDGs. According to the Connected Consumer Report 2030 produced by business think-tank The Future Laboratory for Vodafone Smart Tech, so-called smart circularity—the circular economy as it relates to connected technology and the IoT—can help the world shift away from linear consumption to an economy where resources are flipped back into a closed loop of recycling, reusing and sharing. By 2025, improved resource productivity could deliver an annual net material cost saving of $560 billion in Europe alone, according to the Ellen MacArthur Foundation, and cut greenhouse gas emissions by 39 percent. To reach these ambitious targets, chipmakers and electronic device manufacturers are playing a critical role. Tech products now require reusability, and developers consider recyclability and multi-purpose use in their designs from the beginning. Consumers can expect new devices to be compatible with previous generations of technology. This forward and backward integration is cutting down on e-waste and discouraging over-consumption. Meanwhile, tech advances such as over-the-air firmware updates increase end-product longevity, ensuring users don’t have to buy new hardware to access the latest software product features. The Connected Consumer Report 2030 also notes beyond the electronics design and manufacturing community, IoT technology can also help the whole of society embrace smart circularity with the potential to transform how we view and manage consumption. (See WQ Issue 4, 2022 pg12)

Planned obsolescence in shifts—ranging from continued durability and repair prevention to software lockouts and batteries that can’t be replaced—is now consigned to history.

**TECHNOLOGY TO THE RESCUE**

While consumers and corporations are changing their habits, protecting the planet and its resources for tomorrow will also need widespread deployment of new technology. The UN already recognizes the transformative power of tech, its 2030 Agenda for Sustainable Development states: “The spread of innovation and communications technology, and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies, as does scientific and technological innovation across areas as diverse as medicine and energy—But how exactly to turn that progress, knowledge and innovation towards the sustainability challenge? The IoT will form a foundation platform for sustainable tech. But first it needs to be fully rolled out and that will incur an energy cost. Will that cost be worth it? A Transforma Insights and 6GWorld report, Sustainability in New and Emerging Technologies in 2030, highlights how building the IoT from now until 2030 will significantly increase global electricity use, and 112 million cubic meters of water will be consumed during the manufacture of IoT-enabled solutions until that time. Hydrocarbons used for the distribution and deployment of IoT solutions will add to the cost.

Yet the Transforma report concludes that the positive environmental impact of IoT applications will make the cost well worth the initial sacrifice. In fact, IoT technology will soon generate enough savings to pay back the energy cost of its manufacture and deployment, and, from then on, will save around eight times the energy it consumes. (See WQ Issue 1, 2022 pg10) IoT devices will also conserve nearly 235 billion cubic meters of water in 2030, the report says, with 35 percent of this impact coming from improved water grid operations and the balance boosted by IoT-enabled agricultural applications such as smart irrigation (see WQ Issue 3, 2022, pg10).

The benefits of big data are also expected to be crucial in justifying the IoT’s environmental footprint. When combined effectively with, for example, ML applications, the IoT will generate swaths of information to help people and organizations better understand their energy costs and make informed environmental decisions. (See case study WQ 18 Better waste management using the IoT). Moreover, the key green benefits of the IoT will largely come from enterprise solutions, which are generally associated with efficiency savings—often in the form of reduced electricity consumption leading to lower carbon emissions (see case WQ Issue 3, 2022).

**Case Study: Better waste management using the IoT**

Even in a completely sustainable world there will be some waste which must be carefully treated and disposed of. Some of the companies that do this important work are customers of German firm pdf Networks. The firm is helping the business of traditishon become more sustainable by releasing a Nordic nRF9160 SiP-based smart waste management solution. The system is capable of remotely measuring fill levels in waste containers which enables waste management businesses to better allocate collection resources and avoid overflows. The smart device uses optical sensors to monitor the fill levels of a variety of different containers, including underground waste systems which present additional monitoring challenges through reduced visibility and increased storage volume.

The monitoring process is overseen by Nordic’s nRF9160, which then relays the data and sends it to the Cloud, using its cellular IoT connectivity. Users can then view this information through the centralized web platform, manage waste container assets, as well as review current and historical data. The platform can also perform self-assessment fill level prediction modeling and offers dynamic route simulation to optimize collection crew productivity.

“Our platform has been tailored so customers can easily manage their container fleet and conduct dynamic routing based on fill levels,” says Christian Westerdinck, Senior Product Manager at adhoc networks. “This helps save resources and reduces CO2 emissions by only scheduling waste collection when containers are actually full. With our solution, emissions in waste disposal businesses can be reduced by up to 40 percent.”

The company is supporting a sustainable economy by choosing low power technology to maximise battery usage. “Battery life was a very important factor as the product is designed to be used on a large number of containers, meaning the less we have to change the battery, the better,” explains Michael Ebert, Senior Embedded Developer at the company. “As such the extended lifetime enabled by the nRF9160SiP was a major drawcard for us.”

Better waste management using the IoT

**Need to Know**

Nordic Semiconductors takes its energy responsibilities seriously and has aligned its portfolio with the 2030 Global Goals for Sustainable Development. By 2025, improved resource productivity could deliver an annual net material cost saving of $560 billion in Europe alone, according to the Ellen MacArthur Foundation, and cut greenhouse gas emissions by 39 percent. To reach these ambitious targets, chipmakers and electronic device manufacturers are playing a critical role. Tech products now require reusability, and developers consider recyclability and multi-purpose use in their designs from the beginning. Consumers can expect new devices to be compatible with previous generations of technology. This forward and backward integration is cutting down on e-waste and discouraging over-consumption. Meanwhile, tech advances such as over-the-air firmware updates increase end-product longevity, ensuring users don’t have to buy new...
study below, Smart lights cut carbon emissions) or reduced fuel or water consumption, for example through smart electricity grid operators. [See WQ Issue 2, pg22] On more modest scales, innovative developers are doing their bit to use the IoT to create solutions that cut down the total amount of resources the world consumes. For example, the Smart or Sustainable World Challenge with Nordic Semiconductor competition—launched in conjunction with hardware education community hackster.io (a.k.a. Avnet company)—called upon participants to plan, design and prototype cutting-edge solutions that reduce humanity’s ecological footprint using the power of sensors and wireless connectivity. Projects were provided with the Nordic nRF52832 multiprotocol prototyping platform to help them realize their innovative ideas.

The overall winner, Elijah Maluleke from South Africa, created a smart water tap leakage controller that automatically closes a valve whenever there is an abnormal flow of water through the tap. The volume of water saved by using the IoT device, when scaled to millions of water sources, would have a huge impact on conservation efforts. Another entrant, Mutasim Pajak from Poland, used the IoT technology to create a vertical self-regulating soilless farm built to fight the food storage crisis and at the same time achieve maximum yield.

