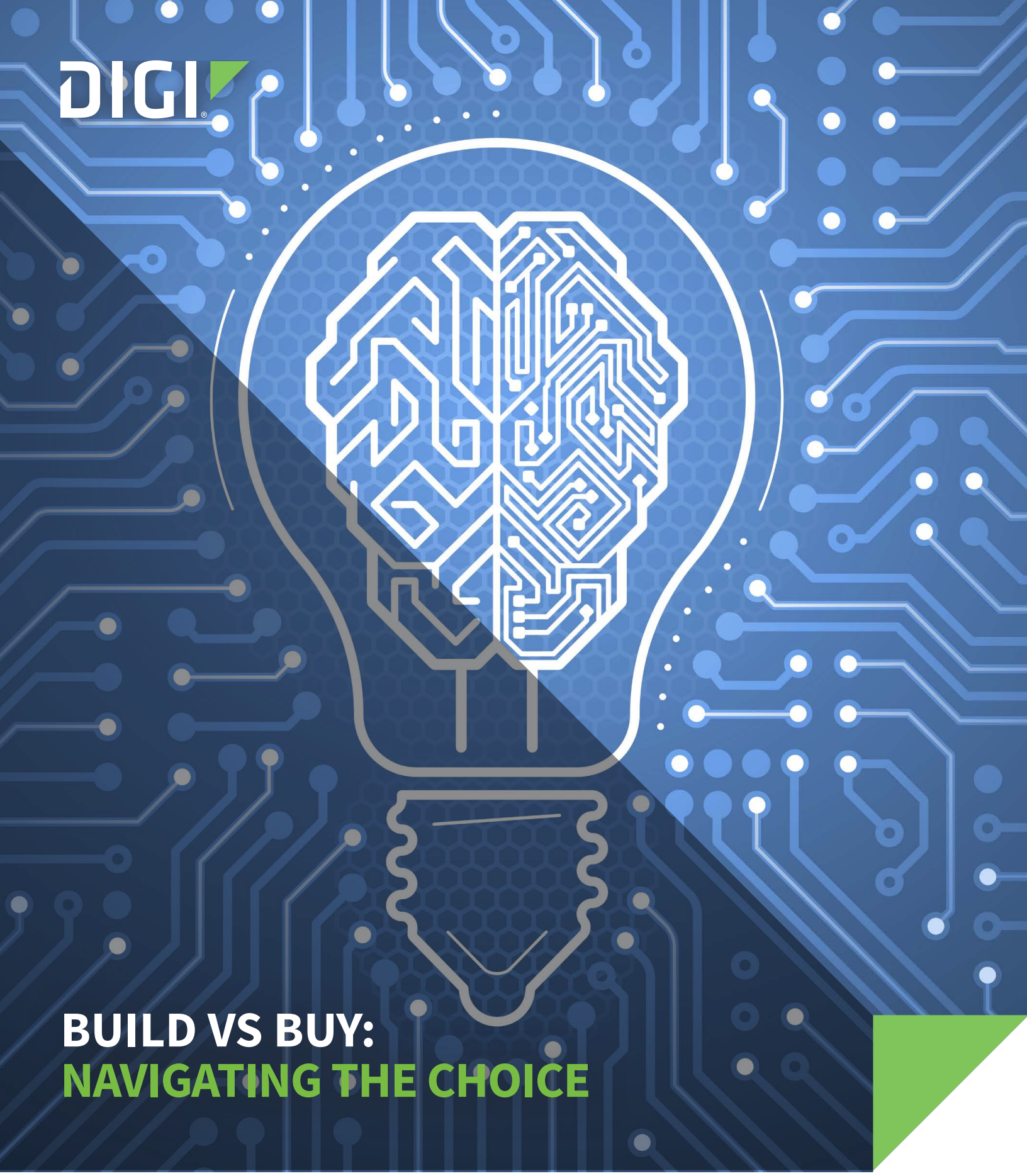
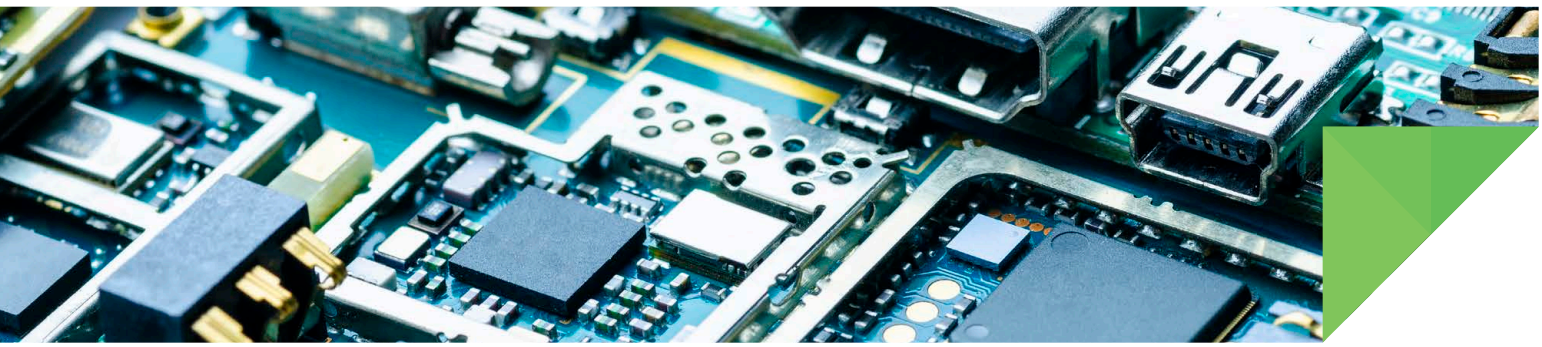


