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Innovation Insight for Item-Level RFID in the Transformation of the Retail Store

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Initiatives: Unified Retail Commerce for Digital Business Execution

Inventory accuracy and proactive stock management have seen renewed focus in retail as store-based fulfillment processes continue to scale. Item-level RFID is a critical contributor to addressing this need. Retail CIOs must evaluate various use cases to apply this technology in their organizations.

Overview

Key Findings

- RFID continues to see traction beyond pallet- and case-level tracking in the retail supply chain toward item-level implementations in the store, with a variety of execution benefits, including inventory accuracy over 98%.
- Soft-line categories like apparel, fashion, footwear and luxury, the traditional playground for item-level RFID implementations, continue to lead overall industry adoption.
- Segments such as beauty and cosmetics have more recently started to gain benefits of item-level inventory control.
- The business case for grocery, which has lagged behind, is gathering momentum by advancements in tag readability and costs and the rising importance of sustainability initiatives.

Recommendations

Retail CIOs evaluating item-level RFID solutions in the physical store to support unified retail commerce for digital business execution should:

- Design and execute an item-level RFID store pilot over the next 12 months by mapping key physical store processes and identifying initial use cases for implementation.

- Articulate and quantify operational efficiencies gained by the use of item-level RFID by conducting a baseline assessment of current processes and measuring ROI through KPIs, such as increase in labor productivity, decrease in shrink and reduction in safety stock.
- Evaluate the impact of deploying item-level RFID solutions to the customer experience by appraising increased product interactions, sales conversions and return visits, as well as assessing positive impact to the store associates.

Introduction

Customers expect to search, transact, acquire and consume products anytime and anywhere. Retailers must provide a fluid, consistent and comprehensive experience across all customer interaction touchpoints to successfully deliver unified retail commerce (URC).

Inventory accuracy and product availability are foundational for a retailer's success and essential to support URC. However, inventory accuracy and proactive out-of-stock management continues to be a challenge for many retailers, which has been further aggravated by the rapid acceleration of store based fulfillment in the wake of the pandemic.

Investments in store inventory management applications tend to fall short of their promised payback and ROI due to high inaccuracies in baseline inventory levels, despite significant time and effort invested by store associates. While not a new technology in retail, item-level RFID has enjoyed a resurgence as a technology to address the severe inventory visibility vulnerabilities that result in inventory distortion in the store due to stock-outs, excess stock or returns.

In addition, a variety of implementation benefits, including real-time inventory visibility, increase in labor savings and improved loss prevention, is further spurring the ROI. The new industry momentum has also been aided by recent item-level RFID supplier mandates issued by retailers like Walmart and Nordstrom. [1,2]

Description

> **Definition**
>
> Item-level RFID technology in the retail store involves tagging and identifying individual inventory units through the transmission of radio waves between an RFID-tagged product and RFID reader. The tags utilized are passive (i.e., non-battery-powered), and the system typically operates in the ultrahigh frequency (UHF) spectrum in the 860 to 960 MHz band.

The term “RFID” has been generally used as an umbrella classification to describe system components across a range of frequencies, from LF (low frequency, 134 kHz) to UWB (ultrawideband, 3-10 GHz). See When and Why Enterprises Should Implement RFID to Track Critical Assets for different types of RFID technologies, frequency ranges and system characteristics.

Store sales remain the greatest contributor to a retailer’s total revenue. The importance of the physical store and enabling technologies have only increased in current market conditions; 80% of retail respondents from the 2023 Gartner CIO and Technology Executive Survey indicated plans to increase store technology investments in 2023. [3] The store continues to play a pivotal role in fulfillment execution to support the growth of digital adoption through Click & Collect, curbside delivery or ship from store. Gartner is observing more and more retailers across several retail segments fulfilling well over 50% or more of their e-commerce orders directly from their stores.

As part of the Internet of Things (IoT), item-level RFID is a significant contributor to a retailer’s data and analytics platform. The technology enables retailers to optimize real-time store inventory visibility and accuracy to reduce safety stock, optimize costs and maintain a compelling product mix.

