NEWS FOR THE ELECTRONICS INDUSTRY

eTECH JOURNAL

ISSUE 10

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ADDING WIRELESS MADE EASY

SMART INFRASTRUCTURE

SMART INFRASTRUCTURE CONNECTIVITY

WIRELESS INFRASTRUCTURE

STREETLIGHT CHARGING FOR EV

LPWAN BOOSTING INFRASTRUCTURE

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Editor-in-chief: Cliff Ortmeyer, Managing Editor: Ankur Tomar

WELCOME

The rapid progress of cities and industries has made smart infrastructure a key element in this evolution, thanks to advancements in technology and energy efficiency and the integration of automation systems. This edition takes a closer look at recent developments for urban environments and industrial applications, offering practical insight relevant to application engineers.

Read about the increasing accessibility of technologies. Delve into the role of smart electric vehicle charging solutions in supporting sustainable urban infrastructure development. There's also a focus on energy efficiency and examining the evolving landscape of energy management systems and Internet of Things (IoT) automation that reshapes architecture. We also discuss the advancements in Arduino-based technology for connectivity in the final stretch of connections and how LP WAN plays a vital role in enhancing intelligent city applications along with the progress in wireless networks for residential areas and urban spaces with practical illustrations to provide engineers with the necessary technical knowledge, for implementing and enhancing intelligent systems.

Whether you're involved in developing urban areas or fine tuning industrial IoT networks this version provides the newest advancements to assist you in staying ahead in the ever changing realm of intelligent infrastructure.

Join us as we navigate these innovations, driving the next wave of technological advancement.

Cliff Ortmeyer Editor, eTech Journal
Email: editor-TJ@element14.com

ADDING WIRELESS HAS NEVER BEEN EASIER

Shishir Malav, Product Manager – Microchip Technology

WIRELESS IS EVERYWHERE

The market for wireless connectivity has witnessed substantial growth and is projected to continue its rapid expansion. The market size is anticipated to escalate from USD 71.6 Billion in 2022 to USD 219 Billion by 20301. A cursory glance reveals that most products nowadays incorporate some form of wireless connectivity. This ranges from smart home devices such as thermostats and televisions to industrial lighting, smart access, and car entry systems. It is becoming increasingly rare to encounter electronic products devoid of wireless features. Wireless connectivity has transitioned from being a mere advantage to a fundamental necessity across consumer, industrial and automotive products.

Over time, wireless technologies have evolved significantly, enhancing our capabilities. However, this evolution has also led to increased complexity in their implementation, thereby raising the entry barrier. Businesses aiming to integrate wireless features into their products encounter considerable challenges. This puts them at a significant disadvantage in comparison to their counterparts with expertise in wireless technology.

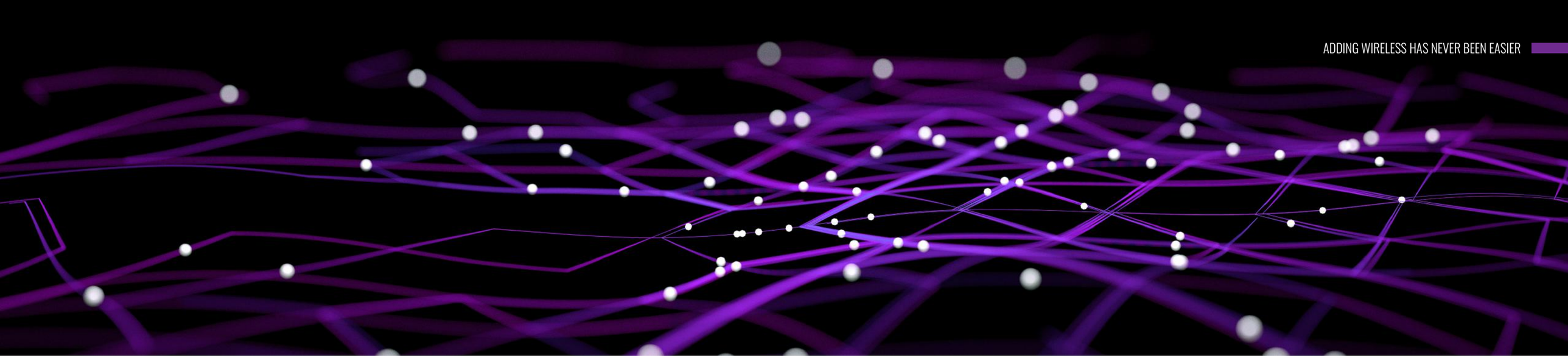
WIRELESS CAN BE HARD

Incorporating wireless functionality into an application presents significant challenges. These can be broadly classified into three categories: Radio Frequency (RF) design, regulatory certifications and software development.

Starting with RF design, this is arguably the most complex aspect of adding wireless capabilities. It demands a profound understanding of electromagnetic theory, making it a daunting task even for experienced RF engineers. The RF design process entails creating a robust circuit design, followed by a Printed Circuit Board (PCB) that is resistant to external interference and maintains strong signal integrity. Even the slightest changes in parasitic capacitance or inductance can severely affect the circuit's performance. Designing a robust RF circuit involves considering numerous physical effects and conducting extensive testing. These tests necessitate specialized tools and environments, which can be both time-consuming and costly.

With RF design, comes regulations. Various standards bodies define regulations for different wireless protocols across different regions. For instance, the Federal Communications Commission (FCC) regulates wireless products in the United States, the UK Conformity Assessed (UKCA) in the United Kingdom, and the Radio Equipment Directive (RED) in Europe. These regulatory bodies have a defined set of steps and tests that a wireless product must adhere to before it can be sold in their respective markets. Depending on the standards body and wireless protocol(s), the regulatory certification process can take anywhere from a few months to almost a year, and it can cost up to USD 20,000.

Finally, there is software development. The creation of software for a wireless protocol necessitates a comprehensive understanding of that protocol. The intricacies of hardware-software interaction are already complex, and this complexity is further amplified by the frequent updates to protocol specifications and features by relevant groups to rectify vulnerabilities and introduce additional features. Furthermore, software development for wireless is not a one-time task. Consider, for instance, a smart home system. It would likely require a blend of protocols such as Bluetooth and Wi-Fi, contingent on the end nodes in your system. In such a situation, software must be developed for these nodes using different protocols, ensuring these protocols play nice together. This significantly escalates the level of difficulty in developing the software for a wireless system.



WIRELESS CAN BE HARD

The challenges mentioned above pose significant obstacles to entry into the wireless industry and hinder innovation. Imagine a solution that bypasses these issues entirely, offering a wireless addition that requires no RF design on your part. A solution that has already passed regulatory certifications and comes with pre-installed firmware, eliminating the need for wireless software development. This is where the utility of plug-and-play wireless modules becomes evident.

Plug-and-play wireless modules are RF ready. They come with a robust RF design already in place, allowing you to simply integrate it into your PCB without any RF design. Features such as high transmission power, antenna matching circuit, on-board antenna and comprehensive testing are already implemented.

In terms of certifications, these modules have been tested and approved by relevant regulatory bodies in numerous countries including the US, Canada, UK, Europe, China, Taiwan, Japan and Korea. Additionally, a lot of countries not already covered have their regulations based on one of the existing certifications, saving you both time and money and accelerating your time to market.

Furthermore, plug-and-play wireless modules come with pre-installed firmware. Developers simply need to connect these modules via UART to a host MCU or MPU and issue basic ASCII or AT-style commands. The firmware on these modules handles the complex aspects of the protocol, requiring no understanding or implementation on the developer's part. Additionally, these modules are compatible with Linux, ensuring that you can add wireless functionality to your design with minimal effort, regardless of your host system.

Let's examine the simplicity of the plug-and-play method. Consider, for instance, that you wish to add Bluetooth to your application. A plug-and-play Bluetooth module, such as the RNBD451, is all you require to activate comprehensive Bluetooth Low Energy (LE) functionality. The RNBD451 Add-On Board allows you to create prototypes with RNBD451 modules in minutes by plugging it to a computer via a USB Type-C cable. With the immediate availability of advertisement upon startup, Bluetooth becomes accessible as soon as the module is powered on. After plugging in, all that's left is to launch a terminal of your preference, and you're set to prototype.