# BUILD VS BUY:
# NAVIGATING THE CHOICE



# Introduction

At some point in the process of planning the development of an IoT product design, many companies face the decision of whether to build or buy. Should you use a pre-made module or a chip-down solution?

The decision is often determined by the anticipated lifespan of the product, or the projected mass production volume. However, there are several other key factors involved in this complex equation. For example, do you have the time and resources to build from scratch? Will it get you to market within your desired timeline?

Assuming that you're not designing and building a one-off project, it is also important to ask this key question: What is your value-added intellectual property? The answer to that question is typically one or more of the following:

- You have developed a unique electronic PCB, built for performance.
- You have an innovative overall hardware design, from its connectivity to its integration, simplicity and sheer design elegance.
- You are particularly proud of your software and end-user experience — such as its porting, GUI, analytics capability and cloud connectivity.

In this white paper, we help you to evaluate the best way to optimize your IP and make the right build-vs.-buy decision to meet your goals.

# Modular vs. Integrated Design: Considerations

The idea that modular design is more expensive than an integrated design is usually unfounded or based on an incorrect understanding of modular design. When in-house technical expertise or bandwidth is limited, a modular approach might be the easiest and most economical way to solve this problem. A modular design can also help deliver the product on-time even with internal resource limitations.

**Things to consider:**

- **Engineering opportunity cost:** If your team is building a custom product, will it require resources that could be better spent on another project to grow your business
- **Technology debt:** You are responsible for the product you deliver to customers. For example, if it needs firmware updates or the outside environment evolves, it can cost multiple development cycles; that requires your team's time and impacts your company's bottom line now and for the future.
- **Timing advantage:** Time-to-market is often crucial for competitive advantage. Have you calculated the additional revenue if you could beat your competition to the market? A related calculation in the case of new innovations is higher product pricing for those first to market.
- **On-time NPI:** Meeting your timeline goals can be crucial for a number of reasons; a full PCB design is a lengthy process, just to get to systems test and certifications, which have their own timelines.