Nordic corporate customers are also sustaining innovative solutions to help other businesses and communities work towards a greener future. One example is China-based NOKO Smart’s MTK1781 Smart Plug, a Nordic-powered Bluetooth LE cellular IoT product designed to be used in IoT solutions to cut down energy consumption by remotely controlling load switches. Another is Canadian technology firm Bluesensing’s Leak Sensor 1.0, a battery-free, self-powered leak detection device using a sensor as both its power source and for detecting water leaks. The solution harvests energy from any fluid flow to power the Nordic nRF52832 SoC that wirelessly connects to a smartphone, from where the user can receive alerts of active leaks via an accompanying app.

The flexibility built into Nordic IoT solutions—which are used in millions of IoT applications optimizing resource usage in areas of energy, travel, transport, agriculture, manufacturing, waste handling, smart cities and more—makes it easy to customize the trade-off between duty cycle, throughput and battery life to suit the needs of the application. Nordic also builds its hardware to last for years, backwards compatible with previous generations of its products. Software is consistently updated to include new features and push connectivity and features through over-the-air software updates. These upgrades make it simple for customers to enhance the performance and lower the energy consumption of products in the field.

STORYING FOR A BATTERY-FREE WORLD

Network equipment provider Cisco suggests that in as little as a decade, there could be more than 50 billion wireless and cellular IoT sensors. Many of these will be powered by batteries. Apart from the maintenance issues—every single cell lasts for a decade, technicians across the globe will be faced with changing millions of batteries every day—those cells threaten to undermine the IoT’s sustainability credentials. Exotic materials such as lithium must be mined, the cells must be manufactured, then distributed around the world, and then there’s the major problem of safely disposing of them once exhausted.

Nordic has continually lowered the power budget of its wireless solutions without compromising performance. Such is the modern power consumption of its latest generation of products that it is becoming a part of everything we design, manufacture, use and discard. We have the technology, we have the tools, we can do. It’s clear the challenges are immense, but the stakes are even higher. By no longer simply taking, making, using and disposing, we are adopting a better way.

To lower the environmental impact, foundries are taking advantage of renewable sources of power

With the distributed intelligence of the IoT, we can now harness renewable energy. For example, the solar element silicon which is used in the manufacture of semiconductors. The elemental form of silicon is rare—but locked-up in rocks as silicon dioxide (silica) it is the second most abundant element in the Earth’s crust (after oxygen). The raw material is typically extracted from sand, which is mixed with lakes, rivers and coastlines, or from quartzite, a silica-rich rock. The mining process is not without an environmental footprint, but it is nowhere near the scale of that for materials such as stainless.

There are some options for making silica extraction a little greener. For example, sugar cane contains significant amounts of silica taken-up from the soil as the plant grows. The sugar industry is thus under way to find ways to economically extract silica from the waste products of sugar refining. Other plant waste, for example that from wheat, corn or sunflowers, also contains significant amounts of silica. A bigger environmental challenge arises when converting the silica into silicon. The process is intensive and locked-up in rocks as silicon dioxide (silica) it is the second most abundant element in the Earth’s crust. Industrial processes for making silicon from silica produce hazardous by-products like the highly purified silicon.

But by no longer simply taking, making, using and disposing, we are adopting a better way. Together with clever engineers, progressive politicians and savvy consumers, the IoT can ensure sustainability becomes a part of everything we design, manufacture, use and discard. We have the technology, we have the tools, we can do. It’s key to our sustainability is built into everything we do. It’s clear the challenges are immense, but the stakes are even higher. By no longer simply taking, making, using and disposing, we are adopting a better way.

Renewable energy is the future of products. The world is now in the process of moving to a wholly green economy. The IoT has a key role to play in this transition. Today lighting companies are already taking the lead.

Nordic has continually lowered the power budget of its wireless solutions without compromising performance.

To lower the environmental impact, foundries are taking advantage of renewable sources of power

Silicon is a purifying high grade raw material for electronics. This silicon is then used in all electronic products to make the semiconductors. The industry has traditionally been energy intensive and required lots of water, lots of energy for arc furnaces running at 2000 degrees centigrade, and carbon (which extracts the oxygen from the silica as carbon monoxide) often in the form of coal.

To lower the environmental impact, foundries are taking advantage of renewable sources of power. Samsung, for example, one of the largest chip makers, said in its 2021 sustainability report it has trialled its proportion of renewable energy since 2018 and the company reused half its water in 2021. Foundry silicon is about 99 percent pure—good enough for most uses outside of electronics (for example, for alloying with aluminum and iron) but not for chips. To rack it in the ‘seven nines’ (99.99999) purity needed for semiconductors requires a process that includes mixing the elemental silicon with water, gases, hydrochloric acid and then put into a reaction chamber using electrodes heated to 1150 degrees centigrade.

The gas then decomposes into the electrodes as seven-nines silicon. The main environmental cost is that the process consumes a lot of energy to keep the electric field hot. However, a lower energy operating system is being developed for mass production. Based on a fluidized bed reactor it does away with the energy-intensive electrodes—instead heating fluidized silicon powder onto which the trichlorosilane gas can decompose into the highly purified silicon.

While the chip industry works diligently to clean up its act, it already does away with the large, intensive electronics—instead heating fluidized silicon powder onto which the trichlorosilane gas can decompose into the highly purified silicon. While the chip industry works diligently to clean up its act, it already does away with the large, intensive electronics—instead heating fluidized silicon powder onto which the trichlorosilane gas can decompose into the highly purified silicon.
Warehouse Rave

Warehouses are rapidly adopting IoT solutions to meet the challenges of the huge global shift towards online shopping.

A few years ago, dozens of malls and retail outlets in the U.S. began shuttering, one closure after the other. Not long after, warehouses and fulfillment centers sprouted up in those very same locations.

Demand for online shopping had begun to take hold, and with it, intense demand for warehouse space from a growing number of online retailers and logistics providers.

Between 2019 and 2019, 734,050 square meters of retail space—including Walmart and Target stores and cinemas—was converted into one million square meters of industrial warehouse space, according to U.S. broadcaster CNBC.

When COVID hit, this nascent trend became a tidal wave. Lockdowns forced even larger swathes of retailers globally to lock up their shopfronts and shift aggressively to digital channels. In the first year of the pandemic alone, the share of e-commerce grew from two-to-five times the rate it had grown prior to 2020, according to McKinsey. Online retail figures everywhere—be it the U.K., U.S., Asia, or Latin America—told a similar story.

To support this shift online, major changes also needed to take place on the ground. Millions of square meters of new warehouse space were acquired and created to support the increased retail demand.

For warehouse operators there was no turning back—three-quarters of people who used digital channels for the first time during the pandemic will continue in this vein, says McKinsey. It’s estimated that 140 million square meters of new warehouse space will be needed globally to meet the rise in e-commerce sales.

As well as the addition of new facilities, the typical individual warehouse is expanding, by more than 140 percent in some parts of the globe. Amazon’s largest ever warehouse, measuring 381,000 square meters, is now being built in California.

