# Efficient, Smart Systems in Town and Country
# Benefit from the New Wave of Connected Infrastructure

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## Abstract

Speed, convenience, and availability are the new watchwords of modern societies: people demand that products and services are increasingly available on demand, wherever they need or want them.

This is leading to moves to enhance the basic technological platforms on which on-demand systems depend and to create new smart connected infrastructure. This includes systems to support ubiquitous payment capability, to provide information and services in the smart city, and to enable automation of metering and control in the smart grid.

Reflecting this new demand for smart infrastructure, connectivity technologies are evolving to provide higher bandwidth, easier integration into smart devices, and robust links in crowded or hostile operating environments.

Technologies underpinning these trends include NFC for contactless payments, power line communication Wi-SUN wireless wide area networking to connect smart meters and smart city systems, and Wi-Fi® networking to provide an internet connection to electric vehicle chargers and other infrastructure.

This white paper describes the powerful forces driving the build-out of smart infrastructure, the role of the leading wired and wireless communications technologies in infrastructure systems, and how Renesas products can support manufacturers in the development of competitive products for smart infrastructure applications.

# Connected infrastructure: streamlining the systems that underpin the modern world

Ask almost any question, and Google search or ChatGPT can tell you the answer instantly.

In dense urban areas, drones and delivery robots operated by e-commerce companies such as Amazon and Alibaba look set to cut delivery times for internet orders to a matter of minutes.

And services such as Uber ride-hailing have cut waiting times to almost zero.

What do these new aspects of the modern world tell us? Life has become faster, distances have shrunk, and people have learned to expect everything to be available everywhere all the time.

This streamlining is most obvious in the products and services that consumers use. But now the same trend is transforming the operation of the infrastructure that underpins modern life – power grids, transport networks, financial systems, and more. And it is thanks to advances in communications technology, enabling these networks to make seamless connections, that the streamlining of infrastructure is even possible.

The evidence of the enhanced speed, convenience, and availability of connected infrastructure can be seen across many facets of everyday life.

In **shopping and retail**, enterprises are bringing to life the concept of 'Pay Everywhere.' Even just a few years ago, a card payment required a terminal equipped with dedicated hardware. Now payment infrastructure is proliferating into ordinary mobile devices – such as smartphones, tablets, and PDAs – which merchants can carry and deploy anywhere with a mobile network connection.

In the **smart city**, connectivity is enabling streetlights to operate on demand and to provide value-added services such as parking space detection. Smart transportation systems can manage traffic flows in real time to ease congestion, and information systems provide the user with essential and useful local data, such as the location and availability of electric vehicle (EV) charge points.

And in the **smart grid**, new smart meters allow households to view their energy consumption and respond hour-by-hour to changes in dynamic pricing. The meter's real-time data feed to the energy supplier helps it to manage the power network more efficiently and reduce carbon dioxide ($CO_2$) emissions while eliminating the cost of manually reading meters.

The wired and wireless connections supporting smart infrastructure are enabled by Renesas Connectivity Solutions. Its chips and modules are optimized to provide for more automation, greater convenience, and easier integration in the infrastructure systems of the future.

# A transformative effect: connected infrastructure in everyday life

The demand for speed, convenience, and availability in today's world is leading to dramatic changes in the way its infrastructure supports systems such as cities, power grids, and financial networks.

In advanced societies, connected infrastructure gets smarter year by year. Its impact is already felt in the everyday lives of their populations: soon, an ordinary day could be enhanced by smart infrastructure in numerous ways.

At home, the consumer will optimize his or her energy use at all times of day or night. Their **smart meter** is connected to the energy company via the electricity grid's cables (power line communication, or PLC) or over-the-air via a Wi-SUN network, so the operator knows which premises are consuming power, and when they are consuming it. A small display in the user's home also shows real-time consumption data and tariffs in real time: this allows the energy supplier to incentivize users to consume energy in low-demand time slots and so avoid overloading the grid at times of peak demand.

On leaving home, our citizens might drive to the city's downtown district. **Smart information systems** connected via a Wi-SUN mesh network flash updates about traffic conditions on roadside displays. On arrival in the city, the driver needs a parking space. Technology in **smart streetlights** – connected by a PLC or Wi-SUN network - enables an AI-based system to scan continuously for empty spaces, and to display availability on the city's travel app.