# Benefits of a Modular Design

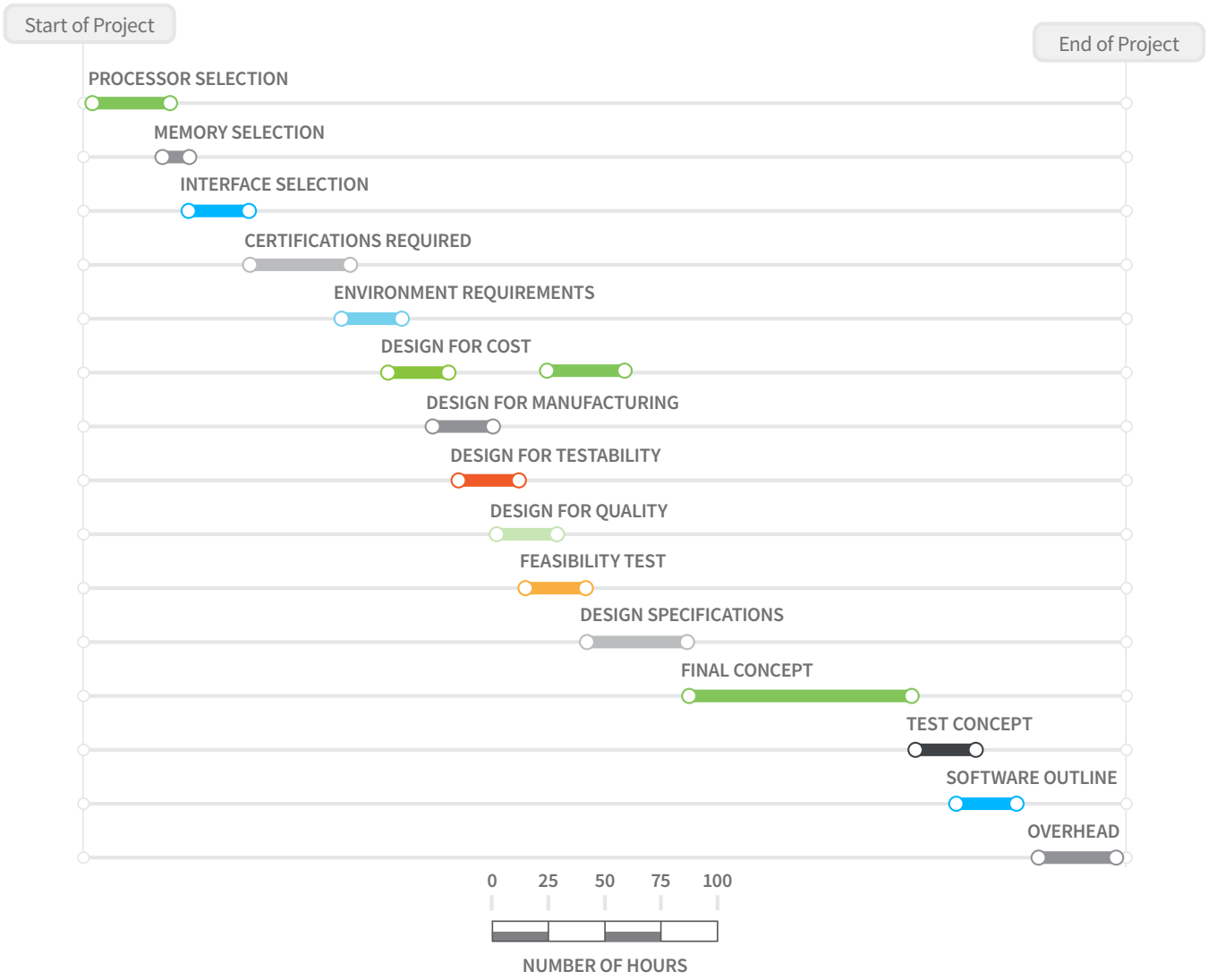
Individual steps in the design process show where a modular design is advantageous. The time saved using modular components can be the difference between viability and a project that won't see the light of day.

Consider these three factors:

- The processor or radio module is already completed and has already been tested (and pre-certified, in many cases, with Digi modules), and thus a crucial component of the hardware design is already available before starting the project.
- This makes it easier to design the application board. Some parts of that circuit can be deduced from the reference design in the starter kit, which allows the application board to be designed even more quickly and reliably.
- The key software drivers are delivered with the module BSP and are ready to be used immediately, so software development can start on day one since the target platform is already available.

As a result, real parallel engineering can take place. Performance tests are often necessary before a final design decision is made. This can be conducted with modules, reducing development time.

# Integrated Design Timeline




Direct cost graph: Engineering time is always costly; your engineering team will have to design, test and verify your hardware design, and write code.

The circuit board is a significant cost factor. The circuit board configuration is always determined by the most complex switching or structural element. For example, an ARM processor with a speed of 1.2 GHz and DDR3 memory requires a multi-layer structure with micro-via and at least ten to twelve layers.

Using a modular design, the application or carrier board can be implemented easily with at least two to four fewer layers. For long-term availability, memory is the most critical component in a processor application. This means that redesign will be necessary in the lifecycle due to discontinued memory. If you are integrating modules, this is the responsibility of the module producer.