Warehouse operators will need to modernize fast in response to the growing size and number of warehouses. Storing goods in their designated places in the warehouse and locating those goods to retrieve them for packaging and shipment are already intensive and exhaustive processes.

Employees spend a third of their shifts just moving around inside the building. With larger tracts of floor space for workers to cover, a shrinking labor pool, and inventories expanding in line with the growth in online shopping, these numbers risk blowing out unsustainably.

Supporting the dynamics of online shopping, warehouses today must also support smaller and more frequent orders and work with more varied products lines and unpredictable buying patterns.

**A PERFECT STORM FOR IoT**

To meet all these demands, leading operators are now turning to technology to build warehouses that are smarter, safer and more optimized.

A prime example of this is Amazon’s Industrial Innovation fund, a $1 billion corporate venture capital investment for projects to improve outcomes in warehouse, supply chain and logistics.

Analyst Frost & Sullivan also predicts the warehouse automation market will double to $27.2 billion by 2025.

Wi-Fi locationing is one geolocation solution that is suited for asset tracking in indoor environments. "In addition to the high propagation of Wi-Fi signal strength, one of the benefits of Wi-Fi positioning is the ability to build off of the warehouse’s existing Wi-Fi connectivity infrastructure,” says Clay Hine, Business Development Manager - Asset Tracking at Nordic Semiconductor. Devices such as Nordic’s nRF9160 Wi-Fi 6 companion IC, when built into an asset tracker, use the known location of the warehouse's warehouse assets can provide workers information about the precise locations of products, allowing them to locate and retrieve those products more efficiently.

Several IoT technologies support this location need. Let’s start with the challenges of locating goods in ever larger warehouses. Connected sensors placed on warehouse assets can provide workers information about the precise locations of products, allowing them to locate and retrieve those products more efficiently.

In Short

Demand for online shopping has seen the addition of millions of square meters of new warehouse space and more varied and dynamic product holdings.

To meet the challenges of the new digital landscape, operators are turning to technology to build warehouses that are smarter and more optimized.

IoT sensors are helping find products faster using technologies such as Wi-Fi, cellular and can help reduce disruptions, changes in product quality, identify damage and prevent workplace incidents.

**U.K. Firm System loc’s asset tracker**

LocTag fits in a case, is embedded in transport tunnels. The device includes a temperature sensor and an accelerometer. The product uses Nordic’s nRF7002 to provide Bluetooth LE connectivity and asset finding. LocTag is suitable for a wide range of indoor industrial or enterprise asset monitoring. The device supports applications including indoor tracking, navigation, asset management, and condition monitoring.
also detect temperature or humidity changes, ideal for warehouses that store perishable goods.

Once warehouses get started with IoT automation, the benefits quickly flow. Sensors can turn warehouse shelves into smart shelves that can detect and broadcast information about stock levels, product displacement or theft. Improving inventory management. Beacons can communicate with driverless robots and forklifts, helping them move more efficiently and safely around the aisles.

Further, the IoT can monitor the performance of critical equipment, by collating sensor data about the operation of key parts and using ML to detect and predict failure.

**TUNING UP FOR THE FUTURE**

A compelling extra benefit that comes with introducing IoT to solve problems such as locating assets, are the rich and broader insights that can be gleaned from the data generated by sensors. In the ‘smart warehouse’ context, sensor data about the location and movement of products, and even movement of workers and machinery, can help operators optimize operations. By using ML and AI, operators can identify potential bottlenecks in the movement of goods and calculate more efficient routes for workers and machinery – supporting both productivity gains and reducing risk of collisions and accidents. AI technologies can also use data on product retrieval frequency to optimize where products should be located for most efficient storage and retrieval.

Establishing an IoT platform also positions warehouses to capitalize on the many innovative integrations as complementary technologies advance. For instance, as enterprise wearable technology becomes more prevalent, connected products or warehouse shelves could communicate with a worker’s wearable smart glasses to guide them to the exact location of a product. And many of the benefits of warehouse IoT will extend beyond the warehouse and into the supply chain. Data about inventory levels could be fed to manufacturing facilities to ensure further production or even movement of workers and machinery, can help operators optimize operations. By using ML and AI, operators can identify potential bottlenecks in the movement of goods and calculate more efficient routes for workers and machinery – supporting both productivity gains and reducing the risk of collisions and accidents. AI technologies can also use data on product retrieval frequency to optimize where products should be located for most efficient storage and retrieval.

Amazon’s warehouse near Ontario, California will have a floor space about a fifth the size of Disneyland. Little wonder then that sometimes things can go missing. In the predigital age, tracking assets indoors was odious, error-prone, manual and slow, often resulting in forlorn packages. Now, asset trackers including a Wi-Fi radio and nRF Cloud Location Services can reveal the position of boxes relative to Wi-Fi access points. Moreover, the Bluetooth Direction Finding angle of arrival feature estimates the distance and angle of a tracking device from an unknown fixed point such as a beacon.

By the Numbers

| **140 million m²** | The warehouse space that will be needed globally to meet the rise in e-commerce
| Source: CBRE |
| **30%** | Average time employees spend travelling inside a warehouse during a shift
| Source: Howitzer |
| **$27.2 billion** | Size of the global warehouse automation market in 2025
| Source: Frost & Sullivan |

When COVID-19 struck, e-commerce in Europe jumped 71 percent. In Asia it rose 82 percent.

Warehouses were suddenly brimming with online orders needing fulfillment. To have a hope of meeting demand, companies have had to embrace wireless tech in an effort to keep pace.

**Tech Check:** Box ing Clever

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As the world’s population ages, pressure is mounting on health and assisted living facilities to provide adequate care to seniors. Cellular IoT-based remote monitoring solutions are plugging the gap that put unprecedented pressure on hospital beds and healthcare systems worldwide; the delivery of healthcare services was already transforming into one increasingly relying on technology—and data–led ‘virtual’ care, remote from hospitals or doctor’s surgeries. While technology adoption may have been accelerated by the pandemic, a significant barrier to adoption has been that many older adults distrust or simply don’t understand technology, making it difficult to practically implement. While technology use has grown markedly among the over 65s in the last decade, today still only 61% of U.S. people in that age bracket own a smartphone, while only 75 percent are internet users, according to a recent study by Pew Research. This compares poorly to 18 to 29 year-olds where both smartphone ownership (96 percent) and internet usage (99 percent) are for practical purposes, universal. In the context of wearables, older Americans are even less well represented, with only 19 percent of over 65s owning such a device in 2021, according to Statista.

TECHNOLOGY AT ANY AGE
Increasing the adoption of technology solutions that can assist older people to stay in their own home—or help residential aged care facilities provide more effective care despite staff shortages—should neither rely on smartphone ownership nor a graduate qualification in wireless communication.