To switch the RNBD451 into command mode, simply send "$$$". Once in command mode, ASCII commands can be transmitted over UART to access the desired features, such as scanning for Bluetooth LE devices or activating power-saving modes when Bluetooth isn't in use. Suppose you want to scan for all nearby Bluetooth LE devices. To do this, simply send the command "F" through your terminal. The RNBD451 will then begin to display all detected Bluetooth LE devices in the vicinity. If needed, you can adjust parameters to alter the default scan interval and scan window. To establish a connection with a device, use the connect command "C", followed by either '0' or '1' for public or private address, and then the MAC address of the desired device. This is how easy it is to connect to a Bluetooth device using RNBD451.

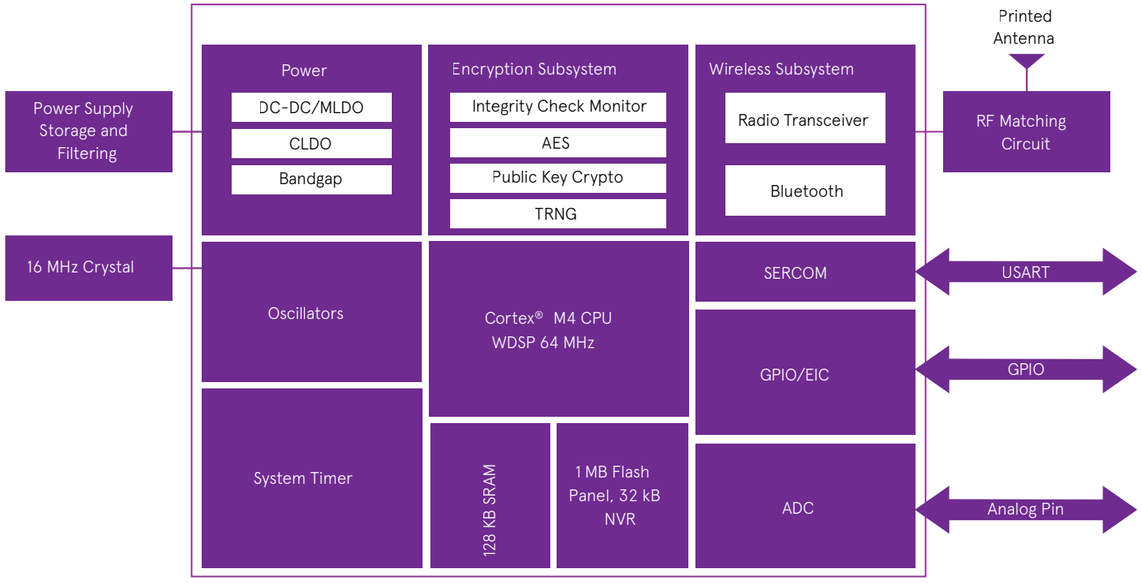
The RNBD451 modules are not only user-friendly but also equipped with advanced features. They have the capability to link with multiple Bluetooth devices due to their multi-link and multi-role support. They also offer a high transmission output power of +12 dBm and Coded PHY support, ensuring an impressively extensive range. The modules also provide a remote command mode, enabling command transmission via a connected Bluetooth device. This essentially creates a standalone mode, eliminating the need for a host to send any commands. Moreover, the RNBD451 module incorporates enhancements specific to Bluetooth 5.x, such as the "Advertising Extension". This feature broadens the scope for configuring advertisement data, making it an ideal choice for various Bluetooth LE beacon applications.

WIRELESS IS FOR EVERYONE

A plug-and-play approach to wireless solutions can significantly reduce the entry threshold, thereby simplifying the integration of wireless capabilities for all with minimal exertion.

A ready-to-use RF solution, globally certified for regulatory compliance, which can be effortlessly managed through a simple AT-style command set over UART, empowers developers who wish to add wireless features but lack the necessary expertise or resources.

This approach enhances the accessibility of wireless technologies across diverse protocols, fostering innovation. Developers are now equipped to incorporate Bluetooth, Wi-Fi, or both, without having to navigate through the intricacies of either technology.



RNBD451 Block Diagram

RNBD451 HIGHLIGHTS

- Bluetooth LE 5.2 stack
- Global regulatory certified (US, Canada, Europe, UK, China, Taiwan, Korea, and Japan)
- Definable beacon feature to make various beacons, such as iBeacon™ and Eddystone™
- Supports PTA control
- Built-in Microchip transparent profile for UART data streaming
- Over-the-Air (OTA) remote configuration
- UART based Device Firmware Update (DFU)
- Built-in Microchip OTA Profile with Client and Server Role for OTA DFU Execution
- Embedded enhanced security
- Multi-Link and Multi-Role
- 2M PHY and long range (Coded PHY)
- Data length extensions and secure connections
- Bluetooth LE Privacy 1.2 with up to eight resolvable and accept lists
- Integrated 16 MHz POSC
- 8 GPIOs
- 12-bit analog-to-digital converters (ADC) successive approximation register (SAR) module for analog to digital conversion
- Add-on up to 6 16-bit UUID GATT services (public service), 4 128-bit UUID GATT services (private service), and each service includes up to 8 characteristic attributes
- Supports Bluetooth LE advertiser, observer, central and peripheral roles
- Supports Bluetooth LE GATT client and server roles

RNBD451 Module Front

RNBD451 Add-on Board

CONCLUSION

Adding wireless has never been easier. For more information on our high-reliability wireless solutions and to explore our full product offerings, visit our Microchip Storefront today.

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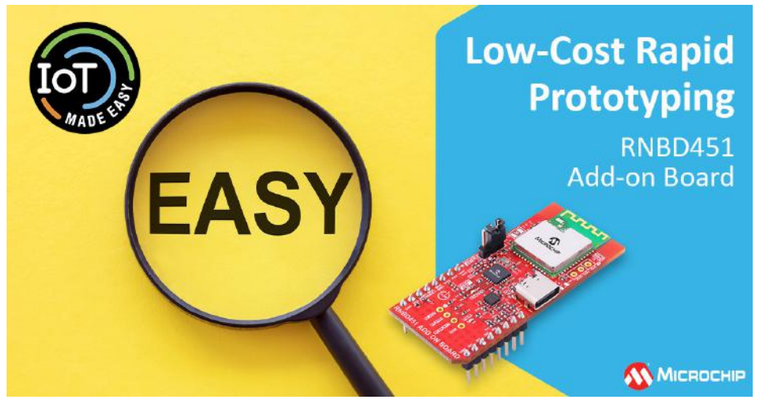

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DIGITIZING, CONNECTING, AND DELIVERING EFFICIENCY

THE FUTURE OF INTELLIGENT BUILDINGS

by Margaret Naughton and Olive Murphy

We are living in a world where urbanization is driving a global need for more housing and office space within cities. It is predicted that the global building floor space will double by 2060, adding the equivalent of Paris to the planet every week for the next 40 years.

Today, buildings are estimated to be responsible for 26% of all energy related emissions and about 30% of global final energy consumption, with 18% of those emissions from the production of electricity and heat used within them.

The day-to-day running of a building needs to be made intelligent to ensure building operations leverage data-driven insights to capture greater energy-efficiencies than is possible with always on or scheduled operations that don't allow buildings to be adaptable. This is why the future of intelligent buildings is embracing digitization and connectivity.

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"Tracking Clean Energy Progress 2023"
International Energy Agency

WITH
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Making buildings more intelligent is not just for new builds (traditionally referred to as a greenfield site) but needs to address brownfield sites (all existing buildings being upgraded or retrofitted for a new purpose) as well. Did you know that according to a European Commission study, more than 220 million buildings (which represents 85% of the EU's building stock) were built before 2001. 85-95% of all buildings within the EU today will still be standing in 2050. This means upgrading and retrofitting of these spaces will be required to ensure they can adapt to fit the needs of a growing urban population, of a changing workforce model, and people's safety and comfort over the coming decades.

An office building has very different lighting, heating, and occupancy needs at midnight than it does from 9 am to 5 pm on any given workday.

Think of the inefficiencies if air conditioning was left running when the building is empty; if lights were always on no matter if the building is occupied. Shops and retail premises, schools, and universities all have the same considerations, as do you in your house – do you leave on all the lights at night when you go to bed? I hope you answered 'no'. You are manually controlling your environment by moving through your house, turning off lights, switches, TVs, and other electrical items to reduce energy waste and making cost savings decisions.
We need to plan today for more connected devices, offering greater intelligence at the edge and the ability to gather insights and more data than ever before to ensure the centralized management and efficient control of a building throughout its 24-hour operations.