In our story, the user is driving an EV, and so chooses a parking space that has a public EV charger connected via 5G mobile. With a simple tap of their mobile phone on the charger's display, which operates as a **smart point-of-sale (PoS) terminal**, charging is paid for quickly and conveniently, thanks to advanced NFC connectivity technology.

With the car safely parked and charging its battery, our citizen takes a walk around the city streets. They happen to see a market stall vendor selling artisan leather items. In the smart city, there is no need to carry cash: the vendor's tablet running on the Android™ platform, which is used to display the leather products catalog, also operates as a **soft PoS payment terminal**. The user taps their payment card on the tablet, and the transaction is completed instantly. Convenient and secure, this 'Pay Everywhere' system operates seamlessly thanks to the latest NFC technology with Android platform integration.

These examples show how connected infrastructure makes everyday activities such as finding a parking space, navigating busy city streets, or paying for goods more convenient and faster, and brings smart technology within reach of people wherever they are and whatever they are doing.

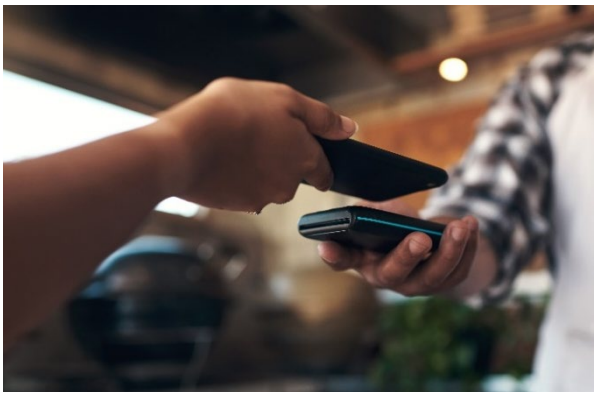
And in all these cases, communications technologies supported by Renesas Connectivity Solutions are a key enabler.

# A portfolio of wireless technologies for connected infrastructure

The concept of ‘smart infrastructure’ spans a variety of use cases and operating conditions and calls for connectivity over distances from the very short – such as the range, measured in centimeters, provided by the NFC connection between a payment card and a contactless payment terminal – to the very long: PLC or Wi-SUN connections can provide a span between nodes of more than 1km.

The communications technologies supported by Renesas Connectivity Solutions continually evolve and improve to meet the emerging requirements of domains such as smart infrastructure, and their key features reflect the needs of the latest deployments of smart infrastructure around the world.

## NFC: enabling smart payment infrastructure



Near Field Communication (NFC) wireless communication has provided the technology foundation for contactless payments and ticketing for much of the 21st century. Operating over a short range of a few centimeters, NFC signals are extremely difficult for digital criminals to clone and are highly resistant to eavesdropping. Security protection is afforded by the main NFC specifications, and by supporting standards such as EMVCo (the protocol specified by the payment card industry for NFC readers and tags used for financial transactions) and the Payment Card Industry (PCI) protocols.

Now NFC has been developed further to support the Pay Everywhere concept: the latest enhancements mean that contactless payments are no longer the sole preserve of dedicated PoS terminals. The latest Renesas NFC software package for the Android platform, the PTX130R Android Integration Stack (AIS), enables commercial off-the-shelf and consumer devices to take contactless payments.

This new AIS is the basis for the new concepts of the ‘Smart PoS’, implemented in devices such as industrial handheld personal digital assistants (PDAs), and the ‘soft PoS,’ implemented in consumer devices such as smartphones and tablets as well as enterprise computing devices. This new capability operating on the Android platform reduces the cost to the vendor to support contactless payment, and so promises a future of dramatically extended contactless payment capability.

With the support of the latest NFC technology, smart payment infrastructure provides the convenience and availability benefits that advanced societies demand today.

The PTX130R, an NFC reader from Renesas, integrates full AIS support into its Software Development Kit (SDK) for the Android OS. The PTX SDK includes an EMVCo module as well as standard NFC Forum reader functionality in the NFC Communications Interface (NCI) 2.x block. This provides ready-made support for Soft PoS payment terminal capability in Android OS-based devices.