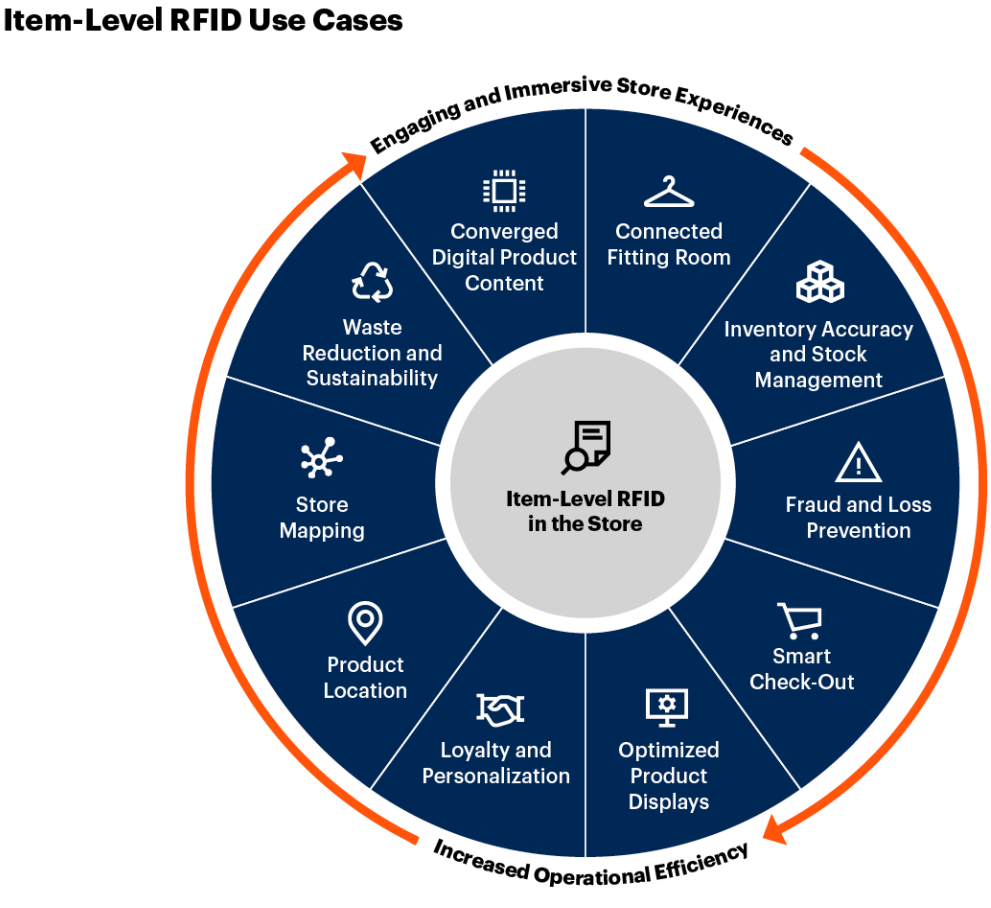
Data generated by item-level RFID can be used to monitor, analyze and display retail store activity through real-time dashboards. IoT-based store monitoring is a high-impact use case as identified in Gartner’s AI research in retail (see Infographic: Artificial Intelligence Use-Case Prism for Long Life Cycle Retail and Infographic: Artificial Intelligence Use-Case Prism for Short Life Cycle Retail). It is integral to understanding the operating pulse of a store in real time, and through AI, to generate continuous intelligence of store operations.

Benefits and Uses

Many retailers continue to struggle with creating compelling experiences for customers and associates in physical locations. Retailers that have deployed item-level RFID have seen significant improvements in execution of in-store processes, realizing material benefits through increased labor productivity, reduction in shrinkage and loss, improved item location accuracy, reduced stock-outs and higher sales.

In particular, retailers can maximize the investment by using item-level RFID to converge their online and offline offerings, elevate customer engagement and use the data as an input to better decision-making. Item-level RFID can yield benefits through a variety of use cases, as summarized in Figure 1.

Figure 1: Item-Level RFID Use Cases



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Inventory Accuracy and Stock Management

Global retailers across a number of segments, such as fashion and apparel, footwear, sporting goods, luxury and department stores, have adopted item-level RFID technology at scale to successfully transform end-to-end visibility of inventory, increase sell-through and improve associate productivity.

