

Impinj Advances Object Tracking with RAIN RFID Powered by AMD FPGAs

Impinj's R700 RAIN RFID Reader connects billions of everyday items to the Internet.



EXECUTIVE SUMMARY

Impinj, a leader in RAIN RFID technology, is expanding the Internet of Things (IoT) by connecting billions of everyday items to the digital world. To meet evolving enterprise needs while adhering to RAIN RFID protocols, the company turned to AMD Artix™ 7 FPGAs to power its R700 RAIN RFID Reader. This high-performance, flexible solution enables long-range, real-time scanning of over 1,000 RFID-tagged items per second, supporting use cases such as loss prevention, shipment verification, and healthcare asset management, as well as delivering enhanced privacy and security features.

Backed by more than 15 years of collaboration, AMD FPGAs provide the speed, scalability, and efficiency that allow Impinj to innovate and deliver tailored solutions for global operations.

INTRODUCTION

Based in Seattle and founded more than 25 years ago, Impinj pioneered RAIN RFID – radio-frequency identification technologies that connect everyday physical items such as parcels, clothing, medical supplies, and groceries to the Internet. The RAIN Alliance, formed in 2014 by companies including Impinj, now has around 150 member organizations working to advance RAIN RFID technologies.

Impinj's mission is to connect everything and ensure trust in every connection, and the company has become a key player in the Internet of Things (IoT) space. Using endpoint ICs to enable connectivity for over 120 billion items to date, Impinj provides business-critical data as items move through manufacturing, logistics, and retail environments, helping organizations improve efficiency and reduce waste, while ensuring goods are accurately identified and where they need to be.

TECHNICAL CHALLENGES

To meet the demands of enterprise-scale deployments, RAIN RFID systems must meet strict timing and performance requirements. As new use cases emerge, customers often need capabilities that go beyond the RAIN radio standard. Impinj needed a flexible, high-performance solution to support evolving needs.

“We frequently develop new capabilities that surpass the current Gen2 standard for RAIN RFID,” said Matt Branda, vice president of global marketing at Impinj. “AMD FPGAs allow us to meet Gen2 requirements while providing the flexibility we need to add innovative Gen2X enhancements and customizations that address our customers' needs.”

INDUSTRY

Industrial

KEY TAKEAWAYS

- Impinj connects billions of everyday items with RAIN RFID
- AMD Artix™ 7 FPGA's flexible and performant fabric enables Impinj to achieve real-time, long-range scanning in complex environments
- RAIN RFID is used for loss prevention, shipment verification, asset tracking, and more

CHALLENGE

Impinj needed a solution capable of meeting the strict requirements of the RAIN RFID standard while supporting evolving enterprise use cases. Barcode systems lacked the flexibility to scale and adapt to new demands such as high-speed item tracking and long-range scanning.

SOLUTION

Impinj's R700 RAIN RFID Reader, powered by the AMD Artix™ 7 FPGA, delivers the performance, efficiency, and flexibility needed for real-time endpoint IC scanning in complex, fast-moving environments. The solution supports advanced features such as loss prevention, asset tracking, and parcel verification.

RESULTS

With AMD FPGAs, Impinj enables its solution partners to meet specific tracking and performance requirements across high-volume, global operations.

AMD TECHNOLOGY AT A GLANCE

AMD Artix™ 7 FPGAs

Industries such as retail, logistics, and healthcare require solutions that improve operational efficiency while also supporting data integrity, privacy, and security. Unlike traditional near-field communication technology (NFC), which only reads items in close proximity, RAIN RFID endpoint ICs enable long-range reading and the ability to process thousands of items at once – and individually identify each item. This makes RAIN RFID ideal for inventory management, shipment verification, automated retail checkout, and loss prevention.

SOLUTION

Impinj's R700 RAIN RFID Reader uses the AMD Artix™ 7 FPGA to meet the RAIN radio protocol's real-time demands while maintaining flexibility for future enhancements. Even in challenging situations, the reader reliably receives and processes data from small, passive RFID tags powered by Impinj endpoint ICs.