“Digitalization is one of the most powerful drivers and potential enablers of positive change across generations toward healthier aging populations,” says Jane Barratt, Secretary-General of the International Federation on Ageing. “The pandemic has served as a propellant accelerating the adoption of devices, models and digitalization faster than might have otherwise occurred, [and] digital access at home and in facilities is now equally critical to our capacity and quality of life.”

Unfortunately, the benefits of technology have been divided highly unevenly between different generations (see State of Play pg28 & Healthcare tech divide). Digital healthcare tech has to be widely available and usable by the demographic most in need of its benefits.

Yet of the people who use healthcare wearables, for example, only 15 percent are over the age of 65, according to the Journal of Medical Internet Research. The solution, according to the American Association of Retired Persons (AARP), is to design the technology to suit the needs of this population group, and to democratize technology by simplifying its use for everyone. Developers are listening.

ELIMINATING THE MIDDLEMAN
While Bluetooth LE remains the most popular wireless technology for connected wearables, cellular IoT is pairing traction in health-related wearable devices as it removes the middleman, doing away with the need for a smartphone or a gateway and enabling continuous monitoring without the need for intervention on the part of the wearer. For older people this is of enormous significance—no pairing, no smartphone, no remembering passwords for Wi-Fi networks, just data sent reliably and securely to the Cloud. Reassuringly for what can amount to life and death applications, LTE-M and NB-IoT low power cellular IoT provides the gold standard in reliable and secure connectivity. In terms of coverage, operators have rolled out networks across the globe with the same country–wide coverage as their mobile phone networks. This means most of the industrialized world—and an ever-increasing proportion of developing countries—offers ubiquitous NB-IoT and/or LTE-M coverage.

Cellular IoT is also about the most secure communications technology around, with baked-in security features as part of the 3GPP standards. Additional security can also be applied at the chip level with devices that offer a secure–by–design product development process. For example, Nordic Semiconductor’s nRF9160 low power SIP with integrated LTE-M+NBIoT modem makes use of Arm TrustZone’s and Arm CryptoCell’s additional layers of security for Internet-level encryption and application protection. This level of security is reassuring to both developers and consumers, particularly when it comes to healthcare wearables handling and transmitting potentially sensitive personal information.

LOOKING AFTER OTHERS
One company driving the development of cellular IoT-based health monitoring wearables for older people is Californian tech firm, SalusWear Corp. Last year the company launched a cellular IoT–powered wearable designed to track and monitor individuals suffering from
KEEPING ON TOP OF HEALTH METRICS

Another company championing the use of device-to-
cellular IoT connectivity in health wearables is August International, that last year launched a pair of
smartwatches that provide continuous monitoring and
recording of a range of key health metrics.

The E2 and N2 devices both integrate pulse oximeter,
temperature, and inertial measurement unit (IMU) sensors
to determine heart rate, blood oxygen, blood pressure,
and body temperature vital signs, while the N2 also includes
an ECG sensor to record heartbeats and rhythm, as well as
providing GPS positioning and fall detection functionality.
As they are primarily designed as healthcare devices
for family members, clinicians and care homes to remotely
monitor the health of the wearers, the company chose to
employ Nordic nRF9160 SiP cellular IoT connectivity to
relay key health data direct to the Cloud, rather than using
a smartphone as a Bluetooth LE gateway.
"Due to COVID-19, there has been a need to reduce the
frequency of face-to-face medical appointments and the
use of remote healthcare devices has subsequently
become a key part of patient care," says Dr Keming
Zhou, Managing Director of August International. "When
doctors have access to data collected by the E2 or N2, they
can obtain a more detailed and accurate insight into the
wearers' condition, and adjust treatment as necessary." For
those requiring urgent care, the smartwatches
include an SOS button which calls for assistance and
transmits the user's location to emergency services, as
well as sending a pre-recorded message alert and position
notification to third parties. The nRF9160 SiP combines
cellular network location data with GPS trilateration for
precise position monitoring in case of any SOS alerts.

Hong Kong-based microelectronics company, Dayton
Industrial, has gone a step further, integrating both cellular
and Bluetooth LE connectivity into its new healthcare
wearable, that can serve the dual purposes of a remote
healthcare/telecare solution as well as a multifunctional
smartwatch.

"The Link2Care Smartwatch DA13700 features a 3D
motion sensor for activity records, inactivity alerts, sleep
monitoring, and fall detection. By pressing the SOS key, the
user can activate an SOS alert message with their health
information—including name, gender, age, blood type and
any drug allergies—and location that is sent to predefined
mobile phone numbers and uploaded to a Cloud server
and service center for emergency response. Further
information, including sleep/activity stats and wellness
data such as daily step count/distance and calories burned,
can be uploaded to the Cloud and a customer service
center using Nordic LTE-M/NB-IoT cellular connectivity.
Nordic’s nRF52832 provides Bluetooth LE connectivity
enabling, for example, calls and notification relaying from
smartphone to wearable. The smartwatch also supports
the Bluetooth LE Beacon profile—allowing connection to
beacon accessories for indoor location tracking.

IT'S A GRAY WORLD AFTER ALL

By 2030, one in six people in the world will be over the age
of 65 years, according to the World Health Organization.
By that time, the number will equate to 1.4 billion people.
Fast forward to 2050, and the world’s population of people
aged 60 years and older will double from what it is now, to
2.3 billion. The demand on assisted living and healthcare
facilities will increase at unprecedented levels, and tech will
be essential in helping manage the challenge. Not only to keep
people in their own homes longer, but also to support staff
in facilities supervise the health of people in their care.

Sophisticated wearables will help the heavy lifting on behalf
of the medical profession by wading through huge volumes
of data to rapidly establish anomalies that could indicate
underlying health issues. Cellular IoT wireless connectivity
will seamlessly and autonomously relay this data to the
Cloud for just-in-time medical intervention, allowing carers
to make rapid, accurate clinical decisions. This is the future
of aged care, and it’s a future that’s closer than we think.

Source: Journal of Medical Internet Research

About the Author

Dr. Keming Zhou, Managing Director of August International.

Feature: Remote Patient Monitoring

Older people have a reputation for struggling with new
technology, a reputation anyone who had to teach their
grandmother how to use Zoom during the height of the pandemic
lock-downs can probably attest. The more serious side of this
disconnect was the difficulty older adults had registering online
for vaccines during the same period.

However, we all need to be careful when it comes to age-based
stereotypes because in some aspects of technology and, the
older brain has been demonstrated to outperform a younger one.
For example, in a study of air-traffic controllers and airline pilots,
those between ages 50 and 69 took longer than those under 50
and master new equipment. Once they had however, they made
fewer mistakes, using it. Reassuring for next time you take your
seat on an aircraft and the captain looks past retirement age.

According to numerous studies, people in their fifties
and sixties also consistently outperform younger people when it
comes to visual spatial processing and reasoning tasks. Visual
spatial processing tells you how far objects are from you and
each other, and means older people are better at some aspects
of driving—reverse parking and merging lanes for example—than
teenagers or people in their twenties.

