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GS1 2D Barcode Playbook for Retail POS Host and Backend Systems

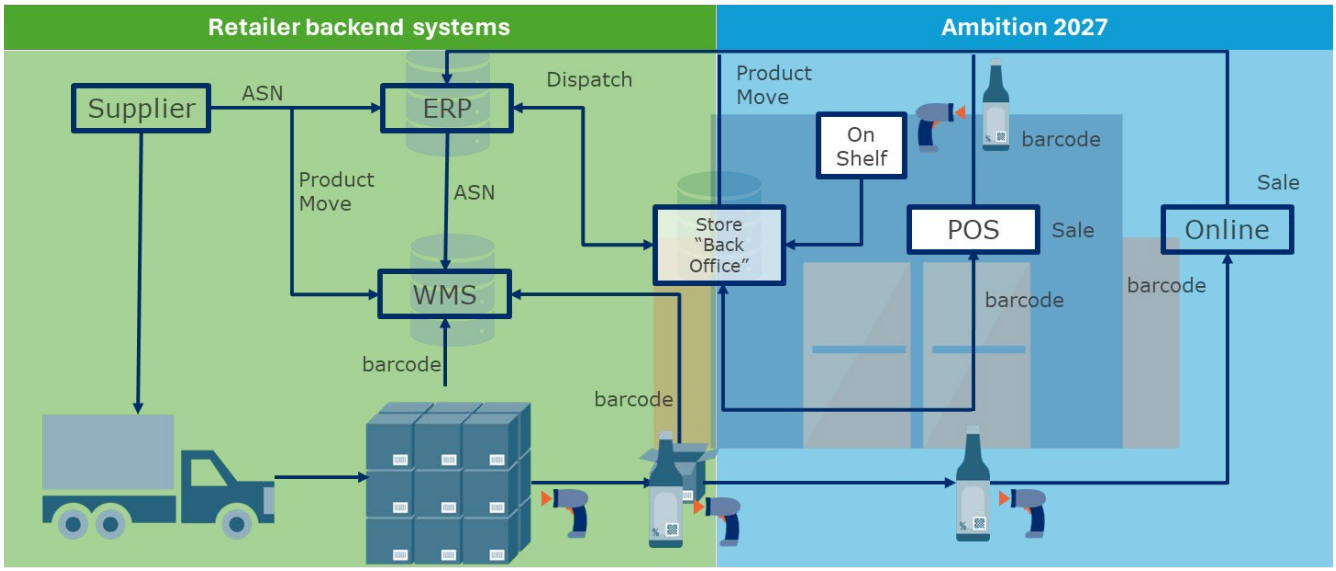

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Table of Contents

1 Introduction

There is a rapidly increasing demand for more information about the products we use and consume. To meet this demand, industry has set a goal that, by the end of 2027 (Ambition 2027), all retail POS systems should be capable of reading and processing a defined set of 2D barcodes with GS1 standards, in addition to existing linear barcodes. As the transition to 2D capability at POS unfolds progressively on different timelines across the globe, brand owners should already be exploring and implementing the most appropriate 2D barcode to address priority use cases for their products and meet critical consumer and business needs. The adoption of GS1 2D barcodes will require software upgrades and may require equipment upgrades if the POS scanner is not already imager-based (camera). Retail scanners capable of decoding 2D barcodes within the retail ecosystem deliver greater value when POS hosts and downstream systems actively parse GS1 Application Identifiers (AIs) and leverage enhanced data—such as expiry dates, batch/lot numbers, serial numbers, amounts payable and URLs—for operational actions.

GS1 and industry are working together to support this migration and generate globally consistent guidance for business use cases. As there is no expectation that there will be a single 2D barcode selected for all industries, GS1 standards are enabling options that empower each industry to choose how they evolve towards more capable 2D barcodes while ensuring globally consistent implementations now and in the future. For example, in healthcare the journey towards 2D started in the early 2000s when industry chose GS1 DataMatrix as the single 2D barcode for product identification. Today there are billions of products with GS1 DataMatrix encoding the GS1 element string syntax. For healthcare products GS1 DataMatrix is the 2D barcode of choice for point-of-sale scanning. Linear barcodes (e.g., EAN/UPC and GS1 DataBar) will not go away and will coexist with 2D barcodes for as long as there are uses for them. During the transition phase, the trade item will feature both the current linear (i.e., EAN/UPC or GS1 DataBar retail POS family) barcode and either a GS1 DataMatrix or QR Code with GS1 Digital Link URI syntax or a Data Matrix with GS1 Digital Link URI syntax.

This playbook serves as the companion document to the GS1 2D Barcode Playbook for Retail Scanners. It provides guidance to retailers, solution providers and system integrators on preparing retail POS host and backend systems for the adoption of GS1 2D barcodes in support of Ambition 2027. It is intended to supplement the 2D in Retail implementation guideline by focusing specifically on preparation for retail system solutions.

