



Choosing an IoT Gateway Prototype Solution

Gateways play a critical role in IoT applications as they typically manage end devices in a complex environment, collect and analyze data from these devices, and communicate aggregated data up to the cloud. Determining how to apply these requirements for your specific IoT use case is undoubtedly an important first step. And, one that most people take by prototyping an IoT gateway solution.

At Rigado we are often asked about the best approach to IoT gateway prototyping and even more specifically, if Raspberry Pi or another solution is the best starting point. In our experience, the answer depends in part on your particular use-case and business landscape. In this paper, we will analyze the pros and cons of various IoT Gateway prototyping approaches - with the common goal of scalable, cost-effective mass production in mind.

The Goal: Cost-Effective Connectivity at Scale

The end goal for most organizations is a production-ready IoT gateway that can be easily installed and used at scale across the environment. Whether used in a retail, transportation, agricultural or other setting, the gateway should effectively serve as a single point of contact for your field devices - filtering, aggregating, and pre-processing device-specific data before communicating it in turn to the cloud.

In determining your specific IoT prototype approach, it is important then to bear in mind:

- Power requirements
- Connectivity needs
- Any exterior and/or appearance-related requirements

Each of these elements requires consideration as you work from your end goal backward to the device you use to prototype your solution.

Raspberry Pi Pros and Cons

Raspberry Pi can be a great prototyping option and one that we see many people choose. It has a strong community and basic connectivity at a decent price - and for these reasons can be a good way to start an IoT Project. However, to see if Raspberry Pi is right for you, let's examine the three requirement areas we listed above to see if Raspberry Pi's capabilities map to your needs.

Power

Power can be a critical consideration for your IoT gateway, especially as many commercial buildings today use Power of Ethernet (PoE). Installing Ethernet cabling to a ceiling tile is considered a "low voltage" installation and as a result, simplifies installation and reduces cost as PoE is less expensive than wiring in an outlet.

With this infrastructure already in place, it is likely very easy to install an IoT device that utilizes PoE and as such is an important design consideration. Unfortunately, Raspberry Pi does not offer PoE as an option. However, this can be mitigated by adding a PoE adapter.

Take-away: Don't let the Raspberry Pi's lack of PoE keep you from evaluating that option.

Connectivity

The Raspberry Pi 3 has both WiFi and Bluetooth built in which is great for IoT projects. However, this can pose an issue if you try to stream too much data as the two radios will compete for time on the air. For example, if your project is supposed to be scanning Bluetooth Low Energy (BLE) for nearby devices that are advertising sensor data or location information, your system will effectively be deaf every time the WiFi radio sends a packet to the cloud. An Internet of Things device wouldn't be too useful if it didn't talk to the Internet, right? And it wouldn't be useful if talking to the Internet ruined its ability to communicate with the Things.

Conversely, if your use case requires cellular connectivity, using Raspberry Pi means you'll need to plug in a USB modem or make a special daughter card. A daughter card will also be required if you need BLE 5.0, Thread, ZigBee or another proprietary mesh protocol. This obviously requires additional engineering and the eventual manufacturing of the daughter card.

Take-away: Raspberry Pi may not be your best choice if your situation requires significant data streaming. However, don't let Raspberry Pi's lack of cellular or mesh support dissuade you from it outright.

Appearance

Many use cases require the IoT gateway to have a professional-looking exterior. Can you imagine the Raspberry Pi with its open plugs, connectors and motherboard at your local restaurant or retailer? Luckily, the popularity of the Raspberry means that enclosures are easy to find, (though most are intended for hobbyists who just want to protect the electronics or even show off the circuits with clear acrylic).

In our experience working with companies across industries, they want an IoT gateway enclosure ready for commercial deployment. That is, one that has a sleek appearance, includes design elements for cable management, and has wall or ceiling mounting options for their IT installers.

Take-away: The final gateway product will likely need a custom enclosure, which should be factored into the Raspberry Pi prototype to production process.