Another survey by file hosting platform Dropbox found IT
workers over the age of 55 are less stressed using technology in
the workplace than their younger peers, and they are better
at using multiple devices at work.

In fact, when it comes to technology, young adults are
not only getting left behind by older generations, but by younger
ones too. A study by U.K. communications watchdog Ofcom,
said digital understanding peaks between the ages of 14 and 15,
before gradually dropping throughout adulthood. The report also
said that while the average six-year-old child may not know
how to tie their own shoelaces, they understand more about
digital technology than most millennials.
The C30 is supervised by the nRF52840 SoC’s 64 MHz, 32-bit Arm Cortex M4 processor with floating point unit (FPU) and the nRF21540 RF FEM power amplifier/low noise amplifier (PA/LNA). The addition of the FEM offers a highly adjustable TX power boost up to +21 dBm, with the LNA providing +13 dB RX gain, enabling the device to relay audio data from headset to headset over a range of 1.2 km, allowing riders to stay in contact on the road.

The C30 is powered by a 1000 mAh LiPo cell that can achieve a battery life of up to 16 hours between recharges in ‘mesh and music’ mode, thanks in part to the ultra low power operating characteristics of the Nordic SoC. The SoC has been engineered to minimize power consumption with a fully automatic power management system. The BluArmor Comms app offers over-the-air firmware updates, dynamic volume control and ride management features.

Last year Japanese bike manufacturer Yamaha announced plans to make the world’s cheapest motorcycle priced at just $500 for the 100 cc model. For those with a bigger budget at the other end of the scale there is the Neiman Marcus Fighter. The limited edition Neiman Marcus bike is powered by a 2000 cc 45° air-cooled V-Twin engine and can allegedly reach a top speed of 305 kph. At auction the bike sold for a cool $11 million.

When it comes to famous motorbike riders, it is hard to beat Evel Knievel, a stunt performer and entertainer in the 1960s and 1970s. Knievel found widespread fame jumping over cars, buses, canyons and sharks, as well as for breaking 433 bones in the process, a Guinness World Record that stands to this day. This conjures three wise words for the dangers for the dangers riders face on the most iconic race courses in North America: Knievel’s final stunt on the loop-de-loop.

The C30 is a Bluetooth LE motorcycle helmet communication unit that offers hands-free long range connectivity between riders. It is a wireless audio device market that is already booming, but is projected to reach $143 billion by 2029 based on current growth trends, according to analyst Fortune Business Insights. The company said Bluetooth-based solutions would likely dominate the industry and propel its growth owing to the technology’s rich connectivity and interoperability features.

This Bluetooth LE motorcycle helmet communication unit offers hands-free long range connectivity between riders. The wireless audio device market is already booming, but is projected to reach $143 billion by 2029 based on current growth trends, according to analyst Fortune Business Insights. The company said Bluetooth-based solutions would likely dominate the industry and propel its growth owing to the technology’s rich connectivity and interoperability features.
Wireless flow monitor provides real-time usage data and leak detection

The Nordic nRF9160 SiP-powered Water Monkey smart water flow device helps ensure accurate water billing and alerts users when water usage exceeds expected volumes.

despite the fact that water makes up over 70 percent of the Earth's surface, less than half of it is fresh, making it an incredibly precious commodity. And yet, waste is happening right under our noses. According to the U.S. Environmental Protection Agency, nearly 4.5 trillion liters of water are lost annually across the country through household leaks. Not only is this hugely detrimental to the environment, it’s costing homeowners and landlords a fortune.

Because leaks can often occur in hard-to-see spots—where damage to the building may not be immediately noticeable—anomalous water use is key to leak detection. And that is not always easy to spot using conventional water meters. It might be that the leak is small but any leak is continuous, so it left unattended losses mount.

“In North America, multifamily residential buildings consume a significant amount of water,” explains Johan van Niekerk, CTO at Connected Sensors, a Canadian green technology company that’s leading the way in the water monitoring and conservation space. “The volume of water is typically measured using a compound meter—however, these meters are not always accurate, and the volumes of water used are sometimes estimated by local utilities, resulting in customers being billed incorrectly.

“In addition, when water meters do function properly, they only provide a summary of the water used over a certain period. Due to this limitation, building owners and utilities have no idea of potential leaks. (And yet) we have seen that leaks alone can account for 30 to 60 percent of a landlord’s total water bill.”

Accurate flow measurements

To help combat these issues, Connected Sensors has released the Water Monkey to the Canadian market. The Water Monkey is a smart water flow device powered by Nordic’s nRF9160 cellular IoT SiP. This product provides residents and property managers with precise water usage data for billing and leak detection.

The Water Monkey uses an impeller—which rotates as water passes through it—to calculate the volume of liquid being used. The device also houses accelerometers to detect the pipe vibrations that might indicate problems are afoot. Using the edge processing capabilities of the nRF9160 SiP, the Water Monkey provides a host of benefits:

- **Accuracy:** The Water Monkey can function for up to five years between battery replacements with the nRF9160 SiP’s low power consumption.
- **Reliability:** With robust LTE-M/NB-IoT connectivity, the Water Monkey can be non-invasively retrofitted to most water meters without the need for an electrician or plumber, as it doesn’t require an external power source.
- **Versatility:** The Water Monkey can be easily retrofit to most water meters without the need for an electrician or plumber, as it doesn’t require an external power source.

Sensor tech and the pandemic have changed the paradigm for wearables

Step counting and fitness may have been the drivers behind the first wave of wearables, but the development of better sensor tech and the demand for real-time data exchange between healthcare providers and their patients is definitely behind the latest boom. COVID-19 created the demand for wirelessly capturing our health metrics and sharing them with our GPs; but this wouldn’t have been successful without the sensors we now carry in a wristwatch-sized wearable. It wouldn’t have been possible without the connectivity, processing and power consumption capabilities of the highly integrated SiC technology.

“The senior care market is going to be a huge driver of wearable tech in the next decade.”

Industry Viewpoint

Tony Chung

Sales & Marketing Manager, Dayton Industrial

Health over fitness drives wearables to careables shift

“The senior care market is going to be a huge driver of wearable tech in the next decade.”

Step counting and fitness may have been the drivers behind the first wave of wearables, but the development of better sensor tech and the demand for real-time data exchange between healthcare providers and their patients is definitely behind the latest boom. COVID-19 created the demand for wirelessly capturing our health metrics and sharing them with our GPs; but this wouldn’t have been successful without the sensors we now carry in a wristwatch-sized wearable. It wouldn’t have been possible without the connectivity, processing and power consumption capabilities of the highly integrated SiC technology.

“The senior care market is going to be a huge driver of wearable tech in the next decade.”