2 Understanding the Retail Systems

The retail industry's Ambition 2027 is focused on the Point-of-Sale (POS), but when migrating to GS1 2D barcodes, the store ecosystem must be updated holistically: cashier and self-checkout scanners; POS terminals (printer, display, keyboard, card reader); optional middleware; and the central/back-office retail systems configuration. Retail systems supporting POS transactions, including the POS host system, store back-office systems, enterprise ERP, inventory and fulfilment platforms and analytics environments may all need updates to fully unlock retail use cases like automatic price markdown.

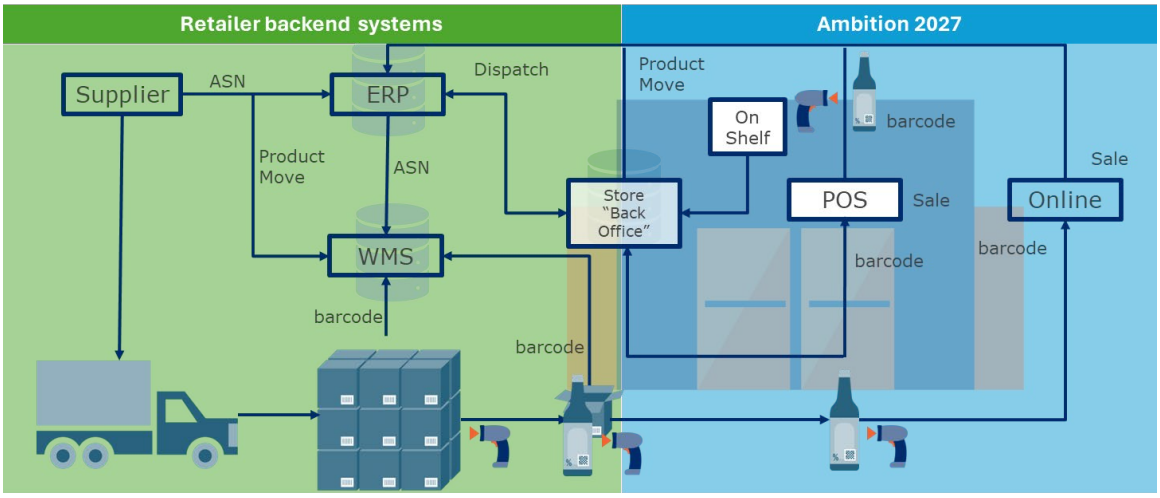

Figure 2-1 Retail systems example

Data content from the 2D barcode expands from GTIN-only AI(01) to include content such as expiry AI(17), batch/lot AI(10), serial AI(21), product version/CPV AI(22) and other GTIN attributes. Retail systems will need updates to remain aligned to GS1 standards to ensure interoperability and future scalability.

In addition to the front-of-store equipment, the retailer's central/head and back office plays a crucial role in configuration management, software updates and system monitoring. Any changes to barcode handling—especially with the introduction of 2D barcodes—must be considered holistically across this ecosystem to ensure compatibility, reliability and efficiency.

3 Preparing Retail Systems for 2D Barcode Adoption

Retail systems form the foundation for realising the value of 2D barcodes beyond the POS. These systems must evolve from the stock keeping unit (SKU) product identification toward GTIN plus attribute identification, while maintaining backward compatibility with existing retail processes.

Some retail systems, like POS host systems may need to support all GS1 barcode syntaxes, 14-digit GTIN processing and optional application identifiers, while other systems will need updates to master data models and controlled data governance. The adoption of GS1 2D barcodes in retail requires, at minimum, the ability to accept and process a GTIN from a GS1 conformant 2D barcode, but to unlock advanced use cases the retail systems need to accept GTIN attributes.

AI	Data Content
01	Global Trade Item Number (GTIN)
10	Batch or Lot Number
11 (**)	Production Date (YYMMDD)
13 (**)	Packaging Date (YYMMDD)
15 (**)	Best Before Date (YYMMDD)
17 (**)	Expiration Date (YYMMDD)
21	Serial Number
22	Consumer product variant
240	Additional product identification assigned by the manufacturer
241	Customer part number
243	Packaging component number
30	Count of Items (Variable Measure Trade Item)
310n (***)	Net weight, kilograms (Variable Measure Trade Item)
320n (***)	Net weight, pounds (Variable Measure Trade Item)
392n (***)	Applicable Amount Payable, single monetary area (Variable Measure Trade Item)
393n (***)	Applicable Amount Payable with ISO Currency Code (Variable Measure Trade Item)
395n (***)	Amount payable per unit of measure single monetary area (variable measure trade item)
422	Country of Origin
7003	Expiration date and time
8008	Date and Time of Production

Figure 3-1 GTIN and GTIN attribute examples

Implementing GTIN with additional data about the item can support the following business use cases and more:

- Consumer and food safety programs at the register and on the consumer receipt
- Improved quality control of products on the shelf
- Food waste prevention/management
- Expiration date management. For example, by encoding the product's expiry date, it becomes possible to automatically prevent the sale of out-of-date products at the POS
- Global or regional traceability initiatives and more effective targeted recalls
- Category/promotional management
- Inventory replenishment and reduced out of stocks
- Returns management
- Improved pricing accuracy at POS (e.g., automatic price mark-downs based on date)
- Global or regional regulatory compliance
- Product authentication and anti-counterfeit

This shift is not merely a technical upgrade—it also requires stakeholder coordination. Retailers must work closely with scanner, printer, POS solution and enterprise solution providers to verify

readiness. GS1 offers valuable tools to support such coordination, including the Barcode Syntax Resource for solution providers, Barcode Test Suites for retailers and brands, 2D in Retail Implementation Guideline, GS1 2D Barcode Colour & Quality Guide and a solution provider capability website on their 2D in Retail readiness.