Other disciplines to be considered on the hardware and software front include (but are not limited to):

- High frequency, impedance control and analog design complexity
- Sensitive parts (such as DDR, differential pairs lines, LVDS, Wi-Fi, Bluetooth Low Energy and buses)
- PCB "real estate management"
- Global regulatory (RoHS, UL, CE) and certifications (such as FCC)
- Bootloader integration and testing
- Driver integration and debugging

For long-term availability, memory is the most critical component in a processor application today.

# Key Factors: Engineering, Software, Security and Approvals

Let's take a closer look at some of the important factors as you prepare to make your build or buy decision.

## Process Engineering: Turning Your Design Into a Product

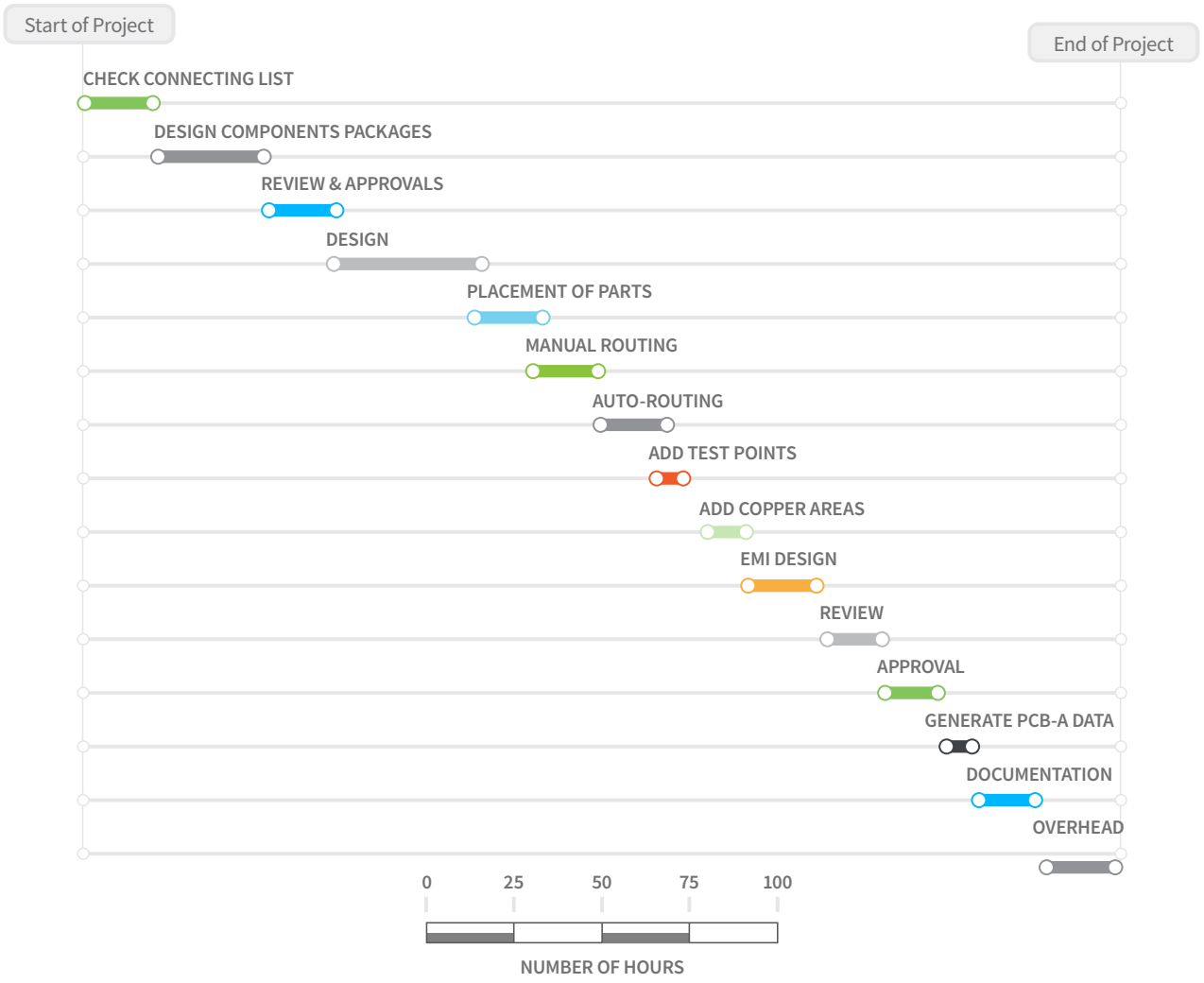
When you design your own platform, you then need to get it produced in small volumes for prototyping and re-spinning. You then need to take the final design to mass production, irrespective of whether you are doing that in-house, or you out-source to the manufacturer. This means you are responsible for all of the following:

- Lifecycle management (accommodating critical component end-of-life and last-time-buy management)
- Component sourcing (reacting to volatile lead-times and holding inventory of hard-to-find devices)
- Maintaining / managing the manufacturing test systems (Wi-Fi+BT test / debug / calibration)
- Understanding the economics of manufacturing yield and fallout costs (and CEM fees)

As an example, a well-designed, reliable i.MX6UL-based SOM, such as the Digi ConnectCore® 6UL, has over 230 components, of which 150 are capacitors and 50 are resistors. An i.MX8-based SOM, such as the Digi ConnectCore 8X, can have over 440 components, of which approximately 300 are capacitors and 80 are resistors.

All factors considered, it is important to evaluate whether it makes business sense to adapt your core competency to module development and testing, vs. turning to a manufacturer whose specialty is developing and maintaining highly integrated, optimized designs. Are you nimble enough to manage that bill of materials and its manufacture? And do you want to invest in developing PCB design, certification and ongoing maintenance?

# Design and Productionising an Integrated Carrier PCB




Production and QA graph: It is critical to establish the minimum flow disruption for manufacturing; the last item off the production line needs to work identically to the first, and that will take some time.

Another key consideration is negotiating on price with economies of scale: Since the module will be used by many customers, each customer will benefit from the excess quantity produced by the module provider. And using a module in other products, at higher quantities, results in additional room to negotiate a price. In addition to avoiding pure development costs, you may need to make continued investments for the acquisition of the appropriate tools for development, manufacture and test equipment.

## Addressing Security

Doing a chip-down design not only means following the core MPU reference design to the last detail, but also integrating your application with the BSP. Designing with a SOM rather than going chip-down should also mean the benefit of engaging with a more comprehensive BSP.

The key software drivers not for the MPU and other key components (such as radios, and security chip) are delivered with the module BSP; apart from usually being more comprehensive, these should be fully validated compared to a chip device BSP, as they include the boot loader, IDE and security framework, and can be used immediately.

This means application software development can start on day one, since the target platform is already available. Thus, real parallel engineering can take place, and performance tests — often necessary before a final design decision is made — can be conducted with modules, reducing development time.

## Wireless Design, Approvals and Certifications

Any full hardware development will incur additional testing and certifications. This invariably adds time and cost to a project — which is another advantage in choosing a pre-certified solution. Most organizations discover, when they embark on this journey, that there are a lot of hidden costs in RF design, starting with the development time and cost of specialized RF design engineers.

RF optimization requires deep technical expertise, and is both costly and time-consuming. There are many potential RF performance factors that can impact your design process and timeline, such as:

- **Antenna type and placement:** Antenna maker, composition, trace shape and length can change signal gain and expected signal energy to the matching network, resulting in mismatch and poor performance.
- **PCB build:** Variations in thicknesses or insulation material between layers, vias, trace widths, screw holes and other components can all have design and RF performance impact. Locations of plastics, screws, batteries and display locations can create interference on the antenna.

RF engineering design also requires investment in special equipment, software, and facilities to debug RF designs. This means an initial outlay on either renting or buying testing resources such as bi-conical antenna, 3D positioner, spectrum analyzer, testing software, wireless standards emulator, sniffer, and debug equipment.

## Addressing Security

Security is a subject of much discussion with respect to IoT applications. According to HP Security Research, 70% of IoT devices are vulnerable to attack. To thwart attackers, it is critical to invest in a device-security framework that simplifies the process of securing connected devices. A security framework should encapsulate:

- **Secure boot:** Authentication capability to ensure only authenticated software updates that have been signed by the manufacturer are allowed.
- **Secure storage:** A file system-level encryption that enables data to be transparently encrypted offering secure storage of sensitive data.
- **Authentication:** Data authentication and device identity management options that also ensure products are not shipped with default user and password settings.
- **Secure connections:** The latest encryption protocols for data in motion and over-the-air (OTA) transmissions to ensure the integrity of data flowing across a network.
- **Protected hardware ports:** Internal and external I/O ports are hardened and access-controlled to prevent unwanted local intrusion.
- **Ongoing monitoring and support:** Ongoing threat measurement and monitoring services as well as performing internal and external security audits and proactive communication regarding upcoming threats.