## PLC: remote reading of the latest generation of smart meters

The main impetus to deploy power line communication (PLC), a low data-rate wired connectivity technology, in smart infrastructure is to support automated meter reading – an application that eliminates the cost of sending staff door-to-door to read householders' meters.

By enabling real-time two-way communication between the utility company and its customers, new value can be added to the relationship, for instance by enabling dynamic pricing: this means that consumers can choose to manage their energy consumption to fit time slots when there is spare generation capacity, and when the unit cost of energy is lower.

The advantage of PLC for this communication is that it uses existing physical assets – the power grid's cabling - and requires no new infrastructure. This physical infrastructure belongs to the utility company so that it is not dependent on a third party – such as a mobile phone network service provider – to enable its communication with its fleet of smart meters.

The same principle is valid for streetlighting applications, for instance in smart city systems for traffic monitoring or surveillance. New use cases for PLC technology include point-to-point links between a central control system and hard-to-reach endpoints such as submersible pumps. PLC connections to systems such as air-conditioning units also provide robust communication without the need to install additional network cabling, or to deploy a dedicated wireless network.

## Wi-SUN: long-range mesh networking for smart meters

Wi-SUN wireless communication makes it possible to span long distances (up to 20km) with medium data rates (up to 2.4Mbps) by using mesh networking technology. This characteristic makes it suitable for smart grid applications, particularly smart metering. Wi-SUN networks also provide communication links to support smart city applications such as street lighting control, environmental monitoring, and smart signage.

The security features included in the Wi-SUN standard's specifications assure the safety and integrity of data. A robust certification process ensures that different vendors' Wi-SUN-enabled products are interoperable and frees manufacturers from the risk of being tied to a single vendor.

Renesas Connectivity Solutions Wi-SUN products provide customers with the flexibility to choose the system architecture appropriate to their needs.

- Transceivers can be combined with a Renesas microcontroller in applications that need high processing power or a specific mix of peripheral functions and communications interfaces.
- Integrated Wi-SUN systems-on-chip (SoCs) enable the entire application to be implemented on a single chip. In systems with a lower requirement for processing power, this can enable the system architecture to be simplified, and bill-of-materials costs to be minimized.

Renesas products support both Wi-SUN FAN profile 1.0 and FAN 1.1. The main difference between the two profiles is that FAN 1.0 supports only the simple Frequency Shift Keying (FSK) modulation scheme, for a maximum data rate of 300kbps.

FAN 1.1 supports the more sophisticated Orthogonal Frequency Division Multiplexing (OFDM) scheme for a higher data rate of up to 2.4Mbps. FAN 1.1 also provides Limited Function Nodes (LFN), which enable low-power operation on a battery power source for leaf nodes.

## Wi-Fi: universal internet connectivity in the home or office

Where connected infrastructure applications require internet connectivity, a Wi-Fi network is the universal communications technology for home and commercial users. A smart EV charging wall box, which takes advantage of periods when tariffs are below normal, needs to keep an active connection to the home router in order to be updated on the utility's load status and the tariff. If the Wi-Fi connection is lost even momentarily, vehicle charging may be stopped.

Operating at high data rates – even higher than 1Gbps for the latest Wi-Fi 6 technology – an EV charging wall box typically requires superior radio performance: wall box chargers are often located in a garage, far from the internet access point inside the home. The wall box is also often competing for radio access with multiple other devices connected simultaneously to the access point or operating in bandwidth occupied by multiple access points in close proximity.

Because this wall box application requires reliable communication without dropping the connection, even when far from the access point and in crowded bandwidth, it calls for robust communication and long-range – features of Wi-Fi modules from Renesas Connectivity Solutions.

## Bluetooth Low Energy: ultra-low power connectivity for long battery run-time

To support connected infrastructure such as streetlights, EV charging points, and intelligent traffic systems, Bluetooth® Low Energy connectivity streamlines maintenance and repair operations and firmware upgrades.

Bluetooth Low Energy technology is a low-power consumer and is well suited to battery-powered applications that make periodic, low-data-rate transmissions of data. This means that Bluetooth Low Energy is increasingly being adopted by manufacturers of battery-powered gas and water meters, in which the wireless link enables contactless diagnosis, maintenance, and firmware upgrades.

Ultra-low power consumption is a notable feature of the Bluetooth Low Energy modules and chipsets from Renesas Connectivity Solutions.