The advent of generative AI in retail could unlock significant opportunities for combining the large amount of real-time, item-level data produced by RFID with the processing power of AI for upstream inventory management across a retailer's enterprise. At this early stage, it remains to be seen to what extent generative AI gets embedded into inventory management application suites to derive business value, though retailers need to start thinking about impacts in their technology exploration.

Studies have indicated demonstrated benefits as a result of item-level RFID deployments, including a more than 25% improvement in inventory accuracy, to overall accuracy levels greater than 98%, 1% to 3.5% increases in sell-through due to lower stock-out and better stock management, and 10% to 15% reductions in inventory-related labor hours. [4]

For example, Central American department store chain Siman Group recently deployed item-level RFID from SML to streamline store inventory management and improve inventory accuracy from 65% to 95%+. [5]

Fraud and Loss Prevention

Retailers are investing in item-level RFID as an alternative electronic-article-surveillance (EAS) solution for protection against shrink and theft. Loss prevention (LP) solutions can be integrated with POS; support self-check-out or product returns; and can be deployed as a stand-alone solution. Tagged products that leave a store without the tag nullified at check-out can trigger an alarm, similar to traditional EAS monitoring.

Further, the same RFID tags can be extended to serve additional use cases in the store, including inventory accuracy to extend the ROI of investment. Item-level RFID for EAS has shown to reduce shrinkage and theft, raising revenue by up to 1.5%. [4] Beyond shrink from the store, retailers are also using the technology to monitor authenticity, tackle return frauds and identify stolen products, particularly for high-value goods.

For example, Under Armour deployed an RFID-based asset protection system for loss prevention. While they had already deployed a traditional EAS system, over time they were questioning the level of service, system accuracy and price of the legacy solution.

Instead, the retailer leveraged ceiling-mounted EAS/RFID readers to replace the traditional pedestals installed at store exits. Doing so allowed them to recognize items, capture item-level data analytics for shrink and enable an open entrance layout for the stores. Having RFID-based capability for loss prevention also allowed them to future-proof their investment by rolling out additional use cases for inventory control in the future. [6]

Smart Check-Out

Smart check-out with RFID can be used to automatically recognize selected products, sum up the total basket cost, apply loyalty and promotional benefits, identify the customer, and receive payment. As a result, it eliminates the need to go through the traditional manned check-out lane and improves the in-store shopping journey for the customer, in addition to realizing labor cost efficiencies for the retailer. RFID-based check-out can also be deployed in a traditional manned till to streamline check-out times.

For example, Uniqlo has deployed self-check-out solutions based on RFID in their stores. When placed on the self-check-out counter, products from the shopping cart are readily recognized to tally the total charge and pop up the billing information, allowing the customers to swipe their payment of choice to make the transaction. [7]

Optimized Product Displays

To satisfy customers' needs to see and touch products before making a purchase, it is critical to ensure that product displays are stocked on the store floor. This will also potentially entice impulse purchases. Item-level RFID enables associates to quickly scan product displays in showrooms to identify missing products so they can immediately be replaced.

For example, Lord & Taylor is using RFID to ensure that every shoe sample in its New York Fifth Avenue flagship store is available and on display. Managing a department of thousands of different styles and colors was extremely challenging, especially as those display samples were moved or sold. By transitioning from the legacy bar code system of tracking samples to item-level RFID, associates could easily walk the floor, conduct a full inventory before the store opened each day and quickly replace any missing shoe samples. [8]

Loyalty and Personalization

Retailers are looking to item-level RFID as a means to connect with customers to improve loyalty and personalization. As customers look for increased service and exclusive perks for their continued loyalty, RFID can enable additional personalized experiences for the shopper. RFID can detect high-value customers as they enter the store. When combined with Wi-Fi or Bluetooth low-energy technology, it enables proximity marketing through real-time contextualized messages or offers throughout points of decision making, recommendations of product selections based on purchase history, clothing sizes, preferred styles and more.

For example, Chanel partnered with Farfetch to enable engaging and personalized experiences for regular clients visiting their flagship stores in France through the use of RFID. Using the Chanel app, clients can prechoose runway or precollection looks and ideas before entering a boutique. They can then book an appointment, and their choices will be ready when they arrive. As shopping assistants, referred to as fashion advisors, bring merchandise into RFID-enabled smart fitting rooms, the system can detect the item and then display that look from the original runway show, along with close-up details and videos of models wearing it on the runway. [9]

Product Location

RFID can be used to precisely identify where products are located within a store or in the stock room. This enables the store associates to quickly find products within the store for a customer or replenish products from the stockroom.

