Gen 2—The Tough Questions, Part 2

One of the architects of EPCglobal's Generation 2 standard addresses end users' concerns regarding Gen 2-based tags and readers.

Aug. 22—This is the second installment of a two-part article by Impinj cofounder and chairman Chris Diorio. To read the first installment, click here. Impinj is a fabless semiconductor company that makes RFID chips, inlays and readers, Chris Diorio was one of the chief architects of the EPCglobal Gen 2 specification. As cochair of the Hardware Action Group that developed the spec, and project coeditor of the corresponding ISO spec, 18000-6 Type C, Diorio is uniquely positioned to answer some of the questions end users may have as they consider deploying the new technology.

Specs are one thing, but how will Gen 2 play out in the real world? Will it cope any better than Gen 1 with the many external factors—for instance, noisy RF environments?

Several recent pilot demonstrations already have shown the significant benefits of Gen 2. But to drive the point home, we, at Impinj, provide a demo using two of our Speedway readers operating simultaneously in dense-reader mode. The interrogators are pointing directly at each other, with two antennas about 15 feet apart and transmitting at maximum power. The tags are right in the middle of the antennas. As you move the tags closer to one reader, it reads all the tags, and as you move the tags closer to the other reader, it reads all the tags.

We're getting reliable reads with the antennas pointing right at each other—with both readers transmitting at high power, without any time synchronization and without using listen-before-talk. In Gen 1 systems, in a multi-reader environment, one reader has to shut off so the other can operate; it's a time-division multiplexing scheme. Gen 2 uses a frequency-division multiplexing scheme, which means both readers can talk simultaneously. Even in this configuration, we've got Gen 2 operating in the worst possible mode and beating Gen 1 in throughput—not only with much faster read rates, but with no ghost reads or any other read errors. That's a significant advantage. That's the kind of acid test that proves Gen 2's superiority.

We've solved one major problem by developing a single, worldwide, high-performance standard. People are now solving the next set of problems, which involves introducing high-quality Gen 2 silicon and reader solutions. Impinj has already demonstrated both, and other vendors are coming out with their own solutions. Still, an interrogator and a chip do not make a complete solution. That comes about by creating a knowledge base, deploying systems in the field, working through the bugs, building the right antennas, writing software into the readers and learning what works and what doesn't. And that's the challenge ahead for all of us going forward, for both the solution providers and the end users. As with any new technology, it's going to take some time.

With readers gaining certification while meeting only a subset of the Gen 2 spec, how robust and manageable will Gen 2 systems really be?

This question gets at a preconceived, but incorrect, notion about the Gen 2 spec. A Gen 2 reader must

implement all mandatory Gen 2 commands. It must be able to talk to any Gen 2 tag in the field. It need not have the flexibility to talk to tags at the full range of data rates, and it may not offer the dense-reader mode, but it is still a Gen 2-compliant reader.

Consider the analogy of a car. There are big cars, small cars, barely capable cars, cars that do everything you want and so forth. But they're all cars, they all drive on the road and if they're sold in the United States, they're capable of being driven on the freeway. It's the same with Gen 2 readers. Every interrogator must be capable of talking to all Gen 2 tags. Now, some readers will be faster, some will work better in dense-reader mode, some will be more robust and some will have better noise immunity. So while it's mandatory that they all be capable of talking to Gen 2 tags, there will still be a range of performance differences. If you're an end user, you'd better know for sure that you're getting what you need. If you have a small shop out in the middle or nowhere, you can get away with almost any Gen 2 reader. If you have a distribution center and plan to deploy 100 interrogators, however, you probably need the best dense-environment-capable Gen 2 reader you can find. With cars, you do your homework before you buy, and that probably includes a test-drive; you should do the same with readers.

Gen 2 tags are essentially broadband receivers with little ability to discriminate RF sources. Is dense-reader mode performance alone sufficient to yield a reliable system in noisy environments?

