How System Integrators and Developers Can Implement Affordable, Secure LoRa IoT Solutions Quickly

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The IoT Hardware Enabler

Executive Summary & Table of Contents

IoT projects involve the development and integration of many different layers of technology and data transformation. Today's developers can build and deploy these projects faster (and more affordably) with ready-to-use IoT hardware and software.

Ready-to-use LoRa sensors and gateways provide significant advantages in power consumption, range, and ease of deployment that when paired with ready-to-use IoT software can enable developers and system integrators to deploy affordable, secure, field-ready projects in days versus weeks and months.

The IoT Development and Deployment Model

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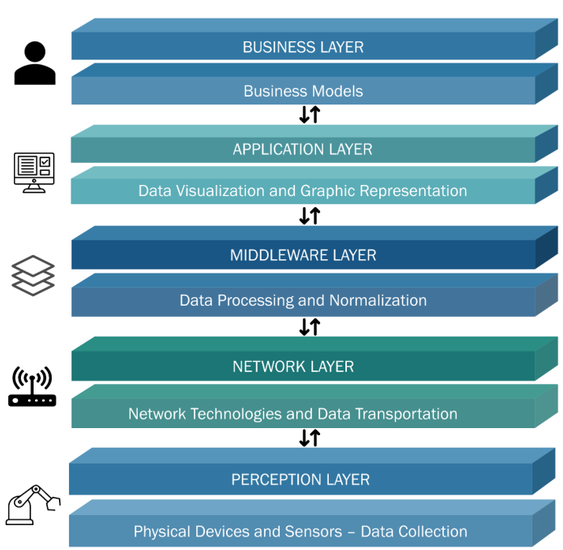
THE IOT DEVELOPMENT AND DEPLOYMENT MODEL

The IoT Project Development and Deployment Model

IoT projects involve a number of components that must be integrated together and deployed (Figure 1) alongside machines and people who do the work:

FIGURE 1: IOT DEPLOYMENT MODEL



- **Perception Layer:** is the physical layer, which has sensors for sensing and gathering information about the environment. It senses physical parameters (e.g. temperature, light, humidity, air quality, power, etc.) or identifies other objects (people, things, devices) in the environment.
- **Network Layer:** consists of network connectivity hardware (gateways, servers and embedded computers) that is responsible for connecting to other smart things, as well as transporting raw sensor data. It is sometimes referred to as the Transport Layer.

- **Middleware and Application Layers:** includes software that processes and normalizes raw data, as well as software that allows for processed data to be visualized, monitored, managed and stored.
- **Business Layer:** manages the whole IoT system, including end-user and vertical-specific applications, business and profit models.

In addition, today's IoT developers must also address key enterprise concerns, which include:

- Data privacy, security and control
- Integration with existing systems and projects
- Power consumption and range of the IoT network
- Time and cost of development and path to ROI
- On- going maintenance and technical support requirements and costs
- Scalability and expandability of IoT systems

The Perception Layer: Build Custom or Go Ready-to-Deploy?

Developers have two choices when it comes to the perception layer:

- Develop custom sensors; or
- Leverage the growing number of ready-to-deploy IoT sensors

Building custom sensors require many different technical areas of expertise and components, including but not limited to:

- Hardware engineering
- Mechanical engineering

- Firmware development
- Testing
- Hardware and communication protocol certifications

Bottom line? For developers this can add up to a lot of upfront hard and soft costs, including specialized technical expertise …even before a project is won. In addition, developing a custom solution puts all the responsibility of providing technical documentation, support, updates, certifications and warranties on the developer or system integrator, which can add on-going costs that can easily consume a developer or system integrator's profitability.

Ready-to-deploy IoT sensors provide several advantages for system integrators and developers, as well as their customers:

- More than 80% of IoT project applications involve monitoring – environmental conditions, asset status, or power consumption, either in a local or remote setting. Today's ready-to-deploy IoT sensors can address most of these requirements
- Reduces the need for vendor lock-in and allows for easier expansion of IoT deployments as they grow and expand
- Ability to go to market faster and develop field-ready proof of concepts
- Reduce the need for additional technical resources and costs associated with maintaining hardware, firmware, and certification updates

The Networking Layer: Why LoRa is Increasingly the Preferred Choice for IoT Deployments

Today, there are a wide range of sensor communications technologies that exist: Wi-Fi, Bluetooth, cellular, etc.; each has advantages and disadvantages (Figure 2). Some key considerations when looking at technology options for the networking layer are:

- Power consumption
- Geographic range
- Infrastructure cost
- Security
- Appropriate throughput and latency
- Ease of deployment

For the majority of industrial and commercial IoT applications – where high data throughput and low latency is not needed – LoRa is increasingly emerging as the best solution. As of 2021, Semtech reports that there are 191 million LoRa end-node devices in service and industry reports project LoRa device adoption growing between 47-100% CAGR through 2027. (1)(2)

FIGURE 2: COMPARISON OF POPULAR WIRELESS TECHNOLOGIES

Technology	Bandwidth	Distance Range	Max Data Rate	Power Consumption	Latency
Bluetooth	2.4000-2.4835 Ghz	up to 100 meters	3 Mbps	1 W/ <30mA	100 ms
Bluetooth - Low Energy	2.4000-2.4835 Ghz	>100 meters	2 Mbps	.01-.5 W/<15mA	6 ms
Cellular - LTE	450 Mhz-37	Global	up to 1 Gbps	up to 3 W	100 ms
LP-Wan: LoRa	125 and 250 Khz	5 km (urban); 20 km (rura	50 Kbps	.1 W	1 sec
LP-Wan: Sigfox	100 Hz	0 km (urban); 40 km (rura	100 Kbps	< .2 W	1-30 sec
LP-Wan: NB-IoT	200 KHz co-exists with LTE bands	1 km (urban); 10 km (rura	200 Kbps	< 0.5W	5 sec
Wi-Fi	2.4 Ghz and 5 Ghz	up to 100 meters	1.3 Gbps	1 W	< 20 ms
Wi-Fi HaLow (802.11ah)	900 Mhz	up to 20 km	< 1 Gbps	.5 W	< 20 ms
Zigbee	2.4 Ghz	10-100 meters	250 Kbps	< 100 mA	< 20 ms

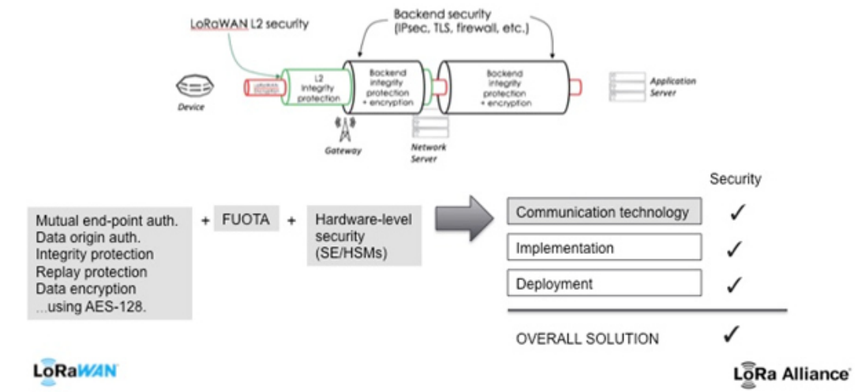
LoRa is an attractive network connectivity choice for many developers and system integrators working on IoT projects for several reasons:

- **Low power consumption.** With battery life measured in years, LoRa can be easily deployed in remote or outdoor locations and require minimal maintenance.
- **Wide geographic range.** LoRa can support deployments over a wide range of distances, including as far as 10 kilometers or more (depending on topography, power output, antenna types, etc.). Even in dense environments, LoRa's range far exceeds that of WiFi or Bluetooth.
- **Lower infrastructure cost.** Because of its range, LoRa requires far fewer gateways to cover a given area when compared to WiFi. Cellular improves on this range but has significant recurring costs. Since LoRa uses ISM bands, there are no licensing fees. This all adds up to lower costs.

- **Enhanced security.** With two layers of cryptography on both end-node and gateway devices, LoRa provides enhanced security (Figure 3). As discussed later in this white paper, when deployed as a Private LoRaWAN network license-free environment, security is further enhanced as the data is on the customer's equipment unless they explicitly send it elsewhere (unlike with a Public LoRaWAN network).