While manual actions work for you around the house, to do the same on the scale of large buildings or environments that need to adapt to a non-conventional 9 am – 5 pm operating model, like factories running 24 hours around the clock, automating these processes is key. Placing intelligence in the form of sensors within rooms and open spaces, to monitor temperature, light levels, occupancy, and many more factors, allows the building to react as needed to guarantee the spaces are managed efficiently. Why have air-conditioning trying to keep a room at a set temperature if it is empty, room occupancy sensing can tell whether the area needs to be ventilated at that given moment.

If you have a lovely sunny day and sunshine hitting your building windows, instead of having to pump up the air-con to bring the temperature back down, the sensors at the window can decide the room blinds need to come down to better maintain that room's environment ensuring the room doesn't heat up to have to be cooled. There are many smart ways to manage a building, but all require localized intelligence through sensors deployed around the building and connecting these devices to a centralized control system (a Building Management System). Hence, digitization and connectivity are both needed to deliver sustainability, creating adaptive environments that react in real-time to the needs of the building versus operating on set schedules.

CONCLUSION

Discover how ADI is shaping the future of intelligent buildings by digitising, connecting, and delivering energy-efficient solutions.
For comprehensive product insights, expert support, and cutting-edge innovations in building automation.

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AMD

VISIT AMD

SMART INFRASTRUCTURE

Smart infrastructure is the integration of advanced technologies into cities, utilities, and transportation systems to optimize operations and management. It improves efficiency, reliability, and sustainability. As urban populations grow, and demand for efficient, sustainable, and safe infrastructure systems intensifies, smart infrastructure becomes increasingly important. Traditional infrastructure systems face challenges in maintaining efficiency and meeting the demands of the growing population.

An important goal of smart infrastructure is to optimize performance and management using real-time data and automation, enhancing citizens' quality of life, and promoting sustainable development. Smart infrastructure provides a solution by leveraging technology to enhance functionality and resilience, enabling real-time monitoring, predictive maintenance, and automated management. It encompasses the use of sensors, data analytics, connectivity, and automation to optimize the operation and management of infrastructure assets.

THE ROLE OF TECHNOLOGY IN BUILDING SMART INFRASTRUCTURE AND OVERCOMING CHALLENGES

Smart infrastructure is revolutionizing urban environments, as it utilizes advanced technologies like the Internet of Things (IoT), Artificial Intelligence (AI), big data analytics, cloud computing, and machine learning, which are crucial for real-time data processing and decision-making. These technologies contribute to the development and management of advanced systems, addressing challenges, and enhancing overall efficiency and safety.

IoT in Smart Infrastructure

- IoT connects physical devices to the internet, enabling data collection and exchange.
- IoT sensors monitor parameters like traffic flow, energy consumption, and structural health.
- Real-time monitoring allows for immediate detection of issues like leaks or equipment failures.
- IoT-enabled systems enable predictive maintenance, reducing downtime and extending asset lifespan.
- IoT-enabled systems optimize resource usage based on real-time demand, improving efficiency and sustainability.

Artificial Intelligence (AI) in IoT

- AI enhances IoT systems by providing advanced data analysis and automated decision-making.
- AI algorithms analyze vast amounts of data to identify patterns, predict future trends, and generate actionable insights for infrastructure management.
- AI systems can autonomously manage and control infrastructure components, detecting anomalies and potential threats in real-time.

Big Data Analytics and Integration of IoT in Smart Infrastructure

- Big data platforms offer comprehensive data integration, enabling informed decision-making.
- Analyzing big data improves efficiency and planning, leading to cost savings and better resource allocation.
- AI and big data analytics facilitate the integration of IoT devices and big data analytics in infrastructure solutions.
- AI-driven security systems protect against cyber threats.
- IoT devices with built-in encryption and authentication mechanisms ensure data privacy.

FEATURES OF SMART INFRASTRUCTURE

Smart infrastructure systems utilize sensors and IoT devices to collect real-time data, providing continuous information about the status and performance of various components. They can predict maintenance needs, optimize energy usage, and enhance connectivity through communication protocols like Zigbee, Z-Wave, and Wi-Fi. Automated systems manage infrastructure components with minimal human intervention, improving response times and operational efficiency. Advanced monitoring and analytics enhance public safety by detecting and responding to potential issues.

Smart infrastructure is a concept that combines advanced technologies and IoT solutions to create an interconnected, efficient, and intelligent urban environment. The block diagram below (figure 1) outlines the various components that contribute to the development of smart infrastructure. It comprises of various components, including smart utilities, smart buildings, smart homes, smart retails, smart appliances, smart streetlights, and smart streetlights. Each component represents a sector where advanced technologies and IoT solutions integrate to create an interconnected, efficient, and intelligent urban environment.

Smart infrastructure systems are designed to accommodate urban populations and demands, ensuring long-term viability. They work with various devices and platforms, facilitating easier integration and upgrades. Robust security measures protect data integrity and prevent unauthorized access, ensuring infrastructure reliability. Smart buildings use building management systems, HVAC controls, smart lighting, and security systems to enhance building efficiency. Smart homes use home automation devices, smart appliances, security systems, and energy management systems to improve energy efficiency.

Smart appliances use connected devices, remote monitoring systems, and energy-efficient appliances. Lighting systems adjust lighting based on real-time data, reducing energy consumption and enhancing public safety.

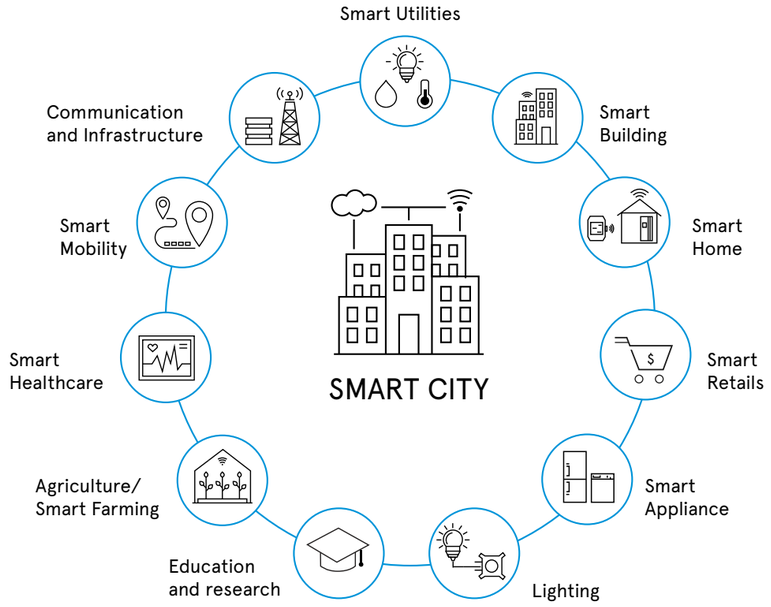


Figure 1 - Elements of smart infrastructure (Source: AVNET)

THE ADAPTIVE SYSTEM-ON-MODULE (SOM)

AI-enabled applications are revolutionizing cities by managing safety and alerting emergency services. These applications can be developed using chip-down development, which involves selecting specific silicon devices and creating a customized circuit board. However, this method can be time-consuming and costly. To save time and costs, design teams can opt for integrated solutions like Multi-Chip Module (MCM), System-in-Package (SIP), Single-Board Computer (SBC), or System-on-Module (SOM).

An SBC is a standalone computing system with a microprocessor, memory, and I/O, typically not designed for production deployment, while a System-on-Memory (SOM) is a production-ready platform that connects to a larger solution.

They are designed to fit into larger edge applications, offering flexibility, ease-of-use, and reduced time-to-market compared to off-the-shelf solutions. When combined with adaptive SoCs, adaptive SOMs provide a comprehensive, production-ready platform for AI-enabled edge applications.

AMD Kria™ SOMs offer significantly more system-level flexibility than microprocessors or GPU-based SOMs available in the market. They provide numerous additional features to accelerate development. There is support for a pre-built and scalable Linux infrastructure, whether users prefer the Ubuntu and Ubuntu Core distributions by Canonical or the Linux kernel managed by AMD with AMD PetaLinux Tools (as shown in figure 2).Additionally, custom builds using Yocto are supported.