4 POS Host System Readiness

A POS Host system is the core retail transaction engine that sits between point-of-sale devices and enterprise backend systems. It receives data from scanners, scales, payment devices and other peripherals, interprets that data, applies retail business rules and completes the sale. While scanners capture barcode data, the POS Host is responsible for understanding that data and determining how the transaction proceeds.

The POS Host receives barcode data transmitted by scanners using standard retail interfaces and identifies the Global Trade Item Number (GTIN) used for price lookup. It can receive data from both linear barcodes (EAN/UPC) and GS1 2D barcodes. Depending on system readiness, this data may include only the GTIN or additional attributes such as batch/lot number, expiration date or serial number.

Once scan data is received, the POS Host parses and interprets it using GS1 conformant barcode syntaxes, including plain syntax, GS1 element string syntax and, where supported, GS1 Digital Link URI syntax or its translated equivalent. It determines which data elements are relevant to the transaction and ensures that the correct item is identified. The POS scanner transmits barcode data based on its setup and capabilities, even when several barcodes are present on a product during the shift from linear to 2D barcodes. For more information, refer to the GS1 2D Barcode Playbook for Retail Scanners Guide.

The POS Host then applies real-time business logic as part of the checkout flow. This includes price lookup, promotion and discount application, tax calculation and validation rules such as expiration date checks or sale blocking for recalled items, where enabled. These decisions must occur instantly and without disrupting checkout speed, as they directly affect the cashier or self-checkout experience.

In addition to executing transaction logic, the POS Host controls the checkout flow and operator interaction. It determines whether the barcode data is accepted or rejected, triggers prompts or messages to the user interface, manages transaction states such as rescans or voids and ensures that only a single transaction is created per item.

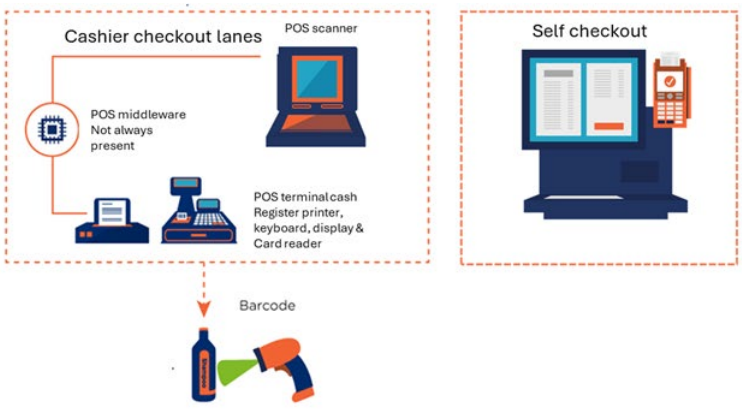

Figure 4-1 POS host system examples

4.1 POS Host System — Essential Steps

Ensure systems can use additional data to support new business use cases:

- Host accepts 14-digit GTINs:

  - e.g., 14-digit GTIN 09506000134352 vs GTIN-13 9506000134352
  - evaluate item lookup table to ensure the linear barcode GTIN and 2D barcode GTIN identify the same item
  - for data beyond GTIN such as expiry date the host system will need to be updated to unlock the uses cases see Figure 3-1 for some Application Identifiers (AIs) and the GS1 General Specifications for all relevant AIs.
- Parsing layer: update to accept GS1 element strings and/or convert GS1 Digital Link URIs to element strings using syntax resources; preserve FNC1/Group Separator handling.
  - all received data should be saved for future use in host or retailer's backend system use case
- Business rule updates might include:
  - implement expiry stop-sale
  - targeted recall blocking by batch/lot or serial number
  - price mark-down automation (based on date/AI 17 or business rules)
- Receipts & audit: capture additional fields where applicable; consider consumer visible data on receipts for safety programs.

> **Note**: It is best practice to pilot any software updates or test in a retail lab to prove out processes before store deployment.

5 Backend Systems and Data Flow

A Retail Backend system is the set of enterprise platforms that manage, store and act on retail data beyond the point of sale, supporting core business operations across stores, distribution and the wider supply chain. Retail backend systems sit logically above the POS Host and are responsible for maintaining master data, inventory state, fulfilment, compliance, analytics and long term records. While the POS Host focuses on completing the transaction in real time, backend systems ensure that transactions, product data and inventory movements are correctly reflected and governed across the enterprise.