FIGURE 3: LORAWAN SECURITY

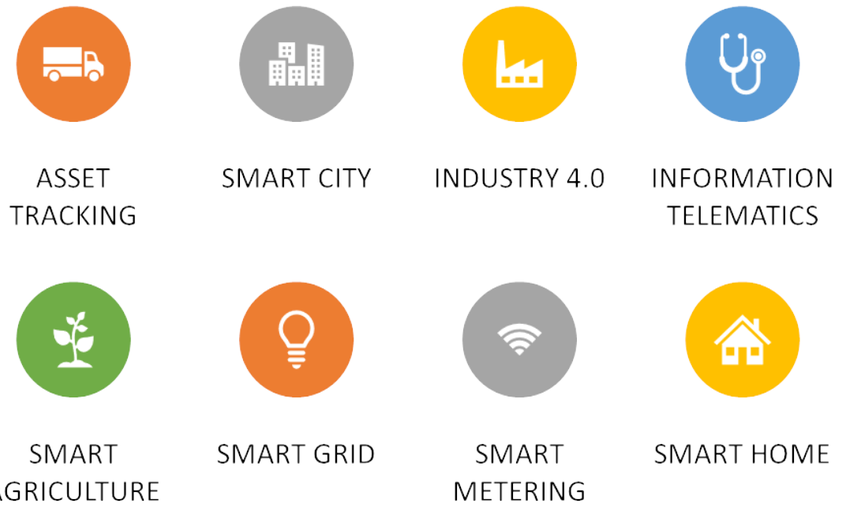
(Source: LoRa Alliance)



With low power consumption, a wide geographic range, low infrastructure costs and enhanced security features, LoRa has over the past several years ncreasingly become a preferred networking option for many IoT projects (Figure 4).

The IoT Project Development and Deployment Model

FIGURE 4: LORA IOT USE CASES



The Middleware and Application Layers: The Rough First Mile of Software for Every IoT Project

For developers, much of the challenge in building and deploying IoT projects isn't visible to end users. Developing software that can transform raw data from the sensors and actuators at the edge to normalized data that can be visualized and acted upon in the application and business layers is both time consuming and technically complex.

Many projects involve a combination of legacy and new devices and sensors that are built:

- By different manufacturers
- Using different interfaces
- With or without a data display
- On proprietary or different protocols
- Using different data formats

Integrating data from all these pieces requires that developers incorporate software to transform data in the networking, middleware and application layers that can:

- **Decode device and sensor data** -regardless of protocol or format
- **Label, normalize, transform and cleanse data** so that it can be visualized, integrated and accessible to users and business applications
- **Enable rules engines to monitor and manage data:**
  - What data is relevant
  - What data can be acted upon immediately at the local level (and how)
  - Who and what applications should have access to specific data and when
  - What data should be stored and for how long
- **Perform local data analytics and calculations**

The IoT Project Development and Deployment Model

Other considerations may include:

- How future sensor and devices can be integrated into the IoT project or network
- How to minimize rip and replace of a customer's existing IoT or machine network

Today's developers and system integrators have two options when it comes to building this rough "first mile":

- Invest significant time, technical and financial resources to create a customized solution for each project; OR
- Leverage ready-to-use, no code IoT software to quickly configure and deploy IoT projects faster

Ready-to-use, no code IoT software, like Machinechat® JEDI One, provides several advantages to developers:

- Reduced time and cost to develop field-ready proof of concepts
- Reduced time-to-deployment or go to market
- Reduced on-going maintenance and support costs
- Ease of integraton and configuration with new and existing sensors and devices
- Reduced cloud data processing costs

SIMPLIFYING IOT WITH THE READY-TO-USE LORAWAN PRIVATE NETWORK

READY-TO-USE LORAWAN PRIVATE NETWORK

As discussed earlier, leveraging ready-to-use IoT sensors, software and LoRa can enable developers to address a wide range of commercial IoT use applications and more importantly, build and deploy field-ready projects quickly. When it comes to building and deploying a LoRa-based IoT project, developers and system integrators have three deployment options:

- Public
- Private
- Hybrid (Public & Private)

While there are circumstances when having a large public network of LoRa gateways and a “sensor-to-cloud” solution is necessary, there are many commercial use cases where it is undesirable and/or unnecessary for data to be passed through unknown gateways or to the cloud, where security may or may not be properly implemented.