Raspberry Pi	Pros	Cons
Support	Strong community with good support.	Community consists of hobbyists, students and professionals making it harder to find answers to specific design questions.
Cost	Reasonable price point.	Additional parts (e.g. expansion board, daughter card, etc.) can add to the overall cost.
Power	Powered by USB.	Lacks PoE
Connectivity	Basic connectivity with both WiFi and Bluetooth.	WiFi and BLE are both 2.4GHz and fight for air time.
		Cellular and mesh connectivity requires a daughter card.
Exterior Appearance		Exterior not included.

Production-Ready Gateway Pros and Cons

Another option when assessing your IoT gateway prototyping approach is to start with a production-ready IoT gateway. Using a solution that has been designed as a Commercial IoT Gateway rather than a hobbyist or educational device has its own pros and cons, which we'll help you map against your particular set of requirements.

Power

The advantage of prototyping with a production ready IoT gateway is that it comes equipped with commercial grade features that are in high demand, such as PoE. With so many commercial building spaces preferring PoE to simplify and reduce the cost of installation, you will be hard-pressed to find a commercial IoT gateway that is not equipped for PoE. An added benefit is that most wireless access points are powered by a switch that has a battery backup, so the IoT system using the same switch can still function even if the power goes out.

Take-away: Production-ready gateways typically feature multiple power options, giving you more flexibility.

Connectivity

Connectivity is where a commercial IoT gateway can really shine. For example, at Rigado we produce the Vesta, an IoT gateway that supports Ethernet, WiFi (2.4GHz & 5GHz), BLE 5.0 & 4.2, 802.15.4 for Thread and Zigbee, as well as giving users cellular connectivity options. All of this means that regardless of how much data you need to transmit, it will do so smoothly, without competition for time on the air.

In addition, leading commercial-grade IoT gateways may support other proprietary protocols, including mesh-based options. If you need to support a mesh protocol, choosing a production ready gateway will decrease the engineering resources needed to design and manufacture your gateway solution.

Take-away: With today's complex connectivity landscape, it's important to understand what options you require for the immediate solution, as well as future-proofing for the long-term.

Appearance

Commercial grade offerings will have a professional exterior appearance. They will be designed specifically for use in environments where looks matter and as a result, you will find that production ready IoT gateways are designed to conceal cables, and will as a matter of course include wall and ceiling mounting options. With these solutions, you can expect in most cases to be able to ship your gateways directly to your end-user customers where installers can simply open the box and add your gateway to the building.

Leading gateway providers will even enable you to customize the gateway's exterior, branding it with your company colors and more. Another consideration is that a production ready gateway can be customized to reflect your serial number nomenclature in the manufacturing process. This helps make the gateway easily become part of your company infrastructure, rather than accommodating a third-party approach.

Take-away: Commercial gateways make the process of moving from prototype to production easier with customizable exteriors ready for mass production.

Production Ready Gateway	Pros	Cons
Support	One throat to choke means you won't have to troubleshoot issues alone.	Yet, support can vary from provider to provider.
Cost	Some vendors, like Rigado, allow you to customize the gateway for your specific needs.	Too many options may mean you pay for what you don't need and/or won't use.
Power	PoE and backup battery options are available.	
Connectivity	Advanced connectivity with support for 2.4GHz and 5.8GHz WiFi, BLE, Thread, ZigBee, Cellular and more.	Consider a vendor that allows you to customize your gateway for your specific need to avoid paying for connectivity options you don't need.
Exterior Appearance	Sleek, sometimes customizable exterior suited for commercial spaces.	

Once you're happy with your prototyped solution, with a commercial IoT gateway, you can load your own Linux image with your edge applications at your own warehouse, or for a minimum order quantity (MOQ) you can often receive pre-loaded gateways direct from the vendor. You can get this all from one partner instead of working with a dozen different suppliers to create your gateway, and instead focus on the key differentiators that make your service or product better than the rest.