The backend systems that this playbook with focus on are:

- Enterprise Resource Planning (ERP)
- Inventory & Fulfilment Management Systems
- Warehouse Management Systems (WMS)
- Returns and Reverse Logistics
- Recall, Compliance and Traceability
- Analytics, Reporting and Governance

Retail backend systems use transaction data from the POS Host and other operational systems and reconcile it with product master data, pricing, promotions and financial records. They manage item identification using the GTIN as the primary key while increasingly supporting additional item attributes such as batch/lot number, expiration date, production date, serial number and product version. This capability becomes especially important with the introduction of GS1 2D barcodes, which enable richer data capture at the point of sale and throughout the supply chain.

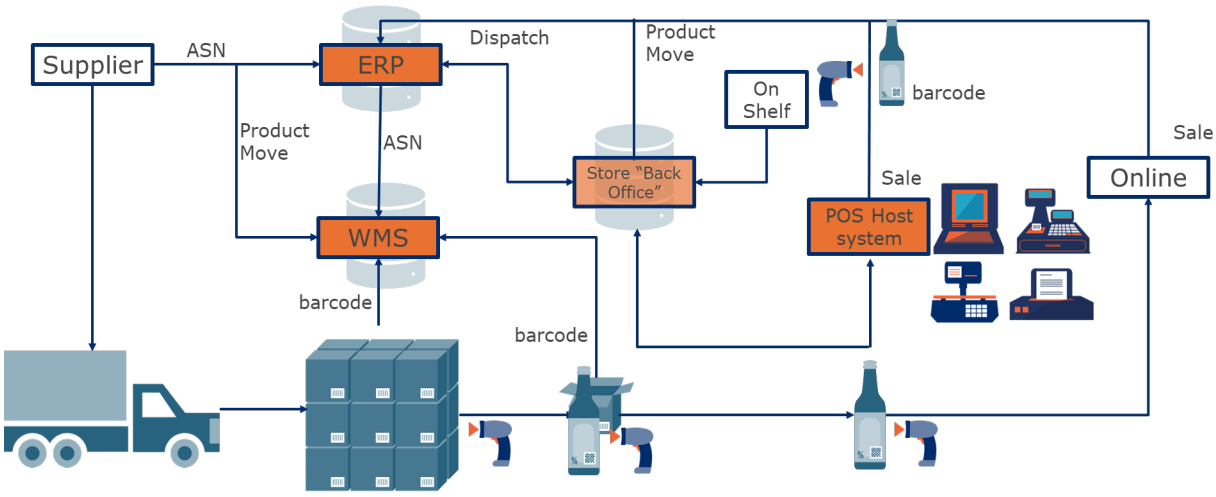

Figure 5-1 Retail system connections example

A core function of retail backend systems is inventory and fulfilment management. These systems track stock across stores, warehouses and in transit locations, while increasingly supporting inventory visibility at batch/lot, date or serial level rather than only at stock keeping unit (SKU) level. This enables processes such as first-expired-first-out (FEFO), targeted recalls, waste reduction and more precise replenishment. Backend systems also support order management, warehouse operations and returns, using captured item attributes to validate shipments, prevent the resale of expired or recalled products and reduce fraud.

Retail backend systems also play a critical role in compliance, traceability and reporting. They provide the data foundation for regulatory reporting, recall execution and auditability, often integrating with traceability frameworks and event based data such as EPCIS where applicable. Analytics and business intelligence platforms connected to backend systems use this data to generate insights into sales performance, inventory health, supplier quality and product lifecycle trends.

In the context of GS1 2D barcodes, retail backend systems are where much of the long term value is realised. While scanners and POS Hosts capture and interpret data in real time, backend systems persist, govern and analyse that data across the enterprise. Without backend readiness to store and use richer item level information, retailers may scan 2D barcodes at checkout but remain limited to traditional linear behaviours, missing opportunities for improved traceability, efficiency and compliance

Backend systems form the foundation for realising the value of GS1 2D barcodes beyond the point of sale. These systems must evolve from SKU product identification toward GTIN(Item) plus attribute identification, while maintaining backward compatibility with existing retail processes.

5.1 Enterprise Resource Planning (ERP)

A Retail Enterprise Resource Planning (ERP) system is the core enterprise platform that manages and integrates a retailer's fundamental business processes, including product master data, pricing, finance, procurement, supplier management and enterprise wide reporting. It serves as the system of record that ensures consistency and control across stores, distribution centres and digital channels, while coordinating with operational systems such as the POS Host, inventory and fulfilment platforms and warehouse management systems. In retail environments, the ERP anchors key business rules and financial integrity while enabling scalable operations across regions and banners.

A retail ERP system maintains authoritative product and pricing data, typically using the GTIN as the primary identifier and ensures that price lookup, tax calculation, promotions and financial posting are applied consistently across the enterprise. With the adoption of GS1 conformant 2D barcodes, retail ERP systems increasingly need to support additional item attributes such as batch/lot number, expiration date, production date, serial number and product version. While transactions remain

financially anchored to the GTIN, these attributes are stored and referenced to support downstream use cases including traceability, recall management, inventory governance and regulatory compliance.