Dense-reader mode works very well, and it's our belief that this mode will be sufficient to field working systems. If we had had the option of building a narrowband tag, we would have jumped on it, but there is simply no practical way to do that. So we will always have broadband tags, and dense-reader mode is the solution we settled on for the Gen 2 spec. We believe it will work sufficiently well. We've already demonstrated its robustness—even under the worst-case RF conditions. Beyond dense-reader mode, tags can, but are not required to, implement noise filtering. Again, some tags will have it and some will not; of those with noise filtering, some will work better than others. Dense-reader mode with high-quality noise-filtering tags should work far, far better in the field than any Gen 1 systems do today.

Given Europe's limited bandwidth, how advantageous will Gen 2's dense-reader mode be there?

Europe is a more difficult environment, because the bandwidth is very limited—2 MHz versus 26 MHz in North America. And the allocated European channels are even narrower: 200 kHz versus North America's maximum 500 kHz. In addition, Europe's "listen before talk" is a stringent requirement—actually, it is a bit *too* stringent and should probably be revisited. Notwithstanding, Gen 2 is essential for European RFID deployment. For example, Gen 1 protocols have no reader transmit masks; by contrast, the Gen 2 dense-reader transmit mask is actually tighter and more difficult to meet than the European ETSI requirements. It's possible to meet ETSI's requirements and still fail the dense-reader transmit mask. Why? Well, the analysis that went into the Gen 2 spec development showed that we needed such a tight mask. The result is that dense-reader mode in Europe can, and will, work very well.

Shouldn't users wait until things settle down and there's more of a proven infrastructure built around Gen 2 before jumping in? What advantage is there to getting involved at such an early stage?

The time to start is now. We have a proven specification that is also on the fast track to ISO approval. We currently have multiple suppliers delivering Gen 2 product, and we've been demonstrating and sampling Gen 2 tags and readers for months now. The ramp-up is actually going to be quick. It's important to realize that it will take time for any user to understand how to deploy RFID in their environment. There will be a learning curve. You can wait until the systems are fully developed before jumping on the bandwagon, or you can get on it now and ramp up early. But the bottom line is, it's a pretty steep learning curve, and in the time it's going to take for end users to get ramped up on that learning curve, there will be plenty of working Gen 2 systems out in the field. So the time is now. If you started today, the solution would be available before you even

finished your ramp-up.

With talk of a Gen 3 already appearing in some press—even before the general deployment of Gen 2—will this technology ever become stable enough to commit to?

The Gen 2 specification, and the products built to it, will be applied, just as intended, to a wide range of applications and environments. These will include the tracking of products in the supply chain. I know of no efforts to supplant Gen 2 with a Gen 3, or anything else. In fact, I've never heard of Gen 3, either from EPCglobal or ISO. There is an option under EPCglobal to produce a Class 2 Gen 2 spec, but the plan for Class 2 is to build upon the existing Gen 2 base—Class 2 Gen 2 will not replace Class 1 Gen 2. It's there to provide a path for additional tag features, such as temperature sensing, additional security and encryption features, read locking and other capabilities, but it will all be built on top of the Gen 2 foundation.

The next objective in the development plan for RFID is an item-level tagging specification, targeted for consumer products and pharmaceuticals, and that will actually be a fairly difficult task. The requirements for item-level tagging present different issues than those of pallet and carton tagging, not to mention another layer of requirements relating to privacy, security, encryption and so on. There will also be requirements for tagging metal and liquid objects, such as bottles of shampoo and cans of soda. It's a pretty tough set of requirements that go above and beyond those addressed by Gen 2. So at some point, an item-level tagging spec will emerge, but it will take time to develop—and may, in fact, be built upon Gen 2, as well. And long before the spec is written, the requirements will have to be defined. The bottom line is that Gen 2 isn't going away any time soon. As an industry, we foresee plans for massive Gen 2 deployments.

Chris Diorio is cofounder and chairman of Impinj, a fabless semiconductor company in Seattle that makes Gen 2-based RFID chips, inlays and readers. He has served as cochair of the EPCglobal Hardware Action Group that developed the Gen 2 specification, and as project coeditor of the corresponding spec (18000-6 Type C) within ISO.