Transitioning from ‘Pi’ to Production

If you used the Raspberry Pi for your prototype and would like to move to a commercial grade gateway, you are not alone. At Rigado, we have seen several customers prototype with Raspberry Pi and ultimately move to a commercial gateway for a production run. This approach has several considerations:

Software Transition

Your programming language can impact how easy it is to move your prototype from a Raspberry Pi to a production gateway. If you are going to pursue this path, be sure to choose a language such as Node.js Javascript, Java or Python that is supported across hardware and migrates easily.

Radio

This consideration is important, but can luckily be quite straight-forward. For example, to run a ZigBee radio on the Raspberry Pi, you will need to hook up several wires that will plug into an expansion board. With the right chip embedded in your production gateway, serial port connections are already made.

Certification

As long as you are prototyping, you will not need to worry about certifying your solution. However, once you begin the transition from prototype to product, regulatory certifications will become a concern. If you were to take your Raspberry Pi prototype to production, you may be classified as an “intentional radiator” by the FCC. Although it is defined simply as any device that is deliberately designed to produce radio waves, the implications are not simple at all. In fact, as an intentional radiator, you are required to comply with CFR 15.249, which involves successfully passing hundreds of tests. Conversely, commercial IoT gateways are pre-certified and have been tested to meet all regulatory requirements, freeing you from the time and expense associated with compliance.

There are many considerations when deciding which path to take for your IoT Gateway prototype. Based on our extensive experience working with companies on their IoT gateways, we highly recommend starting with the end goal in mind, and working backward to find the right gateway for your needs. While the prototyping process is by its very nature iterative, revisions may be more easily addressed with a feature-rich production ready gateway, rather than the Raspberry Pi where you’ll need to source additional components—which can unnecessarily add resource-intensive complexity to producing a final product.

IoT has the potential to revolutionize business through cost savings, increased productivity and even new lines of business. Creating a prototype solution is a natural first step with the IoT gateway being a keystone as it allows you to take advantage of the data and business impact created by your end devices. A well-developed IoT gateway allows you to tap into the collective power IoT can have on transforming your business. As a result, it is important to choose wisely, starting with the strongest foundation possible for the best end results.

About the Rigado IoT Gateway

The Rigado IoT Gateway provides companies with a flexible gateway solution customized to meet their specific needs today, as well as future-proof connectivity options for the future. Each gateway starts with a powerful i.MX6 processor with local storage, which is ideal for Linux-based edge applications, and includes built-in support for popular cloud services. Rigado's Vesta IoT Gateway then offers a range of connectivity and configuration options, including:

- *Connectivity* – Customers can choose a Rigado IoT Gateway built with their specific combination of WiFi (802.11a/b/g/n), Thread or proprietary 2.4GHz, Bluetooth 4.2 Low Energy, and 10/100 Ethernet with PoE.
- *Components* – Companies can put exactly what they need inside the device, without paying for extras that they don't need and won't use. Configurable options include additional DDR, flash memory, a USB 2.0 port, an expansion bus for additional interfaces and much more.
- *Branded exterior* – Even the exterior casing of the Rigado Vesta IoT Gateway can be customized as Rigado offers the ability to manufacture the gateway with a branded color and company logo.

In addition to the included device management and firmware updating applications from Rigado, this Linux-based IoT Gateway can also run third-party and custom edge-applications, thanks to its expandable memory and storage. Additionally, customers may call upon Rigado professional services for custom design, development and integration.

About the Author

Justin Rigling, Co-Founder and Chief Technology Officer, Rigado

As CTO at Rigado, Justin has designed literally hundreds of wireless modules for every application imaginable, from bike computers to heavy industry to golf course watering sensors. Prior to co-founding Rigado in 2010, Justin was a design engineer at Garmin International. He specializes in low-power wireless systems, and holds a B.S. in Electrical Engineering from MIT.

Justin is invited to speak regularly at industry events and he is a member of the Bluetooth Special Interest Group. At 124 miles, he also set the Guinness book world record (alongside Rigado co-founder Ben Corrado) for the world's longest wi-fi connection.

For more info please contact us at: contact@rigado.com