These options come with practical system utilities such as temperature and performance monitors, quality-of-service configuration for DDR memory and other peripherals, over-the-air firmware update capabilities, and built-in self-test functions.

The most significant attribute of Kria SOMs is the growing library of accelerated applications found on the AMD App Store, both for free and for a fee, which can be easily loaded into a Kria SOM.

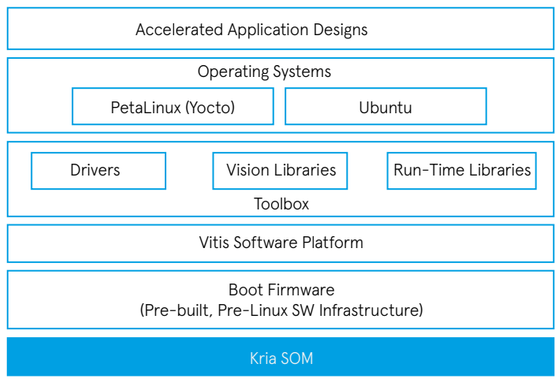


Figure 2 - Pre-Built Linux Infrastructure for AMD Kria™ SOM (source: AMD WP528)

Abstraction Layers of Adaptive SOMs

Adaptive SoCs offer three degrees of freedom: software programmability, hardware programmability, and scalability for embedded platforms. As shown in figure 3, they include a comprehensive set of design and runtime software, enabling the creation of flexible, efficient systems. APIs and pre-built platforms offer access to AI models for common inference functions.

Software developers can accelerate their design cycles by using pre-built configurations for adaptive SoCs, and advances in software tools, libraries, and frameworks allow design teams to use adaptive computing without burdening hardware engineers. An adaptive SoC provides a simple, out-of-the-box experience for developers in familiar environments like Python, C++, TensorFlow, and PyTorch.

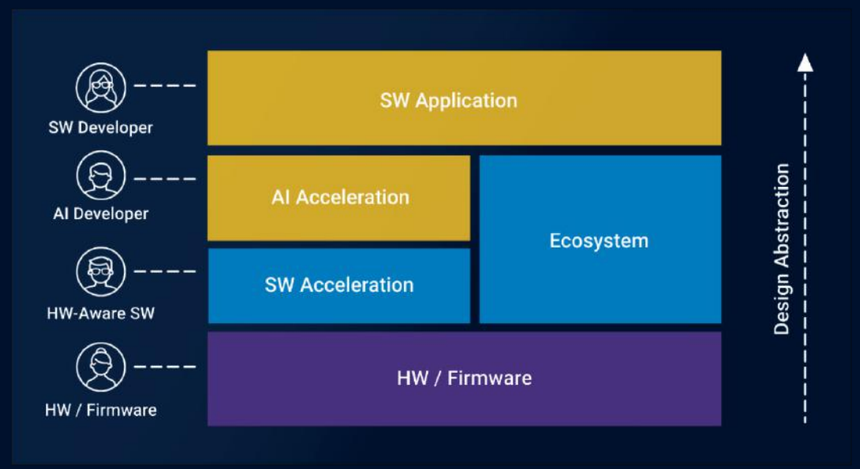


Figure 3 -Adaptive SOMs can be programmed from several abstraction levels (Source: AMD)

AMD Kria™ K26 SOM: A Powerful Solution for Smart Infrastructure

AMD Kria™ adaptive SOMs are built around the AMD Zynq™ UltraScale+™ MPSoC architecture and give developers access to a turnkey adaptive computing platform. By standardizing the core parts of the system, developers have more time to focus on building features that differentiate their technology from the competition. Kria SOMs are an integrated embedded, pluggable, nearly-credit-card-sized, Arm® SoC-based solution. They provide a secure and production-ready multicore Arm processing and FPGA platform, including memory, power management, and your choice of a Yocto or Ubuntu Linux infrastructure to build accelerated AI-enabled applications at the edge.

The AMD Kria™ K26 System-on-Module (SOM) excels in supporting artificial intelligence (AI) and machine learning (ML) algorithms, which are critical for predictive maintenance and optimization in smart infrastructure. By leveraging the Kria K26 SOM's powerful processing capabilities, these algorithms can analyze real-time data to predict equipment failures, optimize resource usage, and improve overall system efficiency. The Kria K26 SOM is a high-performance AI system designed for Vision AI applications. It combines AI performance with adaptability to keep pace with evolving algorithms and sensor requirements. The Kria K26 SOM is available in commercial and industrial grades and is designed for high-volume edge deployments.

It delivers up to 1.4 TOPS for AI tasks and integrates a dedicated H.264/265 video codec for efficient video processing. With 245 I/Os, it can connect up to 15 cameras, integrate with networks at 40 Gb/s, and leverage USB peripherals. Developed for software developers, the K26 SOM features pre-built accelerated applications for common vision functions, streamlining development processes and help to improve time-to-market.

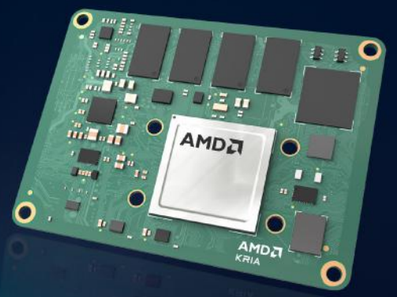


Figure 5 – Picture of the AMD Kria™ K26 SOM (Source: AMD)

Figure 4 – AMD Kria™ SOM product family (Source: AMD)

AMD Kria™ KV260 Vision AI Starter Kit

AMD offers a starter kit that consists of a non-production AMD Kria™ SOM mated to a predefined carrier card with various interfacing options to connect sensors or other peripherals. The starter kit is the easiest way to get started with Kria SOMs, especially with Vision AI applications, and provides a path to move to a custom user-defined production carrier card that is developed for the target application.

The development platform featuring the AMD Kria™ K26 SOM, the AMD Kria™ KV260 Vision Starter Kit, is designed for advanced vision application development without requiring complex hardware design knowledge. This kit focuses on applications such as security, smart cities, traffic management, and retail analytics. These applications have driven design decisions on the Kria KV260 Vision AI Starter Kit, including elements like the chosen connectors for I/O interfacing.

Figure 6 – AMD Kria™ KV260 Vision AI Starter Kit (Source: AMD)

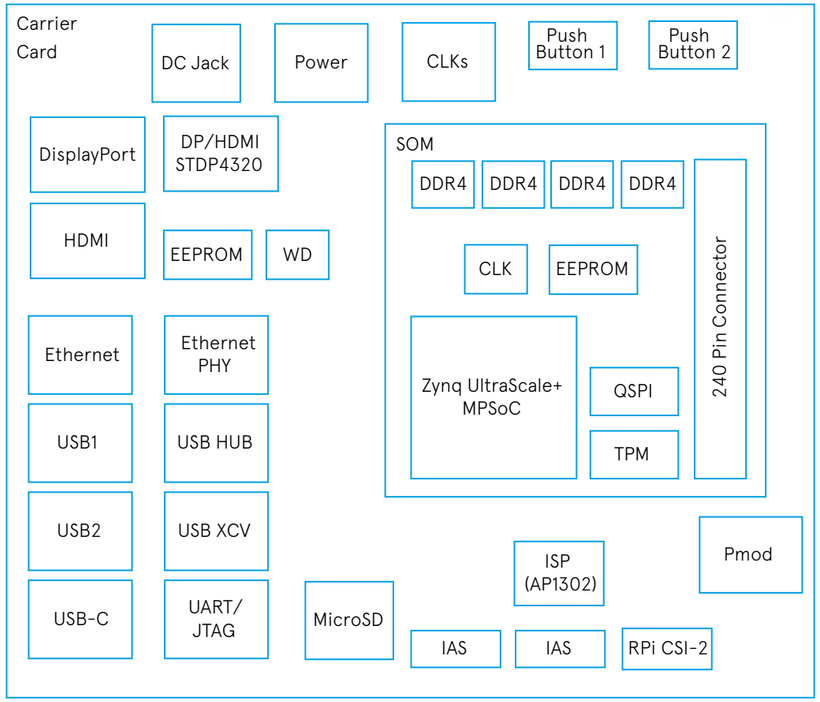


Figure 7 shows a block diagram of AMD Kria™ KV260 Vision AI Starter Kit. It is powered by an AMD Zynq™ UltraScale+™ MPSoC hardware root of trust (RoT) and Infineon TPM2.0 for secure boot ,with 4 GB DDR memory, and 512 Mb QSPI primary boot memory. It features a Vison Ready design, multi-camera support, 3 MIPI sensor interfaces, USB cameras, built-in ISP component (OnSemi), Raspberry Pi camera interface, HDMI and DisplayPort outputs, flexible connectivity via 1 Gb Ethernet and USB 3.0/2.0, and an accessible Pmod ecosystem.