Private or on-prem LoRa networks provide several advantages, including but not limited to:

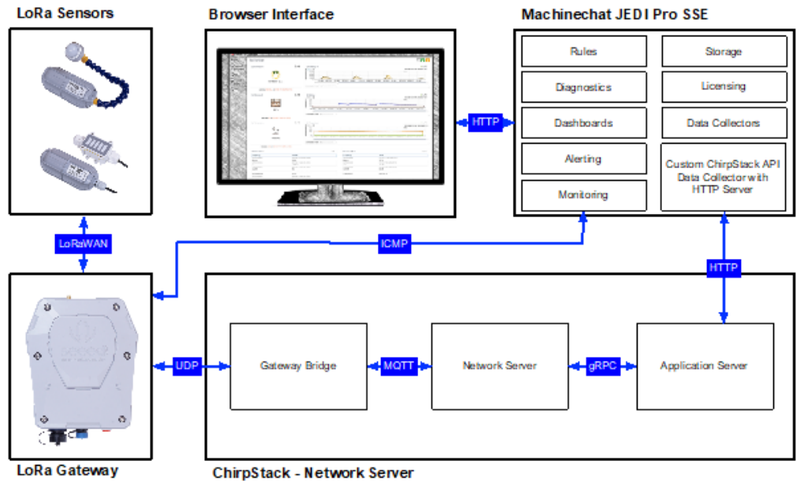
- Network location exactly where you want it
- Network built and operational exactly when you need it
- Single network that does not require sharing with other networks and complete control of traffic, meaning end-users also have control over who has access to data.
- Enhanced application flexibility - not being constrained by network operator imitations

Of course, creating a private LoRa network can provide its own level of complexity and details that can be challenging. This includes:

- Sensor selection and deployment
- Gateway selection
- Configuration and installation (including antenna selection, site survey, power sources, etc.)
- Setup of the LoRaWAN network server including hardware selection and installation
- LoRaWAN network server software selection, installation and configuration
- Selection, setup and configuration of IoT applications software

Utilizing ready-to-use LoRa gateways and no-code IoT software (such as Seeed Studio’s industrial SenseCAP gateways and Machinechat JEDI Pro software - see Figure 5) can reduce the complexity required for developers to build a field-ready private LoRa project and reduce the time required to a few days (versus weeks).

FIGURE 5: PRIVATE LORAWAN DEPLOYMENT



READY-TO-USE LORAWAN PRIVATE NETWORK

Conclusion: Accelerate the Path to IoT ROI Faster and Grow Your Business

Both developers and their customers benefit from accelerating the path from IoT idea to field-ready project by using the Ready-to-Use LoRaWAN Private Network model. These include:

- Lower overall development and deployment costs
- Enables developers to focus more development time and resources on business and user-facing applications and processes that bring the most benefits to the customer (versus getting bogged down in the “rough first mile” of middleware and application layer development)
- Delivers local control over data and reduced cloud data processing costs
- Enhanced data privacy, control and security
- Easier integration with existing systems and applications
- Path to expansion as needs change without the need to build custom hardware or software
- Reduces complexity and costs of maintenance and support by using hardware that can be readily purchased off the shelf

RESOURCES

FOOTNOTES & REFERENCES

(1) https://blog.semtech.com/lora-is-solving-real-world-challenges

(2) Multiple sources, including:

- Global LoRaWAN Market- Segment Analysis, Opportunity Assessment, Competitive Intelligence, Industry Outlook 2016-2027 (2019) https://inforgrowth.com/report/4946697/lorawan-market
- https://blog.semtech.com/lora-technology-lorawan-mass-adoption-key-takeaways-from-amm)

(3) https://lora-alliance.org/resource_hub/lorawan-is-secure-but-implementation-matters/ and https://pages.services/pages.lora-alliance.org/lorawan-private-networks/?ts=1607123605468

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AUTHORS

About Machinechat

Headquartered in San Jose, California, Machinechat's mission is to be the leading supplier of IoT data management solutions that dramatically reduce the cost and time spent developing and deploying IoT projects. Leveraging software-defined networking principles, Machinechat's easy-to-use and affordable solutions enable IoT solution architects, developers and networking OEMs to quickly add data collection, processing of streaming data, data monitoring, and policy-based data management to their products and solutions. Machinechat is the developer of the JEDI One and JEDI Pro software solutions. Learn more at www.machinechat.io

About Seeed Studio

Seeed provides the latest open hardware for IoT, AI and Robotic systems, and helps developers scale new applications. Founded in 2008, Seeed is based in Shenzhen with branch offices in the EU, US, and Japan. By partnering with top tech providers, we speed up the application of new technologies across industries. By enabling global developers to solve real-world problems, we encourage collaboration for a sustainable future. Visit www.seeed.cc for more information.