# The Renesas advantages: performance, integration support and flexibility

The portfolio of Renesas Connectivity Solutions products for smart infrastructure draws on decades of world-class research and product development backed by global engineering support, and participation in industry consortia which create and maintain the standard specifications and interoperability criteria for communications protocols.

Renesas' leadership position in connectivity is reflected in the advantages it offers to developers and manufacturers of smart infrastructure products.

## Performance leadership

In wireless communications applications, the user experience is strongly affected by the performance of the radio system. Technical performance criteria such as range, resistance to interference, and sensitivity are the factors that determine how the application's operation affects the user.

Take the example of the Pay Everywhere trend, enabled by the smart financial infrastructure for advanced payment terminals. Consumers expect contactless payments to work instantly and securely, every time they pay, and in all conditions.

This must be as true of the new generation of soft PoS and smart PoS terminals as of traditional retail devices. Reliable payments depend on reliable wireless communication.

Here, Renesas stands out for its superior RF performance, enabled by the unique sine-wave architecture underpinning its PTX130R reader and other NFC products. This technology enables the Renesas DiRAC™ direct-to-antenna technology, which eliminates the EMC filter in traditional NFC chips and enables advanced wave shaping control.

These technologies result in superior RF performance, which can be measured in a larger operating volume (the space within which a reader device can couple to a tag device such as a payment card), even when operating behind a noisy display, as is normally the case in a soft PoS or smart PoS terminal.

Renesas' performance leadership in communications technology is also in evidence in the ultra-low power consumption of its Wi-Fi chipsets and modules. The Renesas VirtualZero™ technology provides a very long battery run-time in power-constrained Wi-Fi-connected devices. Bluetooth Low Energy products can maintain a low data-rate connection for products such as meters which need to operate for multiple years without battery charging or replacement.

## Easy integration and fast time-to-market

Performance leadership in Renesas connectivity devices provides a hardware platform for OEMs to create winning products for the next generation of smart infrastructure deployments.

But hardware alone does not meet the product manufacturer's requirement: OEMs want a solution to the infrastructure problem they are trying to solve, such as:

- How to provide a seamless payment experience in terminals with a convenient, mobile form factor?
- How to make it convenient for EV drivers to charge their vehicles at home and away?
- How to provide displays with real-time information where people need it in cities?

Solutions to these problems depend on integrating essential firmware into the hardware platform and providing an interface to enable rapid application development. As a partner to OEMs large and small all over the world, Renesas has a close understanding of the integration requirements of manufacturers of infrastructure products.

Software support for system integration can be seen, for instance, in the SDK for Android OS supplied by Renesas with its PTX130R reader. The SDK, which includes built-in EMVCo and NFC Forum modules in the NCI block, provides ready-made payment terminal capability. This means that OEMs which build in the PTX130R NFC reader into devices such as PDAs, smartphones and tablets can provide smart PoS and soft PoS capability with minimal integration effort.

The provision of supporting firmware to ease integration is repeated across the Renesas Connectivity Solutions portfolio: for instance, Bluetooth Low Energy chipsets and modules are supplied with complete implementations of the protocol software conforming to the Bluetooth specifications, and Renesas Wi-SUN modules and systems-on-chip (SoCs) are supplied with firmware conforming to the specifications of either the FAN (Field Area Network) 1.0 or FAN 1.1 protocol specifications.

## Flexible system architecture

OEMs that take advantage of the performance leadership and easy integration of the Renesas Connectivity Solutions portfolio of products enjoy broad flexibility in the way that they implement them into infrastructure system designs.

This is because Renesas combines its heritage in digital control with radio and analog expertise. Renesas is among the top five producers of microcontrollers worldwide and can draw on a deep library of digital and mixed-signal IP to build integrated communications/controller SoCs. At the same time, Renesas also offers customers the option of pairing stand-alone transceivers with any discrete microcontroller from Renesas or elsewhere.

This architectural flexibility is in evidence in the Wi-SUN portfolio of wireless products for metering and infrastructure applications, which includes both wireless transceivers and wireless microcontrollers based on either the RL78 or RX CPU cores.

The same flexibility is available to users of Renesas Bluetooth and Wi-Fi communications chips or modules.