Figure 7 – Block Diagram of AMD Kria™ KV260 Vision AI Starter Kit (Source: AMD WP528)

CONCLUSION

Explore how AMD is revolutionising smart infrastructure with the AMD Kria K26 SOMs, delivering unparalleled performance and flexibility for your applications.

VIEW PRODUCTS

As the world becomes an ever smarter space, the burden on limited energy resources is bound to grow heavier. By 2050 the world's energy demand is expected to double from 575 PJ (Petajoules) in 2020 to 1,178 PJ in 2050. Due to such growth in demand, it is predicted that there will be a 9-fold increase in demand for renewables and a 200% improvement in efficiency.

As circa 50% of energy consumed is in 'Industrials' including commercial buildings , the future requires the re-engineering of systems to meet this need for efficiency.

Creating new smart factories and buildings in greenfield locations is relatively straightforward if expensive, but we cannot afford to reinvent the wheel for each and every project. In order to make maximum use of the world's limited resources, especially in densely populated urban environments it will be necessary to upgrade existing buildings, retrofit factory equipment and convert brownfield sites as the transition to smart cities gathers pace.

Improving efficiency and upgrading existing equipment and buildings typically comes down to how to gain access to and leverage data. Helping people to solve problems is all about providing them with data and information about the processes that are of interest to them.

Existing solutions have been built to be reliable rather than flexible, fortunately though the Arduino Pro platform provides effortless integration. Arduino products and services are designed to play nice with third-party solutions, integrating into existing infrastructures or with other brands' components easily. The entire Arduino ecosystem is agnostic and open-source at heart, allowing industrial customers to add that last-mile connectivity without needing to touch their existing solutions.

Arduino solutions can function outside of a customer's legacy core operation in a collaborative way, meaning that there is no need to re-audit the line. So factories of the future can save through retrofitting, using what they already have and working faster. Arduino can bring the SMARTS to those 'oldies but goodies', the legacy machines that are the cornerstone of manufacturing plants around the globe.

WHAT IS OVERALL EQUIPMENT EFFECTIVENESS (OEE)?

OEE is a "best practices" metric that identifies the percentage of planned production time that is truly productive. An OEE score of 100% represents perfect production: manufacturing only good parts, as fast as possible, with no downtime.

In reality though, manufacturing industries often experience inefficiencies in their production line, resulting in frequent downtime and reduced overall productivity. They lack real-time visibility into machine performance and struggle to identify the root causes of these issues.

There are five main challenges to implementing OEE:

1. Lack of Data Visibility: The existing setup for machines / lines / stations lacks real-time data monitoring capabilities, making it difficult to track machine performance metrics accurately.
2. Manual Data Processing: Companies may rely on manual data entry and analysis, which is time-consuming and prone to errors. This hampers their ability to identify and address production inefficiencies promptly.
3. Limited Scalability: The current infrastructure does not scale well with the growing volume of data generated by machines, hindering future expansion plans.
4. Technical Depth / Interoperability: Some companies might have different types of OT technologies in their sites, making it difficult and/or costly to implement an OEE solution.
5. Lack of Skilled Technical Workforce: Implementing an OEE solution might require some level of technical expertise. This is especially hard to acquire with closed-source technology and/or technology not well known by the community, either for end customers or technology suppliers (system integrators).

SO, WHAT IS THE SOLUTION?

Optimotion, an official Systems Integrator partner of Arduino, developed the following solution based upon the Arduino Pro platform. The proposed solution leverages IoT technologies, cloud computing, and data analytics to address these challenges effectively:

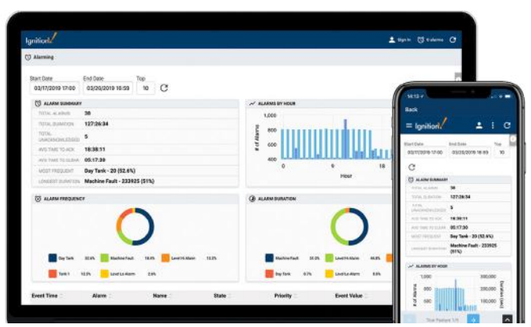
1. Arduino Opta Integration: Implement Arduino Opta micro PLCs to collect real-time data from machines on the shop floor. These are cost-effective and can be easily integrated with existing machinery.

2. MQTT Communication with AWS Cloud: Utilize MQTT protocol for lightweight and efficient communication between Arduino Opta micro PLCs and the AWS Cloud instance. This ensures seamless transmission of data to the cloud in real time. The broker could be any of your choices. Main industrial options: Cirrus link, HiveMQ.

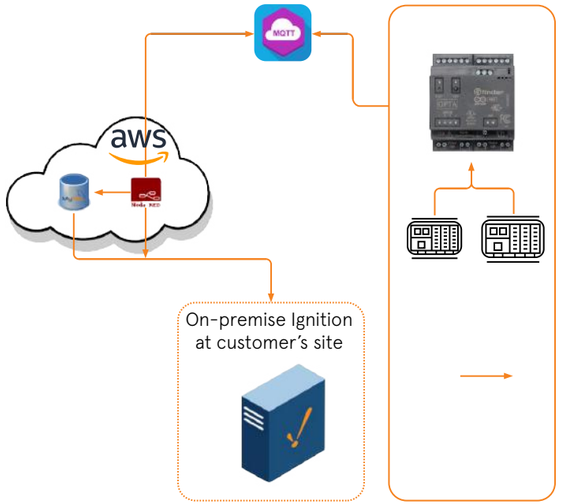
3. AWS Cloud Architecture: Set up an AWS Cloud instance comprising a MySQL database and Node-RED instance. The MySQL database stores the incoming data, while Node-RED processes the data, calculates OEE, and inserts it into the database.

4. Ignition Visualization: Deploy Ignition on premise to connect to the MySQL database hosted on AWS. Ignition provides intuitive dashboards and reports for real-time visualization of OEE metrics, enabling operators to monitor machine performance effectively.

   Also, via its store procedures module, the DB manipulation can be easily achieved. Ignition, with its cirrus link MQTT connectors, can become an MQTT subscriber, acquire information in UDT structure via sparkplug B specification and then perform transaction groups for easy UDT-to-DB applications.



HARDWARE ARCHITECTURE



The Arduino Opta is used as a data concentrator thanks to its powerful Portenta H7 2-core processor. It gathers data using Modbus TCP and RTU, and it is also programmed to be an MQTT gateway to the broker.

In this example, the broker lives in an AWS, but it can also be any kind of broker.

Node-RED would be the "productivity engine" which basically subscribes to the MQTT OEE topics and transforms data into useful OEE historic data.

Also, Node-RED analyzes big chunks of data, and publishes information models through MQTT.

Ignition subscribes to those topics and performs the visualization engine for the OEE application.

RETROFITTING TO IMPROVE PRODUCTIVITY THROUGH DATA-DRIVEN BUSINESS DECISIONS

Steelcase, a global home and office furnishings design company, were developing and deploying the Industrial Internet of Things (IIoT) in all 13 of their production plants to improve productivity by shifting to data-driven business operations.

They improved their workflow by building a simple and cost-effective application around the Arduino Opta. When a machine seems to not work properly at random, "Traditionally, you'd get a person out there with a stopwatch and a clipboard, but it could be days or weeks before they might see this issue arise," says Steven Jones (Technical Process Consultant at Steelcase). Wiring Arduino's secure and easy-to-use Opta micro PLC (supporting Arduino programming experience and PLC standard languages) into existing equipment allowed Steelcase to monitor signals that indicate when a specific problem was occurring.

"I started working in factories in pre-internet times; the technology now is available to do things that were never imaginable before," says Jones. "Opta has digital inputs and digital outputs, analog inputs, outputs, everything that a regular PLC would have."