Digi is a premier supplier of a full range of embedded solutions, including wireless modules, SOMs, SBCs, software and remote management tools to support your development requirements. Whether your chief concern is range, power, programmability, certification, security, or software tools, Digi has your needs covered.

## Managing Risk in Product Development

Managing and mitigating risk is important in any product development, and it is a key consideration in the build vs. buy discussion.

Risk means time and costs, both in the short and long term — and mitigating risk becomes more complicated with the number of variables affecting your design, deployment and ongoing maintenance strategies.

Since the design for the application board is much simpler in a modular design, the risk of eventual redesign is significantly lower. A redesign in the course of the lifecycle usually becomes necessary for the embedded module only where the memory modules are located. Reducing your design and certification hurdles can lead to timely completion of development and play a crucial role in contributing to a product's overall commercial success.

An additional consideration for a product's lifecycle is its "upgradeability." Is your design flexible enough to meet future needs? In a diverse and constantly evolving world, as your customers and their needs change, is your solution flexible enough to stay relevant?

An application / carrier board is much easier to redesign than a tailored chip-down design.

Upgradeability contributes to a product's commercial success and lifecycle longevity, thus securing your design investment. The fact is that while module changes will not necessarily force a re-design, they do provide an easy path of progression, both on cost and performance.

# IoT Devices for Rapid Time-to-Market

Take a brief tour of the device families that support rapid modular development in a world where you can't afford to have product development tied up in certification challenges.

## Ultra-compact, Highly Integrated System-on-Module Solutions

Digi's system-on-modules (SOMs) offer multiple embedded wireless solutions including pre-certified 802.11a/b/g/n and Bluetooth, as well as options to add cellular. Built on the latest processors, such as the NXP i.MX6 UL, i.MX 8X, i.MX 8M Nano and i.MX 8M Mini, Digi SOMs provide device security for connected IoT applications, and you can accelerate parallel software development with Digi's support for embedded Android and Linux development environments including Yocto Project.

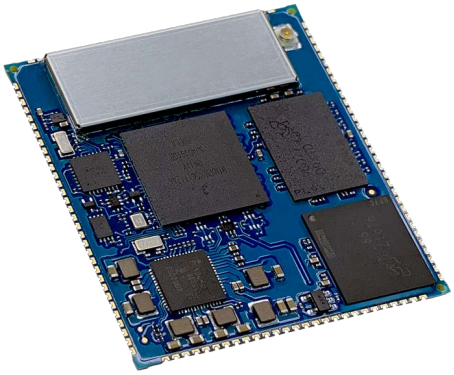


Figure 1: Digi ConnectCore 8M Nano system-on-module (SOM)

## Versatile, Off-the-Shelf Single Board Computers (SBCs)

Borne from our SOMs, Digi's line of compact, cost-effective and versatile off-the-shelf single board computers (SBCs) offer significantly reduced time-to-market by virtually eliminating the traditional risk, effort, and complexity of custom board designs without sacrificing flexibility or capabilities. Digi SBCs support ARM, NXP and Rabbit processors and multiple wireless interfaces.

For our NXP SOM-based SBCs, we also provide complete schematics, Gerber files, bill of materials and resources so developers can rapidly create their own carrier boards.