Tony Chung, Sales & Marketing Manager, Dayton Industrial

Smart Metering

Wireless monitoring

A further advantage of the device is that it can be easily retrofit to most water meters without the need for an electrician or plumber, as it doesn’t require an external power source. And it includes an expansion port, allowing it to be used on both single and compound water meters.

“Conventional ‘water to Cloud’ interface devices often require hardwiring,” says van Niekerk. “However, building owners and managers are often not allowed to alter the wiring of their water meter without having to pay the electricity company. The Water Monkey, on the other hand, can be non-invasively attached to the side of the water meter, allowing it to detect the rotation of the impeller without requiring any changes to the meter itself.

“Water Monkey is the first device of its kind offering the ability to monitor compound meters from a single device over a readily available wireless network while running on battery power for an extended period of time.”

The Water Monkey can function for up to five years between battery replacements with the help of the nRF9160 SiP’s low power consumption. The Nordic product supports both PSIP and eDRX power saving modes, allowing the device to sleep for long periods.

“The reference designs, technical information and development applications provided by Nordic were already enough to convince me that they are a reliable partner,” adds van Niekerk. “But when it came to choose a chipset for the Water Monkey, the additional support and reference material available specifically for the nRF9160 further strengthened my belief in Nordic and made me confident in our decision to use the company’s products.”

It’s a decision that will help to keep the water flowing when we need it but safely stored when we don’t.
Power Management

Nordic announces nPM1300 PMIC to simplify power system design

Nordic Semiconductor has announced its plan to release a third power management IC (PMIC) in mid-2023. The nPM1300 is the company’s PMIC offering by adding support for both charging of larger batteries and four regulated power rails. The nPM1300 will be optimized for efficiency and compact size (3.1 by 2.4 mm WL-CSP or 5 by 5 mm QFN) and is digitally configurable through an I2C-compatible Two Wire Interface (TWI). The digital interface provides access to system management functions that are usually discreetly implemented in Bluetooth LE designs—such as hard reset, battery fuel gauge, system-level watchdog, power loss warning and recovery from failed boot. "Nordic’s customers [now] have access to on-chip functions that enhance product safety and provide additional ways of conserving battery energy," says Gor Rjusevsk, Product Director—PMIC at Nordic.

The nPM1300 provides highly efficient power regulation for Nordic’s nRF52 and nRF53 series multi-protocol SoCs. The PMIC’s four regulated power rails and battery charger make it ideal for compact and advanced IoT products based on, for example, an nRF5340 SoC host and multiple peripheral functions such as sensors.

Examples include advanced wearable and portable medical applications. The nPM1300 charges a single-cell Li-ion, Li-Pol and LiFePO4 batteries with a linear charging module that supports up to 800 mA charge current. The termination voltage is programmable from 3.5 to 4.45 V. The battery charger features automatic thermal regulation with programmable maximum chip temperature during charging to enable simple thermal management that can be adapted to any system requirement.

The nPM1300 is available for limited sampling now, and will be available to order from Nordic’s distributors mid-2023.

LED Lighting

Lighting products allow OEMs to make luminaires Matter–compatible

Austrian lighting technology company, Tridonic, has launched a suite of Nordic nRF52840 SoC-powered solutions to help make professional and hospitality lighting installations compatible with Matter—the smart home standard maintained by the Connectivity Standards Alliance. Matter brings interoperability between smart home devices and ecosystems to reduce complexity. Tridonic’s Matter-enabling lighting products ensure customers can take advantage of popular ecosystems and controls from Amazon, Apple, Google and Samsung, allowing users to build a smart, voice-controlled environment where the lighting systems, plus all other Matter-compatible devices operate over a common application layer. The Wireless Matter Driver is a 24 V constant voltage LED driver that dims and switches LED strips, while the Push Button Coupler, installed in a flush-mounted box, converts existing conventional switches into Matter-compatible smart light switches. The Wireless Matter to DALL Active module (complete with its own power supply) and the Wireless Matter to DALL Passive module (used with an external supply) can be used to upgrade any DALL (Digital Addressable Lighting Interface)–a professional lighting standard—luminaires or existing installation into Matter-ready. This allows commercial units to become Matter-enabled and virtual assistant controllable. Each product works with the Thread protocol so it can be integrated into an existing Thread network without using a gateway. Thread, a smart-home protocol, together with Wi-Fi and Ethernet, forms the transport for Matter (with Bluetooth LE used for commissioning).

“Thread devices compatible with Matter support battery-powered switches and have the ability to support Thread mesh lighting networks in addition to alternative wireless protocols,” says Philipp Heinl, VP Business Development, Tridonic GmbH & Co KG.

Enterprise IoT

Bluetooth LE device and gateway enable indoor tracking

A platform which enables a wide range of indoor industrial and enterprise tracking and monitoring solutions has been launched by India based Semiconsoul Technologies. The Nordic nRF52835 SoC–powered LiNT (Location of Interest) device supports indoor tracking, navigation, asset management and condition monitoring.

LiNT features several sensors including infrared (IR) proximity, Li-Fi, ambient light and addressable LED indicators, as well as footprint on the board for additional sensors including an accelerometer, gyroscope and magnetometer.

LiNT operates in both Bluetooth LE host and peripheral mode under Semiconsoul’s Secure Platform for IoT Data Exchange (SPIDEX). Using the nRF52835 SoC–enabled Bluetooth LE connectivity, this product is able to continuously scan nearby Bluetooth LE devices, and can also act as a peripheral to connect to any IoT gateway or the proprietary, Nordic SoC–powered parent gateway. Special Purpose Industrial IoT Gateway (SPIPGWAY) runs on a Linux open-source system and provides the IoT connectivity framework called C3F (Common Communication and Control Framework) to control data acquisition, data cleansing, filters, device management, over-the-air device firmware updates and edge processing. Multiple LiNT devices can connect to a single gateway with collected sensor data then sent to the Cloud for further analysis. Optionally, the LiNT also supports mesh networking.

“The continuous Bluetooth LE connectivity and ability to acquire sensor data enabled by the Nordic SoC enables firms to improve operational efficiency,” says Govindarajan Gotta, Chief Functionary – IoT Device Platform Engineering & Technology, Semiconsoul.

Internet of Things

Module enables Cloud connectivity for Modbus RTU devices

An IoT module launched by Germany–based grandcentrix (part of Vodafone) enables Cloud connectivity for Modbus RTU protocols. The grandcentrix Modbus Cloud Connect module enables any devices running the Modbus RTU protocol to report their data to the Cloud rather than via a wired connection. By using converters, it can also be used for a range of other device protocols. Typical use cases of Modbus Cloud Connect include the remote connection of industrial machinery. Modbus Cloud Connect connects the Modbus RTU over a local RS–485 interface to a Cloud-based platform or central IT system. The product provides standardised, well-documented interfaces (MQTT and HTTP) to connect to the customer’s Cloud or central IT system.