Unlocking the power of data takes leading enterprises from IoT to AI-powered manufacturing. Industry 4.0 essentially requires embedded systems that connect to the internet, use big data, and finally support decisions about what needs to be done in the factory to achieve better efficiency and productivity: "When you have an idea or an opinion and you can support it with data, you can usually get things to happen much quicker," Jones observes. At Steelcase, this will naturally lead to increased use of AI: "We're positioning ourselves also for the time when machines make decisions. I think if we curate our data appropriately and ask the right questions, it could be revolutionary for us."

TRANSFORMING CONTAMINATED SITES INTO SAFE SPACES

Converting brownfield sites into habitable residential or office spaces is another challenge where a 'smart' approach is aiding the conversion and reducing the risk for occupants. A foundational challenge to buildings constructed over contaminated soil or groundwater from previous industrial usage is ensuring that the indoor air will be safe.

Indeed, where a building rises on top of a site previously contaminated by petroleum or chlorinated solvent products, the off gasses are capped in the ground by the building slab but the gasses can still seep up into the building air. Thus, vapor mitigation systems are used to create a negative pressure under the slab through vent risers and fans which route those gasses safely above the building. Traditionally, environmental consultants would then need to visit their client sites in-person to manually collect differential pressure data to ensure the system was functioning correctly.

Beyond the immense time and costs involved with this cumbersome requirement, the potential for a failure to occur to the sub-slab depressurization system between the duration of collecting differential pressure data without any alerts could put building occupants' health and safety at risk.

AMB Vapor Monitoring provides its customers with 24/7 cloud-based monitoring, control and reporting for their sub-slab depressurization systems utilizing the Arduino Opta and Arduino Cloud.

They recognized that they needed a revolutionary solution, one that could efficiently collect and record data from a centralized network of 20 to 200+ subsurface differential pressure testing locations along with providing real-time failure alerts.

Their system consists of a series of tubes running beneath the building slab to various pressure test locations.These tubes are connected to solenoids which in turn are connected to manifolds, which are then routed to the pressure sensor which takes the readings.

The reading then goes to the Opta, which transfers the data to Arduino Cloud where it is logged and accessible online. The Modbus reading is recording exactly what the sensor detects within milliseconds, working from very small ranges of accuracy to hundreds of thousand of decimal places. With Arduino Cloud logging and displaying the recordings, AMB Vapor Monitoring can easily view graphs with all the differential pressure data either live, hourly, daily, weekly etc. As well as transferring the data to the cloud, the Opta also controls a set of relays, switching them on and off. This turns each solenoid on and off to cycle through each pressure test location, measuring and logging the reading back to the cloud.

The system provides customers with peace of mind, as it automatically takes samples every single day for every corner of the building, showing that everything is working correctly and ok for human health.

MORE ABOUT ARDUINO OPTA

The robust and reliable Arduino Opta micro PLC makes industrial and building automation accessible to everyone. Its versatility allows for integration with existing machines, devices, and production lines, as well as with any of the elements in the modular Arduino ecosystem – from compact sensor modules to powerful SOMs and gateways – offering customizable end-to-end solutions for diverse applications.

Designed for security and durability, Opta supports OTA firmware updates and ensures data security from hardware to the cloud through its onboard secure element and compliance with the X.509 Standard.

Opta enhances industrial automation capabilities by integrating seamlessly with load cells or vision systems to optimize manufacturing processes. It facilitates tasks such as managing production flow on conveyor belts, synchronized time printing on labels using Network Time Protocol (NTP), and real-time monitoring via local HMIs, Bluetooth® Low Energy, or remote connection to Arduino Cloud with custom dashboards. Additionally, Opta enables predictive maintenance by leveraging its computational power and machine learning algorithms to detect and preemptively address anomalies, ensuring uninterrupted operations.

CONCLUSION

Enhance your smart infrastructure with Arduino's Opta Micro PLC, designed to provide that crucial last-mile connectivity.
For comprehensive product insights.

VIEW PRODUCTS

NORDIC SEMICONDUCTOR

VISIT NORDIC

THE WIRELESS INFRASTRUCTURE IN HOMES AND CITIES

The infrastructure in homes and cities continues to evolve, potentially impacting how we live and interact with our environment in the future. The wireless landscape around us is being reshaped from homes with connected devices capable of Machine Learning capabilities to cities implementing advanced technologies for more efficient device management.

Smart infrastructure encompasses a wide range of applications in residential and urban environments. Devices like thermostats, security cameras, and lighting systems have gone from proprietary systems to adopting globally accepted standards like Matter. Matter is a global, open-source standard aiming to minimize the need for multiple apps or hubs to streamline the setup and operation of smart home devices from different manufacturers. Google, Samsung, Amazon and Apple are responsible for making their offerings work together across their respective ecosystems. Amazon also provides a shared network in the US, the Sidewalk technology, to keep devices connected if your home Wi-Fi goes down. Outside our home walls, integrating wireless technologies makes traffic lights, waste management systems, and buildings more intelligent and energy-efficient. Intelligent transportation systems (ITS) use sensors and data analytics to manage traffic flow and reduce congestion. Examples include smart parking solutions and real-time public transportation updates.

The backbone of this infrastructure is a variety of wireless technologies. Vendors provide products with wireless capabilities out of the box today, and it can even be retrofitted to existing infrastructure, like street lighting, to enable seamless communication between devices.
The most used technology is probably Wi-Fi. You can find it "everywhere" because it's widely used for high-speed internet access in homes and public spaces. Bluetooth Low Energy (LE) is an ideal standard for short-range communication and low-power consumption. It's commonly used in wearable and health devices and for most home automation commissioning. Zigbee and Z-Wave provide reliable and secure communication, and Thread is a secure and scalable mesh networking protocol developed specifically for smart home applications.

Finally, by adding NB-IoT, LTE-M, 5G communication and the possibility of local, private networks like DECT NR+ to the mix, decision-makers and developers have a solid technology toolbox for designing mobile networks, high-speed connectivity, low latency, and close to real-time applications. Cellular IoT is now widespread and makes long-range monitoring and measuring possible by using existing cellular network infrastructure. Improving animal and asset tracking and optimizing agriculture are standard use cases for NB-IoT and LTE-M.

Integrating wireless technology into products and devices we surround ourselves with brings both challenges and advantages, as well as convenience and efficiency opportunities. The energy grid and management systems can optimize and balance network loads and help reduce homeowners' electricity usage. Monitoring waste management and improving efficiency in commercial buildings will also contribute to overall energy reduction. As AI and machine learning (ML) models improve, the wireless hardware requirements to run these models go down. Many of the edge devices mentioned can be enhanced by ML and make informed and optimal decisions without the need for any wireless communication. Edge AI saves energy by eliminating the need for costly and energy consuming transmissions to and from cloud services. IoT-enabled applications are projected to save up to eight times the energy they consume by 2030.

Developing and implementing wireless infrastructure also suggests specific economic benefits and business opportunities that can improve productivity and automate routine tasks.

Better traffic management systems use real-time data to adjust traffic signals, reducing congestion and travel times. As a result, commute times can be reduced while enhancing the efficiency of goods transportation. Automated waste management systems use sensors to monitor trash levels and optimize collection routes, reducing fuel consumption and labor costs, freeing up resources for other municipal services.

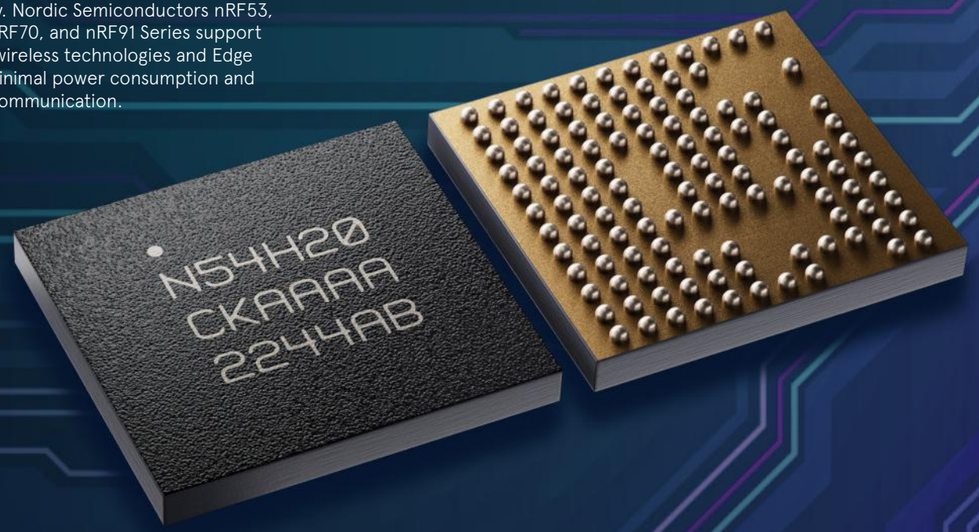
Implementing solutions with robust security protocols is essential to protect any wireless infrastructure. Developers should use the expertise of the hardware vendors and follow the standardized PSA Certified IoT Security Framework approach to security to guides the design process.

