

## FIVE FACTORS FOR SUCCESS

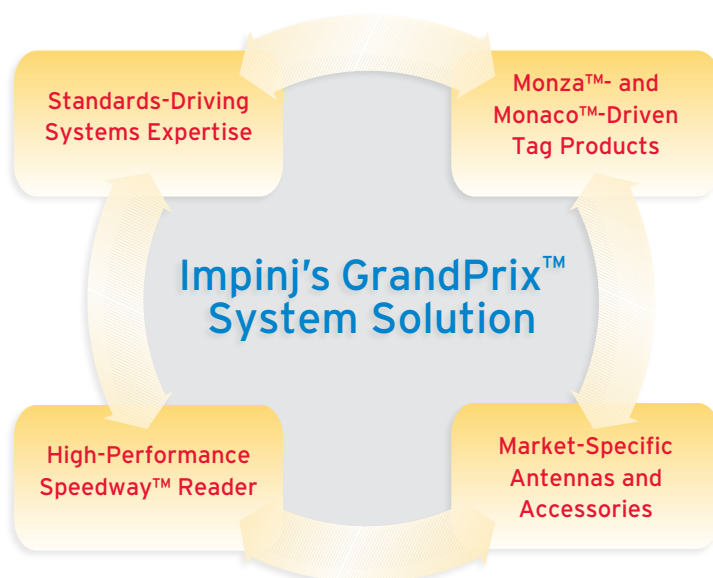
# UHF Gen 2 RFID Systems Engineering



 Engineering robust communications systems is complex; RFID systems are no exception.

One of the keys to success is the “behind the scenes” work of systems engineers who architect the solutions, solve the difficult problems, integrate the tag, reader, antenna, and software components, and then make them all work together. One application at a time.

At Impinj, our unique approach to systems engineering is the foundation of everything we do. It spans our contributions to the UHF Gen 2 standard development to the delivery of innovative, market-leading products to the deployment of successful systems in the field. And just as important, it makes them easy to use. If you are deploying, supplying, or otherwise working with UHF Gen 2 systems you should be very concerned about the architects of those systems. To that end, here are five essential systems engineering attributes that ultimately determine the quality and performance of your RFID implementation—attributes that are embodied in Impinj’s GrandPrix™ solution (comprising the Speedway™ reader, Monza™- and Monaco™-powered tags, antennas, and accessories).



- 1. STANDARDS COMPLIANCE**  
STANDARDS COMPLIANCE IS ONE THING...
- 2. PERFORMANCE**  
PRECISION-TUNED FOR DIVERSE USE CASES
- 3. FLEXIBILITY**  
EASE OF USE ENABLES INNOVATIVE SOLUTIONS
- 4. QUALITY & RELIABILITY**  
CONTINUOUS IMPROVEMENT NEVER RESTS
- 5. DELIVERY**  
INNOVATION PACKAGED AND DELIVERED...

# 1 Standards Compliance

## STANDARDS COMPLIANCE IS ONE THING; HOW YOU APPLY THE STANDARD IS QUITE ANOTHER MATTER

The UHF Gen 2 standard is a framework for building RFID systems that operate in the 860 MHz to 960 MHz band. The standard is not a solution, but a set of rules for solution providers to follow when they design and build their systems. While the Gen 2 standard defines the functionality of system components and the interactions among them, it does not speak to the performance of the components, or even to how the standard might best be applied in any given application. Those details are left to solution providers.

It is worth noting that Impinj's systems engineering group developed their expertise creating communications systems for satellites. In a satellite environment, the system design must work right the first time—and work flawlessly. You can imagine the engineering rigors brought to bear upon such an enterprise. Impinj brings that same philosophy to its RFID systems engineering. When you apply this approach to RFID, you get high-performance, standards-compliant RFID systems that work right the first time. It is also why Impinj was the first company to receive the EPCglobal Conformance and Interoperability certifications for both its tag chip and reader products, and why these products serve as the reference standards for other suppliers' Gen 2 products.

# 2 Performance

## PRECISION-TUNED FOR DIVERSE USE CASES

Systems engineering at Impinj plays a dual role: 1) design of the system architecture (orchestrating the design of the components, tags, readers, and antennas), and 2) performance optimization (conducting the way they play together to deliver optimum performance). The design side of the equation is concerned with predicting the systems performance and allocating requirements to the design team to ensure that the desired performance is realized. The optimization of that performance involves creating and operating the actual use cases inside the Impinj Innovation Center, with partners, and at customer sites, where performance metrics are established and measured. These activities sometimes inform specific improvements to the hardware and accessories, but more frequently lead to improvements in the algorithms—embodied in operational presets—that will ultimately run on the Speedway reader. As you might expect, each use case presents a different set of challenges.