Awards

Nordic’s enhanced PPK2 wins awards double

Nordic Semiconductor’s enhanced Power Profiler Kit (PPK) has been named winner of two highly regarded awards in Greater China. The PPK2 for power profiling and power optimization of embedded solutions won the ‘Best Development Tool’ categories of the 2022 EE Awards Asia and the 21st Electronics Network TopPwr Power Awards.

“The PPK2 is an affordable yet powerful tool used by embedded Bluetooth, Wi-Fi, LTE-M and NB-IoT developers, says Bjørn Åge ‘Bob’ Brandal, Nordic Semiconductor, VP of Sales and Marketing, Asia Pacific. “We’re delighted to receive these awards and recognition for the enhanced Power Profiler Kit.”

The EE Awards Asia celebrates the best products, companies and individuals across the continent’s highly regarded electronics industry. Winning products were required to demonstrate the ability to add value and improve modern life through the application of technology. The 21st Electronics Network TopPwr Power Awards were launched in 2003, and recognize technological innovation in power products.

Low Power Wi-Fi for the IoT

The nRF7002 DK is a easy-to-use Wi-Fi 6 development kit, enabling low-power dual-band Wi-Fi and coexistence with Bluetooth LE, Thread and Zigbee.
An Introduction to Nordic's Low Power Wi-Fi

The launch of the nRF7002 companion IC adds Wi-Fi 6 to Nordic's product portfolio and will enhance current IoT applications while enabling many new ones.

How Wi-Fi 6 has been built for the IoT

Wi-Fi 6 introduced many enhancements to the specification but the most important are Multi User (MU) and Target Wake Time (TWT – a new power saving mode that promotes the use of Wi-Fi, the economic value derived from the tech is a staggering $1.5 trillion. (Global Economic Value of Wi-Fi: 2021 – 2025) The alliance says there are 18 billion Wi-Fi devices in use and 4.4 billion annual shipments of which 2.3 billion meet the latest Wi-Fi standard. Wi-Fi is seriously big business. This popularity is down to Wi-Fi's Internet Protocol (IP) interoperability. A Wi-Fi device can connect directly to the Cloud without the need of a gateway beyond existing Access Points (AP). And the adoption of Wi-Fi made the tech better suited to the IoT where it complements existing IoT technologies used for low power networks, for example, Bluetooth LE and Thread. Wi-Fi offers higher throughput and longer range than these other protocols allowing it to enhance existing IoT applications while enabling new ones. This synergy is evident in Matter, an ecosystem that brings together separate smart home ecosystems (see Wi-Fi 6 at a glance pg3).

low power Wi-Fi capabilities to embedded IoT systems. When combined with Nordic’s nRF52 and nRF53 Series multiprotocol SoCs, the companion IC enables many new applications. For example, the higher throughput supports applications such as video cameras. Wi-Fi also boosts range compared with Bluetooth LE or Thread alone and introduces high-grade security. Wi-Fi is also a good option for ‘always connected’ devices such as home appliances. The companion IC can significantly enhance existing applications. For example, the high throughput is useful for scenarios when occasional high volumes of data are transferred – such as performing over-the-air (OTA) updates for complex firmware. Wi-Fi also brings higher security for sensitive data transfers than Bluetooth LE.

The nRF7002 is a dual band device but cost optimized for one day intervals. Sensitivity (1DSSS, 2.4 GHz) is -98.6 dBm and Tx(MAX) (2.4 GHz) is 21.15 dBm. The nRF7002 supports the Wi-Fi Protected Access (WPA3) high grade security protocol which features increased cryptographic strength and more robust authentication. The nRF7002’s support for WPA3 removes some of the security burden from the host side.

The companion IC implements the IEEE802.11 Physical layer (PHY) and Medium Access Control (MAC) firmware only. The Wi-Fi Driver and Wi-Fi and Transmission Control Protocol (TCP)/IP stack are held on the host processor.

Communication between the MAC and the other parts of the stack is via the nRF7002’s Serial Peripheral Interface (SPI) or Quad SPI (QSPI).

Nordic offers an open source Wi-Fi 6 Certified stack to support the nRF7002 through the nRF Connect SDK, the company’s unified and scalable software development kit. A qualified solution makes it easier for users to get end product certification. The Wi-Fi stack in the nRF Connect SDK is designed for use with the Zephyr Project’s Zephyr real-time operating system (RTOS) but could also be used with other RTOSs.

The nRF7002 DK has just been launched (see pg9). The DK has a nRF5340 host processor (connected to nRF7002 by the QSPI) but Nordic plans further kits with nRF8040 SoC and nRF960 cellular IoT SiP host processors.

Nordic’s Wi-Fi companion ICs make it simple for engineers to extend legacy and future Bluetooth LE and Thread networks directly to the Cloud within Nordic’s familiar development environment. The ICs also make it straightforward to add Wi-Fi-SSD location services by complementing the nRF9600 SiP and nRF Cloud in applications such as asset tracking.

Nordic’s Wi-Fi companion ICs are powerful but remain smaller in size and volume than a separate Wi-Fi SoC. The companion ICs also do not take advantage of Wi-Fi where it might previously have been impossible. Earlier versions of the Wi-Fi standard do include PSK, but the power saving mechanisms are controlled by the AP and offer limited flexibility to the end device. The end device was forced to remain awake to receive the AP’s beacon ahead of a data exchange. The TWT PSK included in Wi-Fi 6 allows the end device to individually negotiate a wake-up schedule with the AP. This enables it to sleep for defined periods which helps to significantly lower power consumption. Data exchange then occurs at the agreed wake-up time. Another advantage of TWT is that it enables interference mitigation by letting the AP allocate dedicated time slots for end device data transfer.

The OFDMA employed in Wi-Fi 6 allows for a higher number of subcarriers within a single Wi-Fi channel. For example, a 20 MHz channel can be further divided into 117 subcarriers each side of the channel’s central frequency. Groups of subcarriers can then be allocated to a certain end device while other groups can be allocated to different end devices depending on the data traffic requirement. This technique (called Multi User uplink/downlink) does add complexity to AP transmission and receiving but this is not the case for the end device which only works with its dedicated subcarrier frequencies. OFDMA is particularly useful for large IoT sensor networks with many end devices; but with each needing to send only a small amount of data, because it enables dynamic, flexible and highly efficient division of the available spectrum bandwidth. Without OFDMA, a large sensor network would typically generate a lot of channel contention, causing higher interference levels and resulting in reduced throughput.