This means that, across a range of applications, OEMs can have their choice of MCU if they need it or save space and reduce board complexity by using an integrated wireless SoC.

# Renesas Connectivity Solutions products for Connected Infrastructure

## Enabling Pay Everywhere convenience with advanced NFC connectivity

The PTX130R is the market's best-performing NFC reader, providing reliable, interference-resistant radio operation, even when sited behind an electrically noisy display – a requirement in the new soft PoS and smart PoS types of mobile payment terminal.

Supporting the Pay Everywhere trend to enable ubiquitous payment capability, the PTX130R includes built-in support for payments on devices based on the Android OS. Featuring the Renesas PTX SDK, which implements the Android Integration Stack (AIS) v1.1.0, the PTX130R is one of the first devices on the market to integrate an EMVCo application, for payment transactions on MasterCard, Visa, and other non-payment-related NFC cards, directly into the Android platform.

The PTX130R therefore provides the easiest way to implement payment capability into Android OS-based devices such as handheld PDAs, smartphones, and tablets.

The PTX130R's DiRAC™ direct-to-antenna technology also eliminates the conventional EMC filter required in competing NFC readers. This results in a lower component count and reduced bill-of-materials cost, as well as better RF performance via a smaller antenna.

Other key features provided by the PTX130R include:

- Support for the latest NFC applications such as Tap on Display, Multi-Purpose Tap, Value Added Services (VAS), and Enhanced Contactless Polling (ECP)
- Support for the Apple ECP protocol in the Android OS for Apple VAS reader applications
- Support for over-the-air software updates, a feature of the reader's split-stack software architecture
  - The PTX130R AIS stack can switch seamlessly between EMVCo and NFC Forum applications thanks to the full integration of both protocols into the Android NCI layer.
- Enabling NFC payment transactions using the Tap on Display capability, the PTX130R allows OEMs to modify their product design into a more compact and smart solution which gives a better user experience.

## Connecting to the grid via existing cabling: Renesas PLC modems

Power Line Communication (PLC) technology enables connectivity over existing power cabling, eliminating the cost and time involved in installing dedicated network cabling. Renesas provides proven modems which implement PLC connections with a range of more than 1km between nodes.

R9A06G037

A complete PLC modem integrating an analog front end, digital signal processor (DSP), and a CPU based on a 138MHz Arm® Cortex®-M3 core backed by 512kB of RAM.

Key features include:

- Support for all open narrowband PLC standards, including G3 Alliance, Prime Alliance, and Meters and More. The R9A06G037 enables the creation of mesh networks to cover large areas, offering stable and secure network formation controlled by an intelligent routing algorithm.
- Operation on multiple frequency bands using OFDM modulation
- Compatible with PLC-only and hybrid PLC+RF designs
- Provides extremely robust communication in single- and three-phase electricity meters, in streetlighting networks, and in wide area lighting control systems

R9A06G061

A high-speed narrowband PLC modem including a CPU based on a 92MHz Arm® Cortex®-M0+ core backed by 32kB of RAM.

Key features include:

- Optimized transmitter output for direct drive without the need for an external line driver
- Operates over AC and DC lines
- Conforms to the specifications of the G3-P2P-PLC industry standard
- Integrates all modem functions in a compact 6mm x 6mm QFN package. The Renesas modem reference design based on the R9A06G061, which has a small footprint of 30mm x 40mm, enables easy integration into system designs.
- Provides extremely robust communication in solar energy generation systems, smart building control systems, streetlighting systems, water heater systems, and central vacuum cleaner systems

## Wireless wide area mesh networking: Renesas Wi-SUN transceivers and SoCs

Renesas Wi-SUN transceivers and SoCs provide a complete solution for robust wide area mesh networking, supporting automated meter reading and many other applications.

R9A06G062GNP and RX65W-A

The R9A06G062GNP is a dual-mode Wi-SUN transceiver IC, and the **RX65W-A** is a dual-mode Wi-SUN wireless controller SoC. Both support the FAN 1.1 profile, and are supplied with a complete Wi-SUN protocol stack.

- Dual-mode capability:

  - OFDM modulation at up to 2.4Mbps
  - FSK modulation at up to 300kbps
- Support US/EU/JP/BZ frequency bands
- Support antenna diversity

RAA604S00 and RL78/G1H

The RAA604S00 is a Wi-SUN transceiver IC, and the **RL78/G1H** is a Wi-SUN wireless controller SoC. Both support the FAN 1.0 profile, and are supplied with a complete Wi-SUN protocol stack.