Retail ERP systems also play a central role in financial reconciliation and reporting. They receive transactional data from POS Hosts and other systems, post sales, returns and adjustments to the general ledger, manage accounts payable and receivable and support audit and compliance requirements. By integrating enriched item level data captured from 2D barcodes, ERP systems can improve accuracy in shrink analysis, recall cost attribution, supplier performance assessment and lifecycle reporting.

In the context of 2D barcodes, the retail ERP system is a critical enabler of enterprise consistency and governance. While scanners and POS Hosts capture data and backend operational systems execute day-to-day processes, the ERP ensures that product identification, financial outcomes and compliance obligations remain aligned and auditable across the retail organisation. Without ERP readiness to accommodate richer item data alongside traditional GTIN based processes, retailers risk limiting the enterprise wide value of the transition to 2D barcodes.

ERP system support for multiple identifiers per trade item is essential, particularly during the transition period where linear and 2D barcodes coexist. ERP systems should keep price lookup, tax logic and financial reconciliation tied to the GTIN, while also supporting the storage and use of additional identifier attributes for downstream processes.

5.1.1 ERP — Essential Steps

Ensure systems can use additional data to support new business use cases:

- Master data schema expansion:
  - add fields for batch/lot number, serial number, expiration date, production date and other GTIN attributes.
  - support multiple identifiers per item (GTIN + GTIN attributes + internal codes).
  - enable hierarchical or nested product relationships (item → version → batch/lot → serial).
  - increase character limits and data structure flexibility to ingest GS1 AIs and potentially GS1 Digital Link URI.
- Ensure Data Model alignment for SKU/GTIN (product level) or price lookup especially for variable measure
  - ensure the data messaging is updated
  - establish FACT table (product information table)
- Mode control requests for additional data for just GTIN (Mode 1) or additional data (Mode 2 & 3). For more information on modes, see GS1 2D Barcode Playbook for Retail Scanners Guide
- Inbound data:
  - accept 2D encoded data from POS, WMS, suppliers;
  - validate AI associations and mandatory fields.
- Traceability & Business Intelligence:
  - enable end-to-end batch/lot and serial tracking
  - adjust dashboards for expiry loss, recall scope, supplier quality and lifecycle performance.

5.2 Inventory & Fulfilment Management Systems

A Retail Inventory and Fulfilment Management System is the enterprise platform responsible for coordinating inventory visibility with order orchestration and execution across stores, distribution centres and digital channels. It combines inventory status with fulfilment logic to determine where products should be sourced from and how orders should be completed, whether for in-store replenishment, e-commerce, click and collect, ship from store or returns. Positioned within the retail backend landscape, this system works alongside the POS Host, ERP, warehouse management and

transportation systems to ensure that inventory is not only accurately tracked but also efficiently deployed to meet customer demand.

The system continuously uses data from POS transactions, warehouse operations, store receiving and inventory movements to maintain an up-to-date view of on-hand, available to promise and reserved stock across all locations. It applies fulfilment rules and constraints such as location priority, service level commitments, inventory freshness and regulatory requirements to decide how each order should be sourced and routed. With the adoption of GS1 2D barcodes, retail inventory and fulfilment systems can also leverage item level attributes such as batch/lot number, expiration date or serial number, enabling more precise allocation, first-expired-first-out (FEFO) logic and prevention of shipping expired or recalled products.

Retail inventory and fulfilment management systems also play a key role in handling exceptions and reverse flows, including substitutions, partial shipments, returns and recalls. They use enriched item data to validate returns, manage restocking decisions and ensure that affected inventory is quarantined or removed from fulfilment pools when required. By coordinating inventory and fulfilment decisions across channels, these systems help retailers improve order accuracy, reduce waste, increase inventory utilisation and deliver a consistent customer experience.

In the context of 2D barcodes, the inventory and fulfilment management system is where richer identification data translates directly into operational efficiency and risk reduction. While scanners and POS Hosts capture and interpret barcode data at transaction points, inventory and fulfilment systems persist, evaluate and act on that data over time, enabling smarter sourcing decisions, stronger traceability and greater resilience across the retail supply chain.

5.2.1 Store Inventory & Fulfilment — Essential Steps

Fulfilment & Inventory systems must support tracking stock at batch/lot, date or serial level rather than solely at SKU level. This enables First-Expired-First-Out (FEFO) or First-In-First-Out (FIFO) logic to be applied automatically. Systems should differentiate inventory by expiry date where applicable and support segregation of stock during recalls, withdrawals or quality events.

- Inventory:
  - track stock at batch/lot or serial level
  - support FEFO processes using expiry data
  - differentiate price or handling based on version/attributes.
- Receiving & returns:
  - parse 2D barcode data on goods receipt to capture batch and expiry
  - validate returns by matching serial or batch/lot to original sale records to reduce fraud.
- Mobile Computer Apps:
  - enable mobile/store apps to decode 2D barcodes (e.g., QR Code with GS1 Digital Link or GS1 DataMatrix) for lookups and operational checks (e.g., expiry, price adjustments).

