

# RFID CHIP-BASED SERIALIZATION FOR RETAIL



An alternative to IT solutions for managing item-level tagging

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# RFID Chip-based Serialization for Retail

An alternative to IT solutions for managing item-level tagging

Item-level radio frequency identification (RFID) using standard Electronic Product Codes (EPCs) is rapidly becoming a key factor in improving retail inventory management. The main driver for adoption is quite simple—taking inventory with RFID is 25 times faster than with bar codes. RFID is faster for two reasons. First, it does not require line of sight access to the tag. Second, the person operating the reader does not have to ensure that they only scanned each tag once.

The key difference is that RFID uses radio waves to count large numbers of tags simultaneously, even if a stack of garments covers the tags or if they are inside a box. During the inventory process, readers often scan each tag several times. For this reason, accurate counts are only possible if each tag carries a unique serial number. In addition to rapid counting, serialization enables the tracking and tracing of individual items throughout the product lifecycle—an additional benefit for some product categories.

As major retailers like Walmart, J. C. Penney, and Macy's roll out item-level RFID, brand owners must find a low-cost, reliable way to implement serialization. Because serialization is new for most apparel suppliers, it has the potential to be disruptive to existing packaging and labeling business processes. Chip-based serialization is a way to avoid disruption by IT projects, constrained supply chains, and extra serialization costs.

Serialization can be regarded as an IT problem that requires an enterprise software solution to allocate and distribute serial numbers, but it doesn't have to be. Chip-based serialization is a non-IT alternative that preserves sourcing flexibility and uses the existing business process for tagging and ticketing. To help retailers understand serialization, this paper overviews EPC concepts for item-level RFID, reviews IT-based approaches to serialization, and introduces chip-based serialization as an attractive solution.

## EPC Concepts

With traditional retail bar codes, all products of the same make and model carry an identical Universal Product Code (UPC) containing a GS1-standard General Trade Item Number (GTIN). Bar codes use visible lines and spaces to represent UPC data, while RFID tags contain a chip with digital memory for storing EPCs. EPCs are like UPCs except that they include a serial number along with the GTIN to form a serialized-GTIN or SGTIN. Brand owners are



responsible for writing the correct EPC data into this memory location using an RFID-enabled printer/encoder, other specialized RFID equipment, or a service provider.

The SGTIN standard used in retail today contains a 96-bit data field. Of this field, it uses 58 bits of data for the GTIN that describes the make and model of the item, and 38 bits of data for the serial number. It is up to the serializing party (typically the brand owner) to ensure that the serial number is unique with respect to the GTIN. This means that no item with the same GTIN has the same serial number. Thus, each item carries a unique ID—a key requirement for inventory counting purposes.

## IT-based Serialization

In IT-based approaches to serialization, software or an administrative process is used to manage serial number allocation. Such solutions can range from a server that distributes serial numbers in small batches on demand, to a spreadsheet containing large number ranges assigned to locations, service providers, or devices that produce tags.

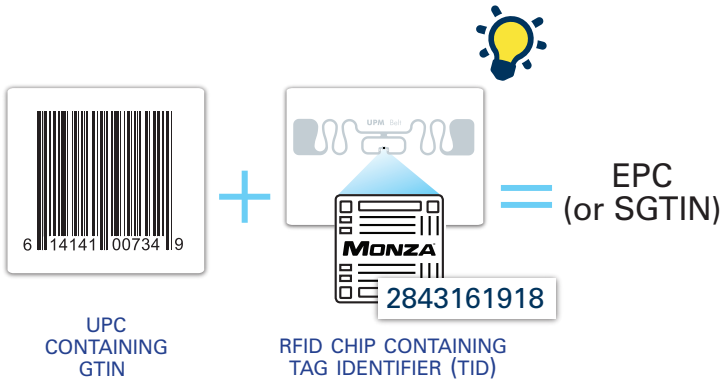
In all IT solutions, serialization is a two-step process. First, serial numbers are allocated and distributed to the point of use, and second, they are combined with the GTIN to produce a complete EPC. The final EPC is then sent to the printer or other encoding device for writing into the RFID tag chip's memory. Development, deployment, and maintenance of the software, systems and business processes for allocation and distribution of serial numbers, and the construction of EPCs, is a primary source of complexity in large-scale, global RFID tagging.

As one example, sometimes referred to as “dynamic” allocation, serial numbers are allocated in small batches to global points of use on an on-demand basis. This approach depends on continuous connectivity and seamless software integration between the server and the remote usage points. In the global apparel-manufacturing industry, high-availability IT infrastructure alone remains a significant challenge, not to mention diversity of equipment and suppliers that make seamless integration difficult. Thus, small errors and system failures can disrupt operations, or produce duplicate tags.

At the other extreme, each tag producer (e.g., factory location or even printer device) is assigned a specific number range. This approach, called “static,” seems simpler than the dynamic approach, but the constant change in apparel manufacturing operations requires tracking number usage so that number ranges can be re-assigned and re-allocated as needed. This complexity leads to business processes that have significant chance of error and duplication.

## Chip-based Serialization

Fortunately, chip-based serialization offers a third approach that avoids the trade-offs of IT-based serialization. In addition to the EPC memory, many RFID chips have another memory location called the Tag Identifier (TID) that is written only once by the chip manufacturer. The TID includes make and model information for the chip as well as a serial number. In chip-based serialization, the EPC serial number comes from the TID on the chip instead of an IT system. Now the entire process is simplified—the distribution of RFID tags also distributes serial numbers.