Nordic Semiconductor's wireless offerings play a crucial role in supporting smart infrastructure. Their Wireless MCU and SoC offering covers Bluetooth Low Energy (BLE) System on Chips (SoCs) used in smart lighting and home control systems, Wi-Fi 6 certified companion ICs used for Thread and Matter applications, to cellular IoT (NB-IoT and LTE-M) utilized in smart grid applications to monitor and manage energy flow, ensuring grid reliability and efficiency. Nordic Semiconductors nRF53, nRF54, nRF70, and nRF91 Series support multiple wireless technologies and Edge AI with minimal power consumption and reliable communication.

CONCLUSION

Enhance your wireless infrastructure in homes and cities with Nordic's nRF54H series, designed for seamless connectivity and reliable performance. For detailed product insights and to explore our complete range of innovative solutions that empower your wireless applications

VIEW PRODUCTS



power integrations

VISIT POWER INTEGRATIONS

STREETLIGHT CHARGING: A SOLUTION FOR URBAN EV INFRASTRUCTURE

In the U.S., 64% of Electric Vehicle (EV) owners have the convenience of a Level 2 home charger, capitalizing on low overnight electricity rates. This aligns with the 70% of Americans who reside in single-family homes, often equipped with garages or driveways, allowing for private charger installation.

However, those living in multi-unit dwellings like apartments or condos face challenges in accessing overnight EV charging. As EVs become more widespread and affordable, the U.S. aims to increase EV adoption to cut CO2 emissions. Crucial to this effort is expanding the charging network, particularly in densely populated areas, to serve commuters and residents of multi-unit housing.

DIVERSE CHARGING OPTIONS

Rapid charging stations can boost an EV's battery to 80-90% in just 20-30 minutes. These stations are strategically placed near highways for long-distance travel or in parking areas where drivers can spend time shopping or getting a cup of coffee. For daily commuters and short-trip drivers, home charging is more convenient. Adding a 20- to 30-minute charging stop is often impractical, making home charging the better option. This need for rapid charging is more acute for residents of multi-unit housing, where private chargers are less feasible.

Europe's dense population creates its own complications for EV charging. With a similar population but half the land area of the U.S., Europe's older cities and apartment-centric living present unique challenges. In the UK, for example, 24% of the population lacks access to private parking. This figure jumps to 46% in inner London, making charging point access a significant barrier to EV adoption.

LONDON'S INNOVATIVE STREETLIGHT CHARGING SOLUTION

In 2016, London piloted a project in Kensington and Chelsea to convert streetlights into EV charging stations. This involved upgrading fuses for safe power delivery without disrupting the electrical network. The conversion process is quick, taking 1-2 hours per streetlight, and involves minimal infrastructure changes, leaving only a discreet charging socket and signage. The borough later added 540 streetlight chargers and 110 rapid charging stations, placing 94% of residents within 300 feet of a charger.

WIDESPREAD ADOPTION AND EXPANSION

The UK now boasts 8,000 streetlight and bollard charging stations. Local requests guide new installations, ensuring demand-driven expansion. The concept is catching on in mainland Europe, with Berlin installing 200 streetlamp chargers and planning for 800 more. Solutions include bollards and wall-mounted boxes for communal parking areas, often with profit-sharing and maintenance agreements to encourage private installations.

In Europe, these stations typically require drivers to carry their charging cables. The stations operate through smart charging cables available in two power options, with renewable power subscriptions, or via mobile apps billing per kWh.

LOS ANGELES' PILOT PROGRAM AND NATIONAL EXPANSION

Los Angeles, while half as dense as London, leads in U.S. EV ownership. With a high rental population and many living in multi-unit buildings, the city faces similar charging challenges. A significant push began in 2019, with the installation of 130 streetlamp charging stations, following an LED streetlight upgrade. The plan is to add 150 chargers annually, supported by grants and private investments.

Other U.S. cities like Melrose, MA, and New York are exploring similar streetlight and bollard charging solutions, with New York aiming for 10,000 curbside chargers by 2030.

A PROMISING FUTURE FOR EV CHARGING

As of 2023, the UK had over 53,000 public charging points, with potential for substantial growth through lamppost conversions. The U.S. Department of Energy estimates the need for 27,500 rapid chargers and over 600,000 Level 2 chargers by 2030 to support an expected 15 million EVs. With 26 million streetlamps nationwide, the U.S. has a significant opportunity to leverage this innovative charging approach.

Streetlamp conversions offer an equitable, efficient, and environmentally friendly charging solution, particularly for those in multi-unit dwellings. This approach promises to be a cornerstone in the nationwide rollout of EVs, ensuring accessible and convenient charging for all.

Power Integrations supports the electrification of transportation with highly integrated power conversion solutions for electric vehicles. Our high-efficiency and high-reliability products for EV charging include InnoSwitch™3-AQ switcher IC families for high voltage auxiliary power supplies and SCALE-iDriver™ high-power gate driver ICs for high-speed DC chargers.

CONCLUSION

Transform urban EV infrastructure with Power Integration's innovative streetlight charging solutions, designed for efficient and sustainable energy delivery. For comprehensive product insights and to explore our full range of cutting-edge solutions that power the future of electric mobility.

VIEW PRODUCTS

VISIT STMICROELECTRONICS

LPWAN CONNECTIVITY IS BOOSTING SMART INFRASTRUCTURE IN A **SMART CITY SCENARIO**

Smart cities aims to improve quality of life of citizens and enhance energy efficiency, by leveraging digitalization, embedding sensor in the connected infrastructure around.

The proliferation of IoT technologies is driving this digital transformation, to better manage energy generation and distribution, and offer a wider range of services to enhance urban living, improve efficiency with sustainability. Smart city applications includes smart homes, building automation, smart meters, public lighting, parking, air quality monitoring, waste management, and smart transportation.

For instance, smart streetlights reduce energy and maintenance costs, smart parking solutions alleviate traffic by indicating available car slots, and smart waste management systems enhance efficiency by monitoring fill levels and optimizing collection routes; Low Power Wide Area Network (LPWAN) connectivity technology can interconnect these infrastructures exchanging real-time data in citywide network.

Moreover, as urban areas expand, issues like noise and air pollution intensify, smart monitoring systems gather data to safeguard citizen health and inform city planning. LPWAN technology can support to tracks environmental factors, providing insights for resource management.

Smart meters offer real-time insights into electricity usage and supply, facilitating efficient distribution and enabling dynamic tariff schemes, resulting in cost savings. Additionally, smart city infrastructure employs sensors for real-time monitoring, such as health building sensors that assess temperature, humidity, and air quality, as well as vibration sensors that detect structural changes. These technologies decrease maintenance expenses and enhance safety, contributing to more efficient, sustainable, and livable cities.

Connectivity is a key enabler for Smart City, and LPWAN technology is playing a crucial role in this regard. Among the various LPWAN options available today, Long-Range Wide Area Network (LoRaWAN) and Narrowband IoT (NB-IoT) are considered the best connectivity options for smart city and smart land solutions, providing low power and secure connections

WIDESPREAD ADOPTION AND EXPANSION

LoRaWAN is a low-power, wide-area network technology designed for IoT devices. It is commonly used in smart cities to connect and manage various IoT devices, including environmental sensors, smart parking meters, and traffic management systems.

LoRa is a patented modulation technique by Semtech that provides low-power, long-range communication. using spread spectrum modulation technique derived from chirp spread spectrum (CSS) technology.