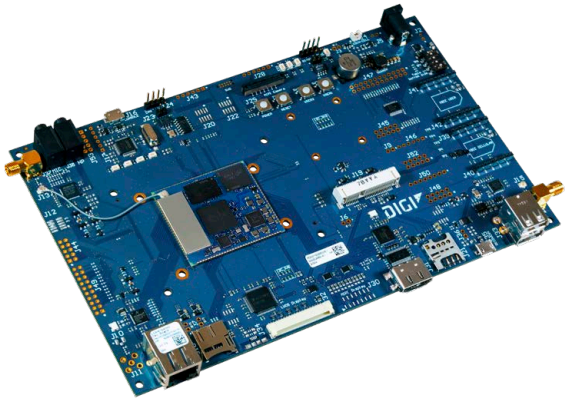


Figure 2: Digi ConnectCore 8M Nano Development Board


Figure 3: Digi ConnectCore 8M Nano Development Kit

## RF Modules in Multiple Form Factors

Digi XBee® RF modules provide wireless connectivity in a range of protocols and form factors to support today's low-power IoT applications. Easy-to-deploy, pre-certified, and configurable using Digi XCTU® and the XBee mobile app, these low-cost modules support all of your wireless design requirements. Digi XBee also offers the easiest way to integrate cellular connectivity into an OEM device. With the introduction of 3GPP standards like LTE Cat 1, LTE-M and NB-IoT, as well as older standards like 3G HSPA/GSM, Digi has the cellular modem for your design. Digi XBee Cellular modems provide easy cellular connectivity without having to go through a costly FCC or carrier end-device certification process. The XBee Ecosystem includes RF modules in multiple form factors for embedded IoT designs and pre-certified embedded cellular connectivity for rapid deployment.

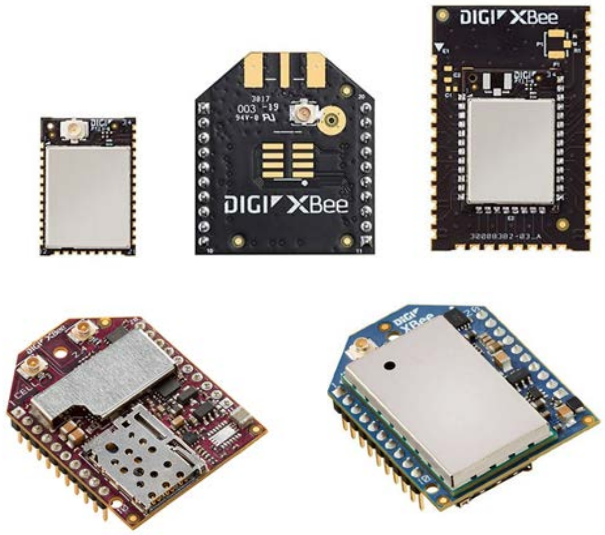



Figure 3: Digi XBee Ecosystem

Digi teams consult closely with OEMs as they identify the right setup for their needs and prepare to deploy. Start the conversation from our Contact Us page.


## Digi TrustFence for Embedded Designs

Embedded security is a critical design component for a growing number of connected IoT applications and devices. The built-in security of Digi TrustFence® gives you immediate access to critical features including secure connections, authenticated boot, encrypted data storage, access-controlled ports, secure software updates, and seamless integration of the dedicated on-module Secure Element (SE).

Many of Digi's customers operate in highly regulated industries. Digi has taken an industry-leading position around the adoption of industry standards and security certifications such as HIPAA, FIPS 140-2, and NIST, as well as helping customers to comply with certifications like PCI-DSS for retail and FDA for medical devices.


## Why Digi?

Digi is a complete IoT solutions provider, supporting every aspect of your project, from mission-critical communications equipment to professional services to get your application designed, installed, tested and functioning securely, reliably and at peak performance.

Digi builds its products for high reliability, high performance, and versatility so customers can expect extended service life, quickly adapt to evolving system requirements and adopt future technologies as they emerge. Digi cellular routers, servers, adapters and gateways support the latest applications in traffic, transit, energy and smart cities.

Our solutions enable connectivity to standards-based and proprietary equipment, devices and sensors, and ensure reliable communications over virtually every form of wireless or wired systems. An integrated remote management platform helps accelerate deployment and provide optimal security using highly efficient network operations for mission critical functions such as mass configuration and firmware updates, including system-wide monitoring with dashboards, alarms and performance metrics.

## Company Background

- Digi is publicly traded on the NASDAQ stock exchange, symbol DGII
- Founded in 1985, Digi has 35+ years of experience connecting the “things” in the “Internet of Things” — devices, vehicles, equipment and assets
- Headquartered in the Twin Cities of Minnesota, Digi employs more than 600 people worldwide
- The business has been profitable for 16 consecutive years
- Digi’s annual revenue is around $279 million
- The company has 285 patents issued and pending (150 issued)
- We have connected more than 100 million devices worldwide

As a communications equipment manufacturer, Digi puts proven technology to work for our customers so they can light up networks and launch new products. Machine connectivity that’s relentlessly reliable, secure, scalable, managed — and always comes through when you need it most. That’s Digi.

## Contact a Digi expert and get started today

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