5.3 Warehouse Management Systems (WMS)

A Retail Warehouse Management System (WMS) is the enterprise system responsible for managing the physical movement, storage and handling of inventory within distribution centres and fulfilment facilities that support retail operations. It controls warehouse activities such as receiving, put away, storage, picking, packing and shipping and ensures that inventory is processed efficiently and accurately as it flows between suppliers, warehouses, stores and customers. Within the retail systems landscape, the WMS works closely with inventory & fulfilment management order management, transportation and related systems to execute fulfilment decisions and maintain inventory integrity.

A WMS mainly handles operations within a warehouse or distribution centre, whereas an inventory and fulfilment system acts as a decision making layer that coordinates activities across various locations and channels, rather than being limited to just one warehouse.

A retail WMS captures and processes identification data at each warehouse touchpoint, using barcode scans or other automatic identification methods to confirm what was received, where it was

stored and how it was dispatched. Traditionally focused on SKU or GTIN level identification, modern retail WMS platforms increasingly support GS1 2D barcodes, enabling the capture of richer item attributes such as batch/lot number, expiration date, production date or serial number. This allows warehouses to manage mixed pallets, enforce lot or date control, apply first-expired-first-out (FEFO) or first-in-first-out (FIFO) picking rules and prevent the shipment of expired or recalled products.

The WMS also optimises warehouse labour and space utilisation by directing operators through system driven workflows that prioritise efficiency, accuracy and compliance. It validates inbound and outbound shipments against expected data, supports quality checks and quarantine processes and provides real time visibility into warehouse inventory status.

In the context of 2D barcodes, the retail WMS is another key enabler of traceability and operational precision. While scanners and upstream systems capture identification data, the WMS persists and applies that data throughout warehouse operations, supporting recall readiness, regulatory compliance, reduced wastes and improved inventory accuracy. Without WMS support for richer item level data, the benefits of 2D barcodes cannot be fully realised within warehouse operations.

5.3.1 WMS — Essential Steps

WMS platforms must be capable of ingesting and processing GS1 application identifiers captured from 2D barcodes during receiving, put away, picking and shipping. Receiving workflows should capture batch/lot, expiry or serial data at inbound scan points. Picking and allocation logic should use this data to enforce FEFO, lot control and regulatory constraints. Support for mixed pallets and serialised handling may be required depending on category and regulatory environment.

- Update ASN (Advance Shipping Notice) processes to include granular product data
  - incorporate GTIN attributes for version, batch/lot, expiry, serial; support mixed pallets and serialised tracking.
- Data Model:
  - incorporate version, batch/lot, expiry, serial; support mixed pallets and serialised tracking.
- Receiving/Put away/Pick:
  - capture GTIN attributes (AIs)for version, batch/lot, expiry from inbound goods
  - implement FEFO aware put away and picking algorithms.
  - implement data validation rules to reject shipments with bad or missing AIs.
- Traceability:
  - support audits and recalls
  - link physical identifiers to digital content and resolver endpoints for rapid information access.

5.4 Returns and Reverse Logistics

Retail returns and reverse logistics are best thought of as a functional domain within the retail backend rather than automatically a single, standalone system. In many retail environments, returns and reverse logistics capabilities are distributed across multiple backend systems, such as the POS Host, inventory management, order management, warehouse management and financial systems. For example, a simple in-store return may be initiated at the POS Host, validated against original sales data held in backend systems and then reflected in inventory and financial records without ever touching a dedicated “returns system.”

5.4.1 Returns and Reverse Logistics — Essential Steps

Backend systems should leverage 2D barcode data to validate returned items against original sales transactions. Batch/lot and serial validation can reduce fraud, support safety checks and determine restocking eligibility. Expiration data may be used to automatically route returned items for disposal or quarantine.

- Verification: match serial and batch/lot against the original sale to authenticate returns and detect fraud.
- Condition & expiry: use encoded dates and batch/lot to determine restock vs disposal; align with safety and regulatory rules.

5.5 Recall, Compliance and Traceability

Backend systems must support targeted recall execution using batch/lot or serial identifiers captured at POS and throughout the supply chain. Integration with traceability platforms and regulatory reporting systems enables faster, more precise response to safety events. Where applicable, alignment with EPCIS event data can support end-to-end visibility.

5.5.1 Recall, Compliance and Traceability — Essential Steps

Ensure systems can execute targeted and auditable recalls.

- automate recall blocking by ensuring batch/lot or serial identifiers are captured at POS and across supply chain events
- ensure backend systems can identify affected inventory precisely
- enforced at POS and fulfilment
- integration with traceability platforms or EPCIS is supported where required

5.6 Analytics, Reporting and Governance

2D barcodes can significantly improve retail analytics, reporting and governance by enabling retailers to move from aggregated, SKU insight to GTIN granularity attribute level visibility across the product lifecycle. Traditional linear barcodes typically contain only the GTIN, which limits analytics to what was sold and where. GS1 2D barcodes, by contrast, can encode additional attributes such as batch/lot number, expiration date, serial number and product version, allowing retailers to understand not just what sold, but which specific items sold and under what conditions.