As there has been an uptick in store-based fulfillment of e-commerce orders, item-level tagging vastly improves fulfillment accuracy and efficiency for retailers and can improve overall store profitability. It also results in faster, improved pick rates and efficiency by store associates to meet the customer promise. Accurate visibility of inventory location also eliminates the need for separate stock for online order fulfillment and store orders, which can create additional value due to reduction in safety stocks and overproduction.

For example, Lululemon's item-level RFID deployment leverages real-time data to provide accurate store inventory visibility and locationing of key fulfillment experiences, such as buy online, pickup in-store (BOPIS). This has also allowed them to proactively manage inventory at a granular level across their store network and distribution centers. [10]

Store Mapping

Data gleaned from RFID-based zones mapped within the store can help retailers track sales by areas of the store, location of best-selling items and sales distribution across the shop floor. This process is called “money mapping” and can arm retailers with critical sales insights to inform visual merchandising decisions, as well as to measure results.

By combining item-level RFID data with AI and machine learning, store management can analyze sales by area, identify parts of the store that are “hot spots” for sales and prioritize the best locations for best-selling goods, high-value items and promotions. In addition, this capability allows retailers to compare performance by store to track comparable sales.

A global apparel retailer has been testing a money-mapping solution across several stores in Europe for its advanced store analytics as part of its investment in RFID.

Waste Reduction and Sustainability

RFID can provide greater visibility into the end-to-end supply chain, enabling retailers to manage inventories more efficiently and reduce waste. In particular, the technology offers significant potential for the food and grocery industry to reduce waste through visibility of exactly what is in stock on the shelf and the proactive management of shelf life. This can substantially reduce surplus food and waste and lower greenhouse emissions generated through methane, a gas 25 times more powerful than carbon dioxide at trapping heat in the atmosphere. [11]

Over the past 24 to 36 months, Gartner has seen a number of retailers placing environmental sustainability in the center of their strategic focus areas, to directly combat wastage and climate change. Assortment management is the primary discipline that a grocery retailer can use to reduce food waste, and item level RFID can directly impact this in the store. Grocery retailers are also leveraging new food-waste programs to cut costs, improve sales and better manage inventory with a limited shelf life. [12]

For example, Japanese convenience store brand Family Mart conducted an item-level RFID pilot in their stores to proactively track food items that have approaching sell-by or consume-by dates. Premium loyalty points, discounts and other incentives were offered on the products to nudge customers to purchase them through the retailer’s consumer app. [13]

Converged Digital Product Content

Some retailers have turned to item-level RFID as a conduit to bring rich, digital product content to physical products in-store. This elevates the shopping journey from transactional to experiential by converging "'digital-like" experiences in the physical store.

For example, Nike leverages item-level RFID for multitouch smart tables in select stores to create this converged experience. When a customer places an RFID-tagged shoe on a smart table, the display reacts by displaying media and information specific to that shoe, such as inventory levels, available sizes, styles and alternate colors. This can help drive the customer's purchase decision by providing a more engaging and enriching store interaction. [14]

Connected Fitting Room

RFID technology has been used to further enrich the shopper experience by creating more-engaging interactions as customers try on items in the fitting room. Customers who use the fitting room have a greater propensity to purchase products and are less likely to return them, than customers who only browse the store.

Data available from the RFID-tagged item allows retailers to garner rich analytics data through its journey through the store (e.g., to and from a fitting room). This data can, in turn, be used as input for new product development and to optimize assortment. RFID also makes it easier to find things that customers leave behind in a fitting room.

