LoRaWAN®

What are LoRa® and LoRaWAN®?

Together, LoRa and LoRaWAN create an IoT platform optimized for solution longevity, robust wireless data transmission and reduced infrastructure costs. LoRa, short for Long Range, is a wireless, RF technology that provides long range, bidirectional communication with the flexibility to support advanced metering and a variety of Smart Water and Smart City devices. LoRaWAN is an open-standard networking protocol that leverages LoRa modulation and ensures interoperability of devices in public and/or private LoRaWAN-based networks. Because the LoRaWAN standard is open, LoRaWAN-based networks can support an ecosystem of devices that is growing rapidly.

What is the LoRa Alliance®?

The LoRa Alliance is a non-profit association consisting of industry-leading companies that develop the LoRaWAN open-standard to promote adoption of LoRaWAN networks across the globe. Neptune's participation in the LoRa Alliance enables a future proof standard that will support water utility needs, allowing the utility to benefit from the combined effort of the LoRa Alliance members.

What are the key benefits of LoRa and LoRaWAN for Smart Water AMI?

- Long range communication reduces the number of gateways required for coverage
- Low power requirements support a 20-year endpoint battery life
- Two-way communication provides time-synchronized hourly readings
- Utility focused AMI network enables solution longevity and flexibility
- Protects meter data with robust end-to-end network security
- Strong support from the LoRa Alliance ensures a future proof protocol

Is LoRaWAN a private or public network?

LoRaWAN is a network standard, and there is no single LoRa network. The LoRaWAN standard has the flexibility to support public networks (i.e. owned, operated, and used by various third parties) or private networks (i.e. owned, operated, and used by only the utility) and a variety of options in between. Neptune's LoRaWAN-based AMI network offerings include Network-as-a-Service (NaaS) and utility-owned network options.

- **NaaS**, similar to a cellular network, provides LoRaWAN-based AMI connectivity without requiring the utility to build, own, and operate the network infrastructure. Like a cellular network, other devices may utilize the same infrastructure for connectivity, and the utility's data is kept private and secure through LoRaWAN' s standard end-to-end cryptographic protections.
- **A Utility-owned LoRaWAN network**, like a traditional fixed network, can be deployed as a private AMI network owned by the utility. This gives the utility control over the AMI network with the option to add additional Smart Water or Smart City devices to the network in the future, if desired. Unauthorized devices will not be able to use the utility's AMI network. Additionally, Neptune's optional AMI services offering allows the utility to own the AMI network without having to operate and maintain the network infrastructure.

What will happen to my AMI system if LoRaWAN becomes obsolete?

LoRaWAN is continuing to grow rapidly and progress toward widescale adoption globally. According to the LoRa Alliance, over 173 network operators offer LoRaWAN connectivity with LoRaWAN private and public network deployments in 181 countries as of March 2023. This includes over 270 million LoRaWAN end-devices and gateways in service. Additionally, the number of LoRaWAN networks available globally has grown by 66% over the past three years.

As a standard optimized for long-term battery powered devices, LoRaWAN enables Neptune to provide a future-proof solution, whether the network is utility owned or provided through NaaS. In the unlikely event that the LoRaWAN ecosystem participation declines, Neptune and/or the utility will be positioned to continue operating and utilizing the deployed network infrastructure for its expected life to continue achieving the benefits of AMI.

How secure is LoRaWAN?

Unlike many other protocols which take a "bolt-on" approach to security, the LoRaWAN protocol is secure by design. LoRaWAN uses well vetted cryptographic algorithms and best practices, approved by the National Institute of Standards and Technology (NIST), to ensure confidentiality and integrity for all transmitted data. This includes security controls such as mutual authentication between the LoRaWAN network and endpoints, end-to-end encryption, integrity protection, and replay protection.

How does the LoRaWAN network protect endpoint data from end-to-end?

The LoRaWAN protocol uses AES 128 cryptography in CMAC mode for integrity protection and CTR mode for encryption which is NIST approved per NIST SP 800-131A. Each LoRaWAN device is personalized with a unique 128-bit AES key and a globally unique identifier (EUI-64-based), both of which are used during the mutual authentication process to ensure that endpoint and LoRaWAN network are authentic. All LoRaWAN traffic is encrypted and integrity protected using two different 128-bit AES session keys derived during the authentication process. Each payload is encrypted by AES-CTR, employs a frame counter, and includes a message integrity code computed via AES-CMAC. These protections ensure that the data cannot be viewed, replayed, or altered from the endpoint to the LoRaWAN network servers.

How many devices can a typical LoRaWAN network support?

LoRaWAN is designed to be highly scalable to support massive numbers of devices using a variety of techniques. First, LoRa utilizes an innovative RF transmission scheme called Chirp Spread Spectrum (CSS) which provides longer range and reduced effect of RF interference. Additionally, LoRaWAN networks optimize the transmissions of connected devices to reduce self-interference and improve battery life. Finally, LoRaWAN gateways utilize many different RF communication channels, with separate frequency spectrum for uplink and downlink transmissions. These features enable a typical LoRaWAN gateway to be capable of supporting more than 50,000 in-range devices.

What types of devices does LoRaWAN support?

Advanced Metering Infrastructure (AMI) is a key use case for LoRaWAN, which benefits from LoRa's long-range and low power consumption, resulting in high reading performance at a lower total cost of ownership for the AMI solution. LoRaWAN also provides the flexibility to support a variety of Internet of Things (IoT) device types such as Smart Water and wastewater sensors, 4-20mA devices, IoT edge gateways, smart lighting, smart parking, security, and asset tracking.

How reliable is the LoRaWAN Network?

Like any other network, a public or private LoRaWAN network is only as good as the components used in the network and the effort put into monitoring and maintaining it. Whether a NaaS or utility-owned network is provided, Neptune only utilizes best-in-class LoRaWAN gateways with UPS battery backup, engineered to withstand harsh environments and meet the utility's needs for a reliable AMI network. Neptune's AMI Services and NaaS offerings ensure that the network is properly operated and maintained, allowing the utility to focus on the critical work of water.

What battery life does LoRaWAN support?

LoRa transmissions and the LoRaWAN protocol are designed to support long-term battery-powered end devices such as AMI endpoints. Leveraging this technology, Neptune's R900® System LoRaWAN endpoint can achieve a 20-year life expectancy.

What compatible Smart Water or Smart City sensors are available for a LoRa® network and Smart City initiatives?

Since the LoRaWAN protocol is an open-architecture standard, there are a variety of devices that can operate on a LoRa network. Please see the LoRa Certified Product website (https://lora-alliance.org/showcase) for a directory of available products.

Will the growth of LoRaWAN and other similar technologies cause the 902-928 MHz ISM band to become saturated?

Federal Communications Commission (FCC) regulations limit the transmit power, transmission on-time, and channel/frequency usage which enables massive numbers of ISM band devices to coexist successfully. This has enabled technology to be developed and deployed in the ISM band for decades without the band becoming saturated, including Neptune's R900 System, which has been deployed for over 20 years with no documented cases of wide scale interference.

How do LoRa and LoRaWAN technology mitigate interference in the 902-928 MHz ISM band?

LoRa Chirp Spread spectrum technology has been proven to be able to successfully deliver transmissions at power levels below the noise floor, enabling robust performance in the presence of RF interference. Additionally, LoRaWAN devices, such as the Neptune's endpoint, use frequency hopping spread spectrum and the built-in self-optimization features of the LoRaWAN protocol to avoid interference within the band.

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