Impinj endpoint ICs are roughly the size of a grain of sand and do not require batteries for power. They are connected to antennas and converted into tags or labels that can be attached to clothing, parcels, or even embedded directly into products, such as tire walls. Impinj's design is so compact that it has even been used to tag bumblebees.

Using radio waves, Impinj readers wirelessly provide power to endpoint ICs, enabling them to transmit data. Each R700 can read endpoint ICs from up to 10 meters away without direct line of sight, even when items are densely packed or moving quickly. Readers can rapidly identify items even in high-volume environments such as retail exits, conveyor belts, and warehouse dock doors.

The R700 runs on a Linux-based operating system and supports developer tools such as REST APIs and MQTT, a standard protocol for IoT systems. This allows businesses to build custom applications that connect directly to cloud environments for real-time tracking and control. Impinj provides technology across the entire RFID system, including endpoint ICs, reader ICs, and cloud services that connect item data to enterprise software.

When paired with Impinj's M700 and M800 series endpoint ICs, the R700 delivers superior performance in high-traffic areas. It also supports Impinj Gen2X, an enhancement to the RAIN radio standard with features such as advanced tag filtering, decluttering, and extended read range. Designed to solve previously unsolvable use cases, Gen2X speeds up the inventory process while inhibiting counterfeiting and protecting consumers.

"Twenty years after [contributing to] the RAIN RFID standard, we released our enhancements in the Gen2X solutions toolbox, which has a lot of momentum. AMD FPGAs made those enhancements possible," said Branda. "Gen2X capabilities help reduce inventory time, minimize

communication errors, and reduce system costs."

Gen2X also includes privacy protections such as secure endpoint IC encoding and a protected mode that hides endpoint ICs from readers unless unlocked with a secure code. The Impinj platform provides a foundation for IoT solutions development, extending the internet's reach all the way from the cloud and edge to physical, non-electric items.

RESULT

RAIN RFID has become widely adopted over the past two decades. "It's a proven technology that's been around for over 20 years. It's a worldwide standard," said Branda.

In retail, RAIN RFID has replaced barcode systems, allowing entire shelves of products to be scanned in seconds. At Uniqlo, for example, customers drop clothing into a bin at checkout, where Impinj readers automatically identify each item and enable a fully automated checkout process.

The AMD Artix™ 7 FPGA family provides the performance, efficiency, and cost-effectiveness needed to support these deployments at scale. With optimized transceivers, strong signal processing, and low power requirements, AMD FPGAs enable Impinj to advance RAIN RFID performance while making large-scale adoption practical.

As a result, the R700 reader now supports fast, accurate scanning in high-volume environments, and is used in applications such as shipment verification, loss prevention, food supply chain tracking, and healthcare asset management. In hospitals, for example, smart cabinets equipped with R700 readers help ensure that medical tools and devices are not misplaced or stolen.

Impinj's collaboration with AMD began more than 15 years ago and has been instrumental in helping the company meet the evolving demands of RAIN RFID. By building on AMD FPGAs, Impinj has been able to meet strict Gen2 technical requirements while also gaining the flexibility to innovate beyond the base protocol to meet customer needs.

"The AMD FPGA team has been proactive in getting us the parts we need to make sure mission-critical use cases are being supplied. AMD's support has been excellent," said Branda.

To learn how AMD adaptive computing powers next-generation solutions across industries, click [here](#).

ABOUT IMPINJ

Impinj is a technology company specializing in RAIN RFID, a wireless communication method that enables business to identify, locate, and track individual items in real time. Founded in 2000 and headquartered in Seattle, Wash., Impinj provides hardware and software that extend internet connectivity to physical objects such as clothing, parcels, groceries, and medical supplies. Its platform supports large-scale automation and data collection, helping organizations improve operational efficiency and inventory accuracy.

ABOUT AMD

For more than 50 years AMD has driven innovation in high-performance computing, graphics, and visualization technologies. Billions of people, leading Fortune 500 businesses, and cutting-edge scientific research institutions around the world rely on AMD technology daily to improve how they live, work and play. AMD employees are focused on building leadership high-performance and adaptive products that push the boundaries of what is possible. For more information about how AMD is enabling today and inspiring tomorrow, visit the AMD (NASDAQ: AMD) website, blog, LinkedIn, and Twitter pages.

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