For example, H&M Group has launched a new in-store technology-based shopping experience in its COS stores across the U.S., which includes a smart mirror that allows customers to request items without having to leave the fitting room. The mirrors will recognize products brought into the room — spotting the item, size and color — and possibly offer personalized product and styling recommendations. [15]

Risks

Gartner research and client inquiry over the years has revealed several risks and challenges associated with the acceptance and implementation of item-level RFID by retailers. Retail CIOs should be cognizant of the following areas as part of their due diligence of evaluating the technology:

- Implementation of item-level RFID needs to be accompanied by business process change to inform how the RFID data can be used to optimize or enhance existing processes. The technology is often rolled out without the necessary redesign of the accompanying processes, thereby restricting its value and ROI.
- Further, the ROI associated with the technology needs to be measured separately from that of business process optimization, which in itself can yield improvements.
- Costs of RFID hardware and tags have significantly reduced over the years. However, the initial deployment costs, as well as ongoing investments for item-level tagging, still present a significant cost driver compared with next-best alternatives, such as bar code labels or manual counting, which can be a fraction of the cost of RFID. In addition, efficiencies of scale are often yielded through source tagging of goods at the point of manufacture, which poses a challenge for multibrand retailers that do not own the end-to-end supply chain.
- Adequate security and authentication safeguards need to be in place to ensure that the data embedded within an RFID tag is not cloned or overridden, or other such fraud on high-value items in the store is not perpetrated.
- RFID data needs to be integrated with the underlying core systems in the store and back office to derive the value of item-level inventory visibility or similar KPIs. However, we find that the needed expertise and skill set to integrate and onboard the technology is out of reach for a significant portion of retailers.

Adoption Rate

Specialty retail, particularly in apparel, footwear, fashion and luxury, have long led item-level RFID adoption in retail, with well-understood and widely known deployments geared toward item-level inventory accuracy and tracking, deployed at scale with proven ROI.

Segments such as food and grocery, and beauty and cosmetics, have been slower to adopt, due to readability challenges in ambient environments, such as liquid, metal or variable temperature. UHF tag technology advancements and drastically decreasing tag costs are helping further this business case.

For example, a UHF RFID tag solution designed for item-level tagging of frozen packaged foods, geared toward product shelf availability and to reduce food waste in grocery stores. Similarly, UHF RFID labels that can be applied to item-level metal or foil packaging and liquid goods are available for the beauty and cosmetics segment. We expect this should drive commensurate adoption in these segments.

Item-level RFID in Grocery

Item-level RFID can be applied to additional store use cases in the food and grocery industry beyond inventory control. For example:

- **Expiration management:** Product expiration dates can be directly encoded into the item-level RFID tag, allowing store associates to scan multiple items at once and significantly cut down the time and labor required to check for expiration dates and remaining shelf life for individual items.
- **Product recalls and traceability:** RFID can enable item-level traceability of goods in the event of product safety recalls, particularly when combined with other track-and-trace technologies, resulting in much faster turnarounds to recalls.
- **Ambient detection:** Item-level RFID tags with built-in sensors that measure different ambient conditions (e.g., temperature, humidity, and pressure) can contribute to preserving product quality in the store and can alert any anomalies in the ambient environment to extend shelf life of perishable goods.

Item-level RFID in Beauty and Cosmetics

Beauty and cosmetics retailers have begun to investigate and test item-level RFID technology. This is a result of RFID tag technology advances and commercial availability of smaller size, lower cost tags conducive to tracking small items in cosmetics.

Use cases where item-level RFID has seen proven success in other segments translate well into this segment, however there are some key considerations:

- The size and shape of an RFID tag is critical for tracking small items like cosmetics.
- As beauty and cosmetics items vary in size and shape, the appropriate RFID tag must be considered based on the type, shape and size of each product to be tagged.
- Smaller tag sizes needed will have a direct correlation on read range; given the small nature of tags, general read ranges tend to be lower, typically between three and five feet.

New Innovations

- Technology startup Radar has built a proprietary overhead sensor that can be mounted on a store ceiling. It combines RFID technology with computer vision, which allows for improved item-level identification, location accuracy and analytics. U.S. apparel retailer American Eagle recently announced the deployment of this solution for item-level inventory to about 500 of its stores over the next year. [16]

- Australian retailer Kmart has rolled out an inventory-tracking initiative to have all the goods it sells across its more than 300 stores across Australia to be RFID-tagged. The items are read by Tory, an autonomous smart robot solution from Metralabs with embedded RFID readers that traverses store aisles at night. [17]