UHF Gen 2 has come a long way since the rolling of pallets through the dock doors of warehouses. Item-level tagging using Gen 2 is an excellent case in point. To cite an example, consider an RFID system, such as a pharmaceutical fill line, that must recognize a specific, fast moving item and then perform an operation on it. It must act very quickly, because right behind it is another item that will also require attention. Performing these functions with 100% accuracy requires problem solving on several fronts; consider the requirements:

- > Meet aggressive throughput demands (many hundreds of items per minute)
- > Isolate the targeted item for real-time operation
- > Operate (read/write/lock) on only that item and no other in that instant
- > Engineer the optimal mix of RF techniques, antenna design, and algorithmic solutions to apply
- > Deploy and fine-tune the system

Engineering solutions (which include determining optimum power thresholds, time-out periods, trigger parameters, mechanical/placement aspects, modes of operation, etc.) to meet these kinds of requirements is one thing; meeting them in RF-noisy, challenging, real world environments—with Six Sigma results—is what separates the wheat from the chaff. And that is what the GrandPrix solution is all about.

## 3 Flexibility

### EASE OF USE ENABLES INNOVATIVE SOLUTIONS

It is no exaggeration to say that a properly designed Gen 2 system has a “million knobs,” each of which may be tweaked and tuned to dial in precisely the performance characteristics required to ensure that ALL the desired tags make it into the user’s business process. Gen 2 was intentionally written that way; it features numerous modes of operation, many commands, and an infinite number of possible sequences for those modes and commands. In this sense, you can think of Gen 2 as a piano, at which limitless musical possibilities might be realized; the systems engineers are the composers of the music.

At Impinj, our systems engineering group has orchestrated a program of key Gen 2 operational presets—pre-packaged algorithms running on the Speedway reader—that address the majority of use cases. These bundled modes of operation are easily user-selected via the graphical user interface (or called from a custom application developed by a third party) that also resides on the reader. This kind of out-of-the box functionality makes the system very easy to use, as it eliminates the requirement to understand the intricate details of the Gen 2 standard. So whether your application involves reading pallets of cases rolling through an RF-noisy distribution center or writing to small items traveling along a fast-moving conveyor, there is a well-tuned Speedway preset or custom GrandPrix solution that will deliver a very high level of performance.

## 4 Quality & Reliability

### CONTINUOUS IMPROVEMENT NEVER RESTS

Quality and reliability manifests in systems solutions that are rigorous, robust, and repeatable. It also means the system delivers the desired results. To achieving that end, Six Sigma methodologies apply to Impinj’s systems engineering as readily as they do manufacturing processes.

The process of defining the system requirements and performance metrics, measuring test results, analyzing the mechanical, RF, and algorithmic dynamics, identifying opportunities for improvements, designing experiments to work them out, and then locking it all down is precisely the definition of the Six Sigma “DMAIC” (Design, Measure, Analyze, Improve, and Control) methodology. The “attributes critical to quality” vary by application but they are all concerned with eliminating the one key defect: missed tags.

## 5 Delivery

### INNOVATION PACKAGED AND DELIVERED IN INDUSTRY-LEADING SYSTEM SOLUTIONS

Impinj is much more than a component provider that delivers only the pieces of a system: readers, antennas, and tag chips. Leveraging our systems engineering work and industry partnerships, we deliver solutions. Much has been written about our successes in applying UHF Gen 2 to better securing the pharmaceutical supply chain, but the same Impinj expertise that was brought to bear upon this challenging scenario is also at work in apparel, library systems, retail, and point of sale applications, to name a few. And working with our extended network of technology partners, including middleware developers, tag manufacturers, and packaging engineers, we continue to deliver our greatest value: innovation.

## Conclusion

As we have seen, the successful RFID deployment depends on much more than the mere integration of discrete components. The performance, cost of ownership, and resulting ROI of any RFID system is tied directly to the quality of the system solution. To that end, only Impinj has demonstrated the levels of systems engineering expertise, product innovation, and manufacturing capability required to deliver the best performing, most reliable UHF Gen 2 solutions available.

### About Impinj

Impinj, Inc. is a semiconductor and RFID company whose patented Self-Adaptive Silicon® technology enables two synergistic business lines: high-performance RFID products and semiconductor intellectual property (IP). A leading contributor to the RFID standards for high-volume supply-chain applications worldwide, Impinj leverages technical expertise and industry partnerships to deliver the GrandPrix™ solution, comprising tags, readers, software and systems integration to offer RFID that just works™. Impinj licenses innovative IP products, core to the company's RFID tags, to leading semiconductor companies worldwide, allowing them to seamlessly integrate crucial nonvolatile memory (NVM) alongside analog and digital functionality on a single chip. Impinj's IP products include the popular AEON® family of embeddable cores, which provide rewriteable NVM technology in logic CMOS manufacturing.

For more information, visit [www.impinj.com](http://www.impinj.com).