From an analytics and reporting perspective, this richer data enables more precise measurement of inventory performance, waste and risk. Retailers can analyse sell through and shrink at batch/lot or expiry date level, identify products that consistently approach expiry before sale and measure the effectiveness of markdown or FEFO strategies. In regulated or safety critical categories, analytics can also support faster and more targeted recall reporting, supplier quality analysis and compliance dashboards. Over time, this attribute level data can feed advanced analytics and machine learning models that improve demand forecasting, replenishment accuracy, shelf-life optimisation and loss prevention.

2D barcodes also strengthen data governance by making item identification more explicit, structured and standards based. When GS1 Application Identifiers are used consistently, retailers can define clear policies about which data elements are captured, stored, shared and retained across systems. Governance frameworks can specify, for example, which attributes are required at POS, which are optional and which must be preserved for audit, recall or regulatory purposes. This improves data consistency across POS, inventory, fulfilment and analytics platforms and reduces ambiguity or misuse of unstructured barcode data.

In addition, 2D barcodes improve accountability and auditability across the retail enterprise. Transactions and inventory movements can be traced back to specific batches or serialised items, enabling more accurate audits, dispute resolution and regulatory reporting. For serialised or high-risk products, governance controls can be applied to protect sensitive identifiers, enforce access controls and comply with privacy or security requirements. As a result, retailers gain not only better insight, but also stronger control over how product data is managed and trusted across the organisation.

Overall, 2D barcodes shift retail analytics and governance from a retrospective, aggregate view of sales to a forward looking, data driven capability that supports efficiency, compliance and continuous improvement. Without backend systems ready to capture and govern this richer data, the analytical and governance benefits of 2D barcodes remain largely unrealised.

5.6.1 Analytics, Reporting and Governance — Essential Steps

The introduction of item level attributes significantly increases data volume and sensitivity. Retailers should define governance policies for which application identifiers are captured, stored and retained. Analytics platforms should be updated to leverage new data for insights into waste reduction, shelf life performance, supplier quality and compliance reporting.

- Data lake (centralised data repository) ingestion:
  - bring in batch/lot, expiry and serial events and POS transaction enrichments
  - analyse expiry related losses and sell through, batch/lot performance, supplier discrepancies and lifecycle analytics.
- Governance: define which AIs must be captured, retention periods, privacy controls for serialised identifiers and exception workflows (e.g., missing expiry).
- Machine learning opportunities: predictive replenishment, recall risk modelling, shelf-life optimisation and markdown effectiveness.

6 Operational Considerations and Best Practices

Migrating retail host and backend systems to support 2D barcodes is not a one-size-fits-all effort and requires careful coordination across transaction processing, data management and enterprise workflows. During the transition period, host and backend systems must be designed to reliably handle the coexistence of linear and 2D barcodes on the same product, ensuring that a single GTIN is consistently recognised and that duplicate or conflicting item identification does not disrupt pricing, inventory or financial records. Clear rules for barcode precedence, data parsing and exception handling are essential to maintain transaction integrity while enabling forward looking capabilities.

Operational readiness also depends heavily on how host and backend systems interpret and act on the additional data encoded in 2D barcodes. Systems should be configured to process GS1 barcode syntaxes consistently and to clearly distinguish between data elements that are required for transaction completion and those that are optional or informational. This helps prevent unnecessary transaction delays while allowing retailers to progressively enable advanced use cases such as expiration checks, recall blocking or batch level traceability as backend capabilities mature.

Effective training and change management extend beyond frontline staff to include IT, operations and support teams responsible for host and backend systems. These teams must understand how 2D barcode data flows from scanners through the POS Host into inventory, fulfilment, analytics and reporting systems and how system prompts, warnings or rejections are generated. Clear operational procedures are needed so that the store and the support teams can respond quickly and consistently when exceptions occur, such as duplicate scans, invalid data elements or backend validation failures.

Finally, retailers should maintain close collaboration with their POS and backend solution providers, GS1 Member Organisations and industry working groups throughout the transition. Participating in pilots, controlled rollouts and feedback loops allows retailers to validate host and backend behaviour under real operating conditions, refine system configurations and stay aligned with evolving standards and best practices. This collaborative approach helps ensure that backend readiness keeps pace with scanner capability, enabling retailers to safely unlock the full value of 2D barcodes over time.

7 Conclusion

The transition to GS1 2D barcodes represents a foundational shift in how retail systems identify, process and govern product data across the enterprise. While Ambition 2027 is anchored at the point of sale, the true value of 2D barcodes is realised only when POS hosts and backend systems are prepared to consistently parse, store and act on richer item level data. This playbook has outlined how retail systems must evolve beyond GTIN-only identification toward item plus attribute capabilities, while maintaining backward compatibility and operational stability during the transition period.

Achieving readiness for 2D barcodes is not a single upgrade, but a coordinated transformation spanning POS hosts, ERP, inventory and fulfilment systems, warehouse operations, returns processing, analytics and governance. When implemented holistically, 2D barcodes enable safer products, reduced waste, more precise recalls, improved inventory accuracy and stronger regulatory compliance, while also laying the groundwork for advanced analytics and machine learning–driven insights. Collaboration across retailers, solution providers and GS1 Member Organizations will be critical to ensure interoperable, standards based implementations that scale globally.