- Amazon has recently released RFID technology in select smart check-out stores. The technology will use RFID tags on loose apparel and soft goods as a way to authenticate the sale of such merchandise. A RFID-powered store does not require cameras and sensors typically found in “Just Walk Out” implementations. Instead, customers select the merchandise they want and use a credit card or Amazon One at exit to pay for the items they left the store with, without having to wait in line. [18]

- Israeli luxury retailer Factory 54 has deployed a solution from technology startup Nexite that leverages passive Bluetooth low-energy (BLE) to provide real-time location of apparel, shoes and other accessories. The offering is a direct alternative to item-level RFID use cases and includes item-level tags, overhead readers that communicate via Bluetooth and a cloud-based software platform. [19]

Recommendations

Retail CIOs evaluating item-level RFID solutions in the physical store to support unified retail commerce for digital business execution should:

- Design and execute an item-level RFID store pilot over the next 12 months by mapping key physical store processes and identifying initial use cases for implementation.

- Articulate and quantify operational efficiencies gained by the use of item-level RFID by conducting a baseline assessment of current processes and measuring ROI through KPIs, such as increase in labor productivity, decrease in shrink and reduction in safety stock.

- Evaluate the impact of deploying item-level RFID solutions to the customer experience by appraising increased product interactions; sales conversions and return visits; as well as assessing positive impact to the store associates.

Representative Providers

- Alien Technology
- Avery Dennison
- Checkpoint Systems
- Honeywell
- Impinj
- Johnson Controls (Sensormatic)
- Nedap
- SimplyRFiD
- SML
- Zebra Technologies

Evidence

The findings in this research are supported by Gartner's ongoing research on item-level RFID in retail. It incorporates findings from item-level RFID related client inquiries and vendor briefings with current and proposed Gartner retail clients between 2021 and 2023.

[1] Walmart Recommits to RFID, RFID Journal.

[2] Nordstrom Issues Supplier Mandate for RFID Tags, RFID Journal.

[3] **2023 Gartner CIO and Technology Executive Survey:** This survey was conducted online from 2 May 2022 through 25 June 2022 among Gartner Executive Programs members and other CIOs. The survey was conducted to help CIOs and technology executives overcome digital execution gaps by empowering and enabling an ecosystem of internal and external digital technology producers. Qualified respondents were each the most senior IT leader (e.g., CIO) for their overall organization or some part of their organization (for example, a business unit or region). The total sample was 2,203 respondents, with representation from all geographies and industry sectors (public and private), including 79 from retail. Disclaimer: Results of this survey do not represent global findings or the market as a whole, but reflect the sentiments of the respondents and companies surveyed.

[4] RFID's Renaissance in Retail, McKinsey.

[5] Siman Group Streamlines Stock Management With RFID, Chain Store Age.

[6] Under Armour: Introducing a Game-Changing Loss Prevention Strategy, Nedap.

[7] Uniqlo's Parent Company Bets Big on Tiny RFID Chips, Wall Street Journal.

[8] RFID Helps Lord & Taylor Manage Retail Displays, DC Velocity.

[9] Chanel Planning to Roll Out Its Farfetch Augmented Retail Experience Project in New Stores, Fashion Network.

[10] Lululemon Leverages RFID, Supplier Relationships to Manage Inventory Amid Coronavirus Demand Drop, Supply Chain Dive.

[11] Importance of Methane, U.S. Environmental Protection Agency.

[12] More Grocery Retailers Turning to Food Waste Solutions, The Food Institute.

[13] Japan Uses E-Tags to Check Food Wastage at Grocery Stores; Offers Discounts on Products Nearing Expiry, Asian Community News.

[14] Nike Digital Retail Experience, RedPlant.

[15] H&M Tests Smart Mirrors at COS Stores in a Bid for a More Personalized Experience, Retail Dive.

[16] Radar Brings Its RFID Magic to American Eagle, Women's Wear Daily.

[17] Meet Tory: The Robot Kmart is Using to Manage Inventory at Its Stores, SmartCompany.

[18] Discussions with Amazon.

[19] Nexite Launches Its Connected Merchandise Solution, MarTechCube.

Document Revision History

Innovation Insight for Item-Level RFID in the Transformation of the Retail Store - 10 August 2021

Recommended by the Author

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Hype Cycle for Retail Technologies, 2022

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