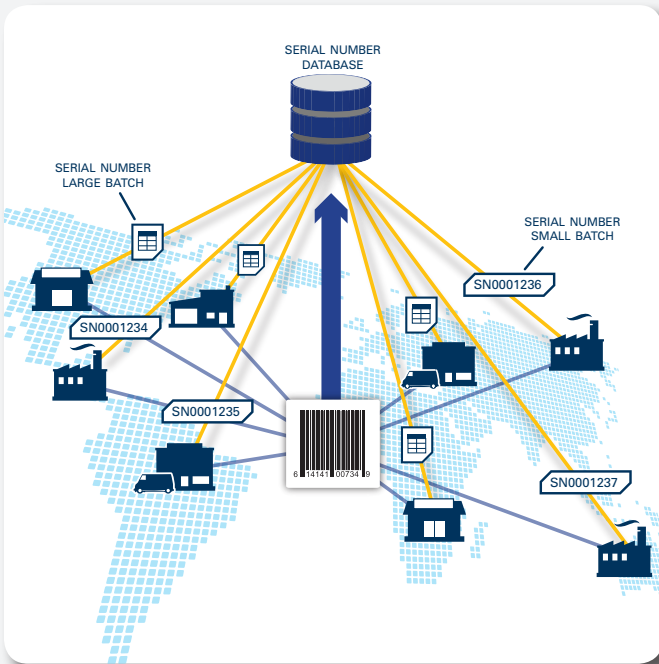


During RFID label printing and encoding, the printer or other RFID encoding system produces the complete EPC internally. This method combines the GTIN from the printer driver (as normally required for bar code printing) with the TID serial number from the tag chip. From a business-process, software, and variable data management perspective, producing an RFID label using chip-based serialization is no different than producing a traditional bar code label. The serialization happens under the printer's hood.

With chip-based serialization, a brand owner relies on an RFID chip vendor to accurately serialize its tag chips rather than on an internal system or a third party. Chip manufacturers are already in the business of precise serialization because many downstream applications rely on this TID feature. Using the TID for serialization is a win for the brand owner because the chip vendor has already made the serialization investment.

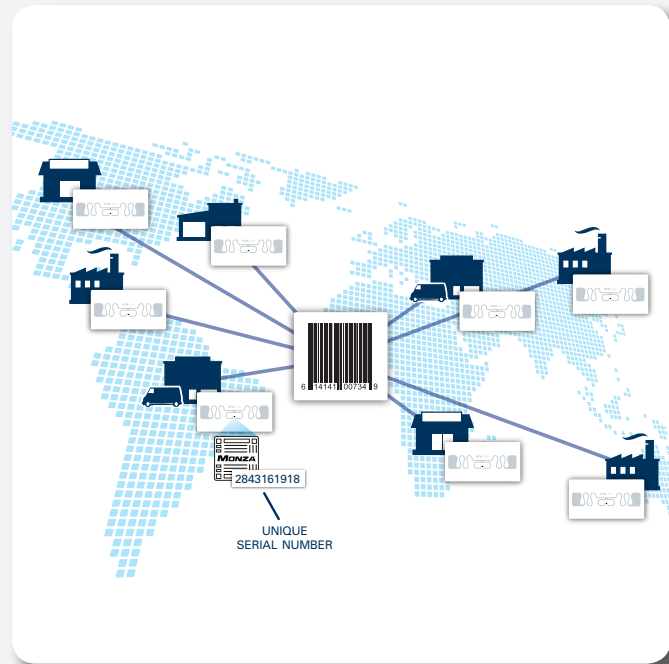
Brand owners who implement chip-based serialization can take advantage of the investment already built into the tags they are buying. However, the brand owner must give some thought to proper implementation of the chip-based approach. Some considerations include how many bits from the TID to leverage, and how to ensure compatibility with prior or existing serialization solutions as part of a migration plan, or for ongoing operations. Once designed, brand owners can implement a chip-based serialization solution easily and safely. We recommend that interested brand owners contact the authors of this paper for further discussion.

### IT-based Serialization



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### Chip-based Serialization



Chip-based serialization avoids the complexity of IT-based approaches. In chip-based serialization, the EPC serial number comes from the chip's Tag Identifier (TID) instead of an IT system. During printing and encoding, the printer or other RFID encoding system produces the complete EPC internally by combining the UPC GTIN from the printer driver with the TID.

### About Impinj, Inc.

Impinj is the leading provider of UHF RFID solutions for identifying, locating and authenticating items. Impinj draws on its technical expertise and industry partnerships to deliver a wide range of products and solutions, comprising high-performance tag chips, readers, reader chips, software, antennas and RFID subsystem integration. Impinj's products provide robust performance, integration and cost effectiveness to a global customer base across numerous vertical markets with applications including inventory management, asset tracking, authentication and serialization. For more information about Impinj, visit [www.impinj.com](http://www.impinj.com).

### About UPM RFID

UPM RFID, part of UPM's Engineered Materials business group, is the world's number one producer of HF, NFC and UHF radio frequency identification (RFID) tags and inlays. UPM RFID has a global service network consisting of factories in China and in the United States and a broad network of sales offices worldwide. The UPM Group employs around 24,500 people and it has production plants in 16 countries. UPM's annual sales exceed EUR 10 billion. UPM's shares are listed on the Helsinki Stock Exchange. Further information is available at [www.upmrfid.com](http://www.upmrfid.com).

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