- FSK modulation at up to 300kbps
- Renesas supplies a high-performance reference design, which includes a high-power RF amplifier, RF switch, DC-DC converter, power regulator, RF transceiver, and MCUs.
  - The RF subsystem can be replaced with high-power components to increase range and performance

## Short-range wireless connectivity adds value to infrastructure applications

Where a smart infrastructure application requires an internet connection, the most direct solution is to connect to an existing router or access point. A typical application is a home EV charging wall box, which requires an internet connection to enable communication with an electric utility that implements dynamic pricing.

In this use case, the Wi-Fi system requires excellent RF performance to allow for the wall box to be sited at a long distance from an access point, with a signal potentially strongly attenuated by masonry and by interference from the multiple other Wi-Fi devices in the home.

DA16200

Featuring Renesas' unique VirtualZero™ low-power technology, the **DA16200 SoC** is a fully integrated wireless networking device that implements the Wi-Fi 802.11n technology. Matter-ready, it is supplied with a complete Wi-Fi protocol stack for use in stand-alone mode or with an external host controller.

The DA16200's outstanding RF performance provides for reliable connectivity over a long range and in the presence of interference from other Wi-Fi transmitters.

VirtualZero™ technology offers four sleep modes, including an unconnected mode which reduces operating current to nanoamp level. Ultra-fast wake-up gives a fast response to user inputs and enables a fast return to sleep mode to save battery power. This is especially useful in applications that require long intervals between battery replacements. It also enables compliance with energy efficiency regulations for wall-powered products such as EU 801/2013.

Based on an Arm Cortex-M4F CPU core, the DA16200 supports a wide set of security functions, including hardware cryptography, TLS and WPA3 Wi-Fi security, and over-the-air updates.

The SoC is also supplied as a module with the part number DA16200MOD.

Superior Renesas Wi-Fi technology is available in the DA16600, a dual-mode Wi-Fi/Bluetooth Low Energy SoC.

DA14531

Smart infrastructure systems of various kinds can implement Bluetooth connectivity to provide a simple, convenient connection to a user's smartphone. This can support simple, convenient pairing to a device, for instance to download diagnostic information to support repair and maintenance, or to download firmware updates to the device.

For low-power Bluetooth Low Energy connectivity, the **DA14531** is an ultra-compact and very low-power radio IC. Using the DA14531, a complete Bluetooth Low Energy system can be realized with the addition of just six external passive components, and a crystal timing device. It is supplied in a 2.0mm x 1.7mm or 3.0mm x 2.2mm package.

## Renesas Customer Success Stories

### Famoco Touch: soft PoS based on Renesas PTX130R


Famoco is a France-based manufacturer of mobile devices and terminals which provide multiple functions for enterprise applications. Famoco products based on the Android platform can accept contactless payments, enrol new customers, track shipments, and scan transport tickets.

The Famoco Touch is the company's latest mobile terminal, a more powerful, ergonomic, and affordable terminal for businesses looking to optimize their field operations.

In the design of the Famoco Touch, the company's developers faced various challenges, in particular the software integration, and the design of the antenna to operate behind the device's large display.

Famoco chose to use the Renesas PTX130R NFC reader after conducting thorough tests and market research. Benoit Ravier, Chief Commercial Officer of Famoco, says: *'At Famoco, we are convinced that soft PoS technology is disrupting the payment world well beyond consumer smartphones. That is why we have chosen to rely on the best-in-class NFC performance of the Renesas PTX130R, powering our new Famoco Touch terminal with features including Tap-to-Phone, Apple VAS, and Google Wallet support.'*

The PTX130R includes the latest Renesas Android Integration Stack (AIS) software, which enables soft PoS functionality on the Android platform. In addition, the PTX130R offers superior NFC performance including extended read range and easier integration of the antenna into the host device, as well as a reduced bill-of-materials.

## Hexing: smart meter implements power line communication based on Renesas modem


Hexing, a manufacturer of electrical equipment and products for power utility companies, has developed an Advanced Metering Infrastructure (AMI) system that uses Power Line Communication (PLC) technology based on a Renesas PLC modem.