Nordic recently launched the nRF7002 Wi-Fi companion IC. The new IC enables constrained applications to take advantage of low power Wi-Fi that might previously have been impossible. The nRF7002 Wi-Fi companion ICs make it simple for engineers to extend their legacy and future Bluetooth LE and Thread networks directly to the Cloud within Nordic’s familiar development environment.
**RF SoCs and SiP**

<table>
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<tr>
<th>RF SoC/SiP</th>
<th>Package</th>
<th>CORE SYSTEM</th>
<th>SECURITY</th>
<th>PERIPHERALS</th>
<th>FREQUENCY</th>
<th>TIMER, RTC</th>
<th>TEMP SENSOR</th>
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**Power Management ICs**

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<td>nPM6001</td>
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**Cloud Services**

**nRF Cloud Services**

Description: nRF Cloud Services are optimized for Nordic’s low-power IoT devices. nRF Cloud Services support Device-to-Cloud or Cloud-to-Cloud use cases. In the former, the device connects directly to nRF Cloud. In the latter, connection is to a customer’s Cloud that then connects to nRF Cloud’s REST API.

Services: nRF Cloud Services are offered in nRF Cloud and include GPS, cell-based and Wi-Fi assisted locationing. The product can securely request a location via nRF Cloud, where the location is calculated. Cell-based services use base stations to predict location. Each location feature has its advantages, so switching between different location services during operation can be useful.

**Tech Spec**

**nRF7002**

Description: nRF7002 is a Wi-Fi 6 Companion IC for use in the 2.4 and 5 GHz bands. The product offers good coexistence with Bluetooth LE devices and features one Spatial Streams (50), 20 MHz channel bandwidth, 64 QAM (MC7), 86 Mbps PHY throughput and QAM64 modulation and QPSK.

Operation: The nRF7002 Wi-Fi 6 Companion IC is a low-power and secure Wi-Fi device for IoT applications. It provides Wi-Fi connectivity using nRF7002 with a power-saving feature allowing the IC to negotiate a wake-up schedule with the access point (AP) to which it is connected. The nRF7002 accompanies Nordic’s nRF52840 and nRF52833 Series Bluetooth LE SoC and the nRF51822 Series cellular IoT SoC. The nRF7002 can also be used as a companion IC in applications hosted by non-Nordic products. Development is supported through Nordic’s nRF Connect SDK.

**Tech Spec**

**Output power**

Adaptable output power settings up to ±2 dBm

**Receive gain and noise figure ratings**

10 dB receive gain, 2.1 dB noise figure

**Packaging**

4x4 mm QFN48

**Development tools**

nRF7002 DK, nRF7002 DK

**Applications**

Asset tracking, smart home, industrial, toys, audio

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**nRF21540**

Description: The nRF21540 is an RF front-end module (RFM) that improves range and connection robustness for Nordic nRF52840 and nRF52833 Series SoCs. The nRF21540 is a complementary device operating as a plug-and-play range extender with the addition of just a few external components. The nRF21540 is a 13 dB RX gain and low noise figure of 2.7 dB, coupled with up to ±21 dBm TX output power, ensure a superior link budget boosting the range of supported SoC combinations by over 6.5 dB. The nRF21540 suits all applications that require increased range and/or robust coverage. In demanding RF environments, where the application is operating closer to the range limit, it can be more energy efficient to use the nRF21540 than continuously resend packets.

Operation: The nRF21540 supports Bluetooth LE, Bluetooth mesh, Thread, Zigbee and 2.4 GHz protocol applications. The nRF 21540 TX output power is dynamically adjustable and can be set to comply across all geographical regions. The nRF FEM can be used with Nordic’s extended temperature-qualified nRF5340, nRF52833 and nRF52805 SoCs in industrial applications.

**Tech Spec**

**Output power**

Adaptable output power settings up to ±2 dBm

**Receive gain and noise figure ratings**

10 dB receive gain, 2.1 dB noise figure

**Packaging**

4x4 mm QFN48

**Development tools**

nRF21540 DK, nRF7002 DK

**Applications**

Asset tracking, smart home, industrial, toys, audio

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**Wi-Fi 6 Companion IC**

**nRF7002**

Description: nRF7002 is a Wi-Fi 6 Companion IC for use in the 2.4 and 5 GHz bands. The product offers good coexistence with Bluetooth LE devices and features one Spatial Streams (50), 20 MHz channel bandwidth, 64 QAM (MC7), 86 Mbps PHY throughput and OFDMA (downlink and uplink).

Operation: The nRF7002 Wi-Fi 6 Companion IC is a low-power and secure Wi-Fi device for IoT applications. It provides Wi-Fi connectivity using nRF7002 with a power-saving feature allowing the IC to negotiate a wake-up schedule with the access point (AP) to which it is connected. The nRF7002 accompanies Nordic’s nRF52840 and nRF52833 Series Bluetooth LE SoC and the nRF51822 Series cellular IoT SoC. The nRF7002 can also be used as a companion IC in applications hosted by non-Nordic products. Development is supported through Nordic’s nRF Connect SDK.

**Tech Spec**

**Compliance**

IEEE 802.11(b/g/n) - 2.4 GHz (I/F) B - 2.4 GHz (I/F) A - 2.4 GHz (I/F) A - 5 GHz (I/F) A - 5 GHz (I/F) A - 5 GHz (I/F) A

**Features**

Low power, good coexistence with Bluetooth LE, Wi-Fi

**Development tools**

nRF7002 DK, nRF7002 DK

**Applications**

Asset tracking, smart home, industrial

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**Cloud Services**

**nRF Cloud Services**

Description: nRF Cloud Services are offered in nRF Cloud and include GPS, cell-based and Wi-Fi assisted locationing. The product can securely request a location via nRF Cloud, where the location is calculated. Cell-based services use base stations to predict location. Each location feature has its advantages, so switching between different location services during operation can be useful.

**Tech Spec**

**Location services**

Supports Cloud-to-Cloud use cases via a dedicated Cloud-to-Cloud service.

**nRF7002 Companion IC**

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Operation: The nRF7002 Wi-Fi 6 Companion IC is a low-power and secure Wi-Fi device for IoT applications. It provides Wi-Fi connectivity using nRF7002 with a power-saving feature allowing the IC to negotiate a wake-up schedule with the access point (AP) to which it is connected. The nRF7002 accompanies Nordic’s nRF52840 and nRF52833 Series Bluetooth LE SoC and the nRF51822 Series cellular IoT SoC. The nRF7002 can also be used as a companion IC in applications hosted by non-Nordic products. Development is supported through Nordic’s nRF Connect SDK.

**Tech Spec**

**Output power**

Adaptable output power settings up to ±2 dBm

**Receive gain and noise figure ratings**

10 dB receive gain, 2.1 dB noise figure

**Packaging**

4x4 mm QFN48

**Development tools**

nRF7002 DK, nRF7002 DK

**Applications**

Asset tracking, smart home, industrial

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**Wi-Fi 6 Companion IC**

**nRF7002**

Description: nRF7002 is a Wi-Fi 6 Companion IC for use in the 2.4 and 5 GHz bands. The product offers good coexistence with Bluetooth LE devices and features one Spatial Streams (50), 20 MHz channel bandwidth, 64 QAM (MC7), 86 Mbps PHY throughput and QAM64 modulation and QPSK.

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