

WHAT IT MEANS, WHY IT MATTERS:

UHF Gen 2 Interoperability



Multi-vendor interoperability: This was always the vision for UHF Gen 2. It is, after all, what an open standard is all about. So it was not without some fanfare that the first interoperability certifications were awarded by the standard's keeper, EPCglobal. But what, exactly, does that mean? Why does interoperability certification matter, especially considering that Gen 2 compliance certification is a prerequisite to interoperability testing? In answering these and other questions, it's helpful to understand Gen 2's bigger deployment picture.

Long before the standard was ratified, EPCglobal outlined a multiphase certification program that would serve both the development and the deployment of high-quality Gen 2 products. One can think of this program as a roadmap for building a winning sports team: first, individual athletes must qualify to join the team. Second, the team members must play well together. And third, those teams with the best-performing athletes will be expected to prevail on the field of play. In many respects, this is the very model adopted by EPCglobal.

In this case, individual product qualification is determined via compliance testing, team play via interoperability testing, and finally, getting to the big game, by performance testing. The earliest Gen 2 compliance certifications were awarded in September 2005; the first interoperability certifications were awarded almost exactly a year later. The third leg, performance testing, will commence in 2007. All this is intended to ensure that end users have everything they need to field the best-performing, most robust RFID solutions available.

in•ter•op•er•a•bil•it•y *adj:*
the ability of two or more
systems or devices to exchange
information using the same
communication protocol

UHF Gen 2 Goes Plug 'n' Play

RFID hardware interoperability determines the ability of tags and readers manufactured by different suppliers to work interchangeably—to be, in fact, plug-and-play. This is critically important to end users, who simply need to know that the Gen 2 readers they've installed in their warehouses, distribution centers, or retail stores will read all the Gen 2 tags that come through their doors—regardless of what company or companies manufactured them. And products are either fully interoperable, or they're not interoperable at all. In order to achieve an interoperability certification, a tag must pass all 267 test suites (defined by EPCglobal and their testing partner, MET Labs) with each reader and each printer-encoder. Likewise, a reader

or printer-encoder must pass its set of test scenarios with each tag. When they do, they earn the right to bear EPCglobal's UHF Gen 2 interoperability "mark."

Compliance Testing is a Good Start

Although all products submitted to interoperability testing must first be certified for compliance to the Gen 2 standard, it's not uncommon for some manufacturers to have misinterpreted certain elements of the specification, preventing their tags, for example, operating with other Gen 2 devices. More insidiously, certain tags and readers may be interoperable with each other, but not with all other Gen 2 devices. As such, the scope of interoperability tests was designed to exercise, as much as possible, the full functionality of the Gen 2 spec (including operation at timing limits) with a prime objective of assuring true multi-vendor compatibility.

Now, interoperability testing would be unnecessary if EPCglobal's testing partner, MET Labs, could design test procedures for conformance testing that completely exercise the tag and reader. But this is not possible. Particularly in a lab. While the authors of the Gen 2 standard worked to ensure that the spec is as explicit and unambiguous as possible, there remains the opportunity for misinterpretation. What's more, there are a great many variables in any sequence of commands that might be issued by a reader. In fact, given the complexity of options and modes of operation available in Gen 2, there is practically an infinite number of possibilities in the way that a reader can communicate with a tag, both in terms of the commands it can send and what it can ask the tag to do.

So what good is conformance testing? Plenty. At minimum, it's a critical filter that ensures that a reader and/or a tag meet the essential aspects of the Gen 2 spec—that products issue the correct wave forms; that they exhibit the right timing parameters and properly exercise key elements of the protocol. And while a number of products were certified in the first round of submissions, the process actually sent many of them back to the drawing board. Therefore, earning the conformance certification is an appropriate first hurdle for products to clear. The early availability of certified products also enabled a great many deployment pilots, which was critical to building out and testing the new UHF infrastructure—especially when considering

that Impinj® was the only certified supplier of Gen 2 tag chips for more than a year! The fact that interoperability testing is underway now is a significant indicator of the industry's maturity. In short, with multiple Gen 2 products available now, interoperability testing can pick up where conformance testing left off.

Inside Interoperability

The process of interoperability certification allows EPCglobal to verify the correct operation of tags with a reference reader system, and readers with a reference

tag system (Impinj's Monza™ tag silicon and Speedway™ reader are key elements in this "golden" reference system). The interoperability testing covers the vast majority of cases users can expect

interoperability testing n: the functional testing of a product against another operational product according to a set of test specifications

to see in the field, providing the assurance that both tags and readers—even those from various manufacturers—will respond properly. To this end, test suites are created by assembling a group of test cases that exercise the major functionality subsets of the Gen 2 protocol. Four test suites were defined for certification purposes: Select/Inventory, Memory Access, Permalock/Kill, and Special (optional). Each test suite is run for a given set of reader/tag air interface conditions. (The set of parameters that define the air interface settings is called the mode, which defines the user-settable reader-to-tag characteristics (data rates, modulation schemes, etc.), as well as the tag-to-reader characteristics.)

The fact that Impinj's Speedway reader and Monza tag chips were the first (and at the time of this writing, only, tag chip and reader combination) to receive interoperability certification speaks to the rigorous engineering processes that went into them. To guarantee the robustness of Impinj products to the UHF Gen 2 protocol, we ran an exhaustive set of functional and timing verification test suites—more than double the number of scenarios evaluated by MET Labs—putting the products through their paces, and exercising them under demanding system-level conditions.

What's Next?

Clearly, certified UHF Gen 2 interoperability is a major milestone in the development of RFID systems. Important as that is, though, performance is still what matters most to RFID deployments. As demonstrated in numerous user

pilot programs, a UHF Gen 2 system made up exclusively of Impinj components (Monza- and Monaco™-driven tags and the Speedway reader) always yields superior performance. Why? Because Impinj products have a higher degree of receptivity, meaning both tags and readers are not only extremely sensitive to each other's signals, they are able to reject the interference from other RF sources operating in the area.

test case n: a fundamental functionality within the Gen 2 protocol. Test cases are grouped in order to verify a test suite.

EPCglobal, recognizing the critical importance of receptivity to system performance, created a working group to address these and other issues. In the process of defining minimum requirements, they'll address not only the performance of tags applied to various classes of products (RF-friendly materials like paper, plastic, wood, etc., as well as the more problematic materials such as liquids and metals), but all the key aspects of tag performance: sensitivity, interference rejection, orientation, ESD, and others parameters. Once the objectives are defined, the EPCglobal Hardware Action Group will draft the specifications for performance testing. This will complete the promise outlined by the framers of the UHF Gen 2 standard.

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.

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