The Hexing AMI smart meter, which complies with the requirements of the G3-PLC/G3 Hybrid communication standards, features the Renesas R9A06G037, supplied in the RTK0EE0003D01002BJ, a CPX3 solution for PLC connectivity. Each smart meter's CPX3-based PLC module allows data to be sent to a data concentrator over the utility's power cabling. This enables data collection and remote management of the smart meters.

Hexing selected Renesas as the supplier of its PLC transceiver because of its expertise in PLC implementation and ease of integration based on the CPX3 solution. Mr. Lin, Director of the IoT Application Product Line at Hexing, said: *'The mature, proven CPX3 solution from Renesas helped us to quickly and smoothly carry out product development. In addition, thanks to the strong support from the teams at Renesas and our substantial investment in product development, our products can be swiftly deployed in the field, achieving excellent performance in our AMI offerings.'*

# Get started with Renesas Connectivity Solutions the easy way: Winning Combinations

Users of Renesas Connectivity Solutions can simplify the product development process and accelerate time-to-market by starting projects with a Winning Combination: this is a pre-tested reference design architecture for specific applications and use cases. Various Winning Combinations are suitable for connectivity solutions that support smart infrastructure applications.

### Wi-SUN Winning Combination:

The JP202-EVK is a complete development kit for implementing a system to wirelessly transmit either stored still images or captured data from a camera and temperature/humidity sensor over a Wi-SUN wireless link.

This Winning Combination implements the Wi-SUN link with a pair of QCIOT-000-CWXPOCZ RF modules based on the R9A06G062GNP Wi-SUN transceiver IC.

The JP202-EVK also includes:

- One camera sensor kit (JP202-CWXCAMPOCZ)
- EK-RA6M3 microcontroller evaluation kit for transmitting images and data from the cameras and the temperature/humidity sensor
- EK-RA6M3G MCU evaluation kit for receiving images and data and displaying them on an LCD screen.

### PLC Winning Combination for smart lighting:

The JP167-PLCDCPOCKITZ kit enables quick prototyping and demonstration of an LED lighting system controlled by Power Line Communication (PLC) over a DC power line. PLC reduces the amount of wiring needed in a system, lowering installation cost and effort.

The Renesas PLC solution provides flexibility to choose the protocol and frequency band for various countries. The distance between nodes can stretch to more than 1km without a relay.

Communication speeds up to 1Mbps are supported, and an AES-128 cryptographic hardware engine provides for high-level security.

The kit consists of:

- JP167-PLCDCREFZ DC-PLC module board based on the R9A06G061GNP PLC modem – this connects to DC power lines for both the power supply and communication
- JP167-LEDAPLEVZ application board to demonstrate control of two LED illumination bars over a PLC link provided by the DC-PLC module board
- RTG0EE0007Z07001BJ filter board for noise rejection and to enhance the impedance of the power supply line

Users can add sensors or controllers via a Pmod™ connection for other PLC applications.

## Metered EV charging station: Winning Combination

This EV charging station design is suitable for connected consumer or business electric vehicle (EV) chargers.

Its modular approach enables a variety of connectivity solutions, including Wi-Fi and Bluetooth via a DA16600 combination Wi-Fi/Bluetooth module. The design also supports PLC communication via an R9A06G037 or R9A06G061 modem, as well as Cat-M1 LTE. It also offers the option to add interfaces such as Ethernet or MODBUS.

A PTX100R NFC reader allows for customized billing and access control. Power consumption can be monitored in a standard AC power environment through a modular metrology solution which also supports load balancing and safety features.

The design supports both single- and three-phase chargers.

## Mobile point-of-sale terminal: Winning Combination

This highly integrated and secure mPoS terminal design supports both contactless payments made via a PTX130R reader for NFC wireless communications, as well as contacting payment card transactions.

The design implements local area wireless connectivity using the DA16600MOD module for Bluetooth and Wi-Fi communication. Based on an RZ/G2L microprocessor, the mPoS design also includes a thermal printer driver for printing receipts. It operates at low power to extend usage time on a battery power supply.

Security features such as anti-tamper, secure boot, and authentication provide confidence in the integrity of transactions. The terminal supports USB Type-C® wired charging and Qi-compatible wireless charging.



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