LoRa's modulation, changes its frequency over time, this redces interference and the need to re-transmit data. Unlike FSK, LoRa's signal is resistant to in-band interference mechanisms, require much less power, increasing battery life, allowing them to function in many places

LoRaWAN is an open standard developed by the LoRa Alliance to allow LoRa communication over long-range networks. LoRa Technology presents a suite of technical and business benefits tailored for smart city applications. It excels in delivering long-range connectivity up to 15km, simplifying deployment without the need for intricate coverage analysis, and is well-suited for both indoor and outdoor environments, operating within an efficient star network topology.

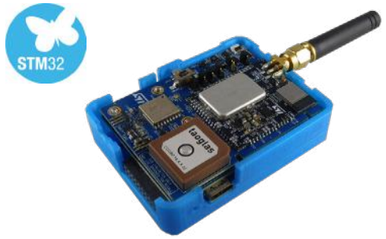
Moreover, LoRa ensures robust data transmission, thanks to its protocol that incorporates a Listen Before Talk (LBT) function, inspired by the Aloha method, and features like automatic frequency hopping and rate adaptation, which collectively guarantee reliable and efficient data exchange.

In terms of energy consumption and cost, LoRa is providing great ultra low power consumption for long-range connectivity, Sensors powered by batteries can operate up to more years, substantially reducing maintenance expenses and proving ideal for inaccessible or remote areas.

Security is not an afterthought with LoRa; it integrates advanced security protocols including end-to-end encryption and AES-128 encryption, ensuring that data transmission remains secure. The network's security framework is fortified during device registration, which facilitates mutual authentication between the end-device and the LoRaWAN network.

LoRaWAN is an open standard backed by the LoRa Alliance, guarantees smooth and straightforward scalability. Its unique star-of-stars network architecture is capable of supporting expansive networks with millions of devices.

Finally, LoRa Technology empowers cities with the flexibility to select from multiple network service providers, potentially driving down costs. Cities also have the option to establish their own municipal networks to host various applications, further optimizing expenses by leasing bandwidth to local businesses seeking to run their applications.



Bluetooth

LoRaWAN

sigfox 0G Technology

Temperature

Pressure

Accelerometer

Gyroscope

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STMicroelectronics offers a comprehensive range of end-node solutions for LoRa applications, including sensors, processors, and RF communication solutions. The STM32WL is the world's first wireless microcontroller to integrate a LoRa transceiver on its silicon die, providing a more integrated solution than previous industry offerings. STMicroelectronics offers several evaluation boards based on the STM32WL, including the STEVAL-ASTRA1B, which is a multi-connectivity solution that includes LoRa, Bluetooth, and NFC, as well as GNSS positioning and several MEMS sensors such as temperature, pressure, accelerometer, and gyroscope. This solution is an end-to-end proof of concept, with the STAssetTracking Mobile app for configuration and real-time monitoring via BLE and a web-based cloud dashboard, the DSH-ASSETRACKING, for remote real-time monitoring.

Moreover, STMicroelectronics offers an intriguing solution for LoRa connectivity with the STDES-CBMLoRaBLE reference design. This design is ideal for infrastructure monitoring, featuring Bluetooth and sub-GHz devices for connectivity. With a vibrometer and inclinometer on board and dedicated algorithms for vibration analysis and tilt monitoring, it's possible to monitor assets and infrastructure using long-distance connectivity for predictive maintenance applications. Additionally, ST provides a software solution that uses AWS, the DSH-PREDMNT, to help provision the device, log data, visualize information, and perform cloud asset monitoring anytime and anywhere.

NBIOT TECHNOLOGY

Recently, another interesting LPWAN technology has emerged, NB-IoT (Narrow Band Internet of Things), provides long-range and low power connectivity, It operates over existing mobile networks, LTE band, which allows it to leverage existing mobile networks, using existing infrastructure to guarantee its widespread adoption and effectiveness.

One of the technical strengths of NB-IoT is its use of Orthogonal Frequency Division Multiplexing (OFDM) with modulation schemes like QPSK (Quadrature Phase Shift Keying) or BPSK (Binary Phase Shift Keying). These multi-carrier options are highly robust against interference, which is a common challenge in wireless communication. The result is a reliable and efficient way to transmit data over long distances without the need for high power consumption. NB-IoT's native support for IPv6 ensures that it can handle the huge number of devices that are expected to be part of the IoT ecosystem. With IPv6, each device can have its unique address, facilitating seamless communication across the network.

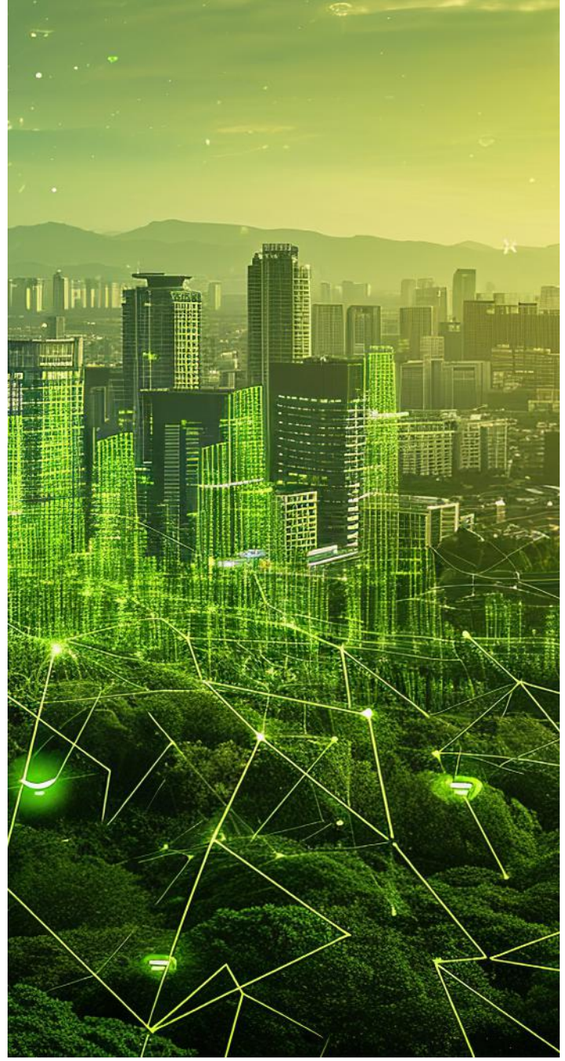
Security in IoT is a must, and NB-IoT addresses this concern by utilizing encryption and authentication mechanisms that are on par with those used in mobile phones. With 256-bit encryption as standardized by the 3GPP, NB-IoT ensures that data transmitted across its network maintains integrity and confidentiality.

The Global System for Mobile Communications Association (GSMA) Infrastructure plays a pivotal role in the success of NB-IoT. It offers worldwide coverage, ensuring communication reliability and the ability to support a large number of devices. This standardized technology is crucial for interoperability, allowing devices from different manufacturers and service providers to work together seamlessly.

Perhaps one of the most compelling advantages of NB-IoT is the low cost of deployment. Since it operates within the 4G/5G GSMA cellular infrastructure, there is no need for additional hardware or infrastructure investment. This aspect is particularly attractive for businesses and municipalities looking to implement IoT solutions without incurring significant expenses.

STMicroelectronics is providing interesting NBIoT solution based on module approach,

The ST87M01 is a turn-key, ultra-compact, LTE Cat NB2 NB-IoT and GNSS module that offers global multi-frequency band coverage and is certified under 3GPP Release 15; it boasts secure Firmware Over-The-Air (d-FOTA) updates, advanced security features, and customized AT commands, ensuring a 100% ST product with Bill of Materials (BoM) and supply chain independency, alongside a product longevity of over 15 years.



CONCLUSION

LoRaWAB and NBIoT technology are the most promising communication technologies for Smart cities applications scenario, and ST offers the right technologies, such as products and solutions, to help professionals accelerate proof of concept and field-testing phases.

That are designed to facilitate the development and deployment of both LoRa and NB-IoT applications. Moreover, ST's commitment to fostering a 'ready-to-go' ecosystem is evident in its collaboration with partners, ensuring that customers not only have access to the hardware but also to software, tools, and community support necessary to bring their smart city solutions to life swiftly and efficiently.

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