By preparing retail systems now, retailers can move beyond simple barcode scanning toward a more resilient, transparent and data driven retail ecosystem. This readiness not only supports Ambition 2027, but positions retailers to meet evolving consumer expectations, regulatory demands and business innovation opportunities well beyond the transition to 2D barcodes.

By following the steps outlined in this playbook and aligning with GS1's best practices, retailers and their partners can ensure a smooth and future proof transition to 2D barcode enabled retail host and backend systems. Section 8 has a check list to help ensure no major steps are missed.

8 Retail POS Scanner Readiness Checklist for 2D Barcodes

8.1 Retail Systems Readiness Checklist

Confirm that the overall retail systems landscape has been assessed and aligned for 2D barcode adoption.

- ☐ POS hardware includes imager based scanners capable of decoding GS1 2D barcodes
- ☐ POS terminals and peripherals are validated for compatibility with updated POS host software
- ☐ Middleware or integration layers are reviewed for barcode data pass through limitations
- ☐ Central/back-office systems are included in scope for barcode related updates
- ☐ Coexistence of linear and 2D barcodes is explicitly supported across systems
- ☐ End-to-end data flow from scanner to backend has been documented and validated

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8.2 Preparing Retail Systems for 2D Barcode Adoption Checklist

Ensure retail systems can move from GTIN-only identification to GTIN plus attribute processing.

- ☐ Systems can accept and process GTINs encoded in GS1 2D barcodes
- ☐ Support exists for 14-digit GTIN handling where applicable
- ☐ Additional GS1 Application Identifiers (AIs) can be ingested, stored or ignored safely
- ☐ Backward compatibility with existing linear barcode processes is preserved
- ☐ Data models and interfaces are reviewed for extensibility and scalability
- ☐ Stakeholders across IT, operations and solution providers are aligned on scope and sequencing

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8.3 POS Host System Readiness Checklist

Validate that the POS Host can correctly interpret and act on 2D barcode data.

- ☐ POS Host accepts scan input from both linear and 2D barcodes
- ☐ GTIN lookup returns identical item records regardless of barcode type
- ☐ Parsing logic supports GS1 Element String syntax
- ☐ GS1 Digital Link URIs are either supported natively or translated into element strings
- ☐ FNC1 / Group Separator handling is preserved and validated
- ☐ Business rules support optional use cases such as:
  - ☐ Expiry date stop sale
  - ☐ Batch/lot or serial based recall blocking
  - ☐ Date based price markdown automation
- ☐ POS Host ensures a single transaction per item even when multiple barcodes are present
- ☐ Receipts and audit logs can capture additional item attributes where required
- ☐ Software updates are piloted and validated prior to store rollout

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8.4 Backend Systems and Data Flow Checklist

Confirm backend systems can ingest, persist and govern enriched barcode data.

- ☐ Backend systems receive enriched transaction data from the POS Host
- ☐ GTIN remains the primary key for pricing and financial reconciliation
- ☐ Additional item attributes (batch/lot, expiry, serial, version) are supported in data models
- ☐ Data integrity is preserved across interfaces and integrations
- ☐ Attribute data is retained for downstream operational, analytical or compliance use cases
- ☐ Governance rules define which data elements are mandatory, optional or ignored

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8.5 ERP System Readiness Checklist

Ensure ERP platforms support extended item identification and traceability.

- ☐ Master data schemas include fields for:
  - ☐ Batch/lot number
  - ☐ Expiration date
  - ☐ Production date
  - ☐ Serial number
  - ☐ Product version / CPV
- ☐ Multiple identifiers per trade item are supported during barcode coexistence
- ☐ Character limits and data structures accommodate GS1 AIs and Digital Link data
- ☐ Pricing, tax and finance logic remains anchored to the GTIN
- ☐ Inbound data from POS, WMS and suppliers is validated against GS1 standards
- ☐ ERP supports mode control for GTIN-only vs GTIN plus attribute processing
- ☐ Reporting and BI dashboards include attribute level insights

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8.6 Inventory & Fulfilment Management Systems Checklist

Validate that inventory and fulfilment systems can act on item level attributes.

- ☐ Inventory is tracked at batch/lot, date or serial level where applicable
- ☐ FEFO or FIFO logic is supported using expiry or production dates
- ☐ Allocation and sourcing rules consider freshness, regulatory and service constraints
- ☐ Goods receipt processes capture 2D barcode attributes
- ☐ Returns processing validates batch/lot or serial data against original sales
- ☐ Systems can segregate or quarantine affected inventory during recalls or quality events
- ☐ Mobile and store apps can decode GS1 DataMatrix or GS1 Digital Link barcodes

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8.7 Warehouse Management System (WMS) Checklist

Ensure warehouse operations can execute attribute aware workflows.

- ☐ WMS can ingest GS1 Application Identifiers from 2D barcodes
- ☐ ASN processes can include batch/lot, expiry, version and serial data
- ☐ Data models support mixed pallets and serialised inventory
- ☐ Receiving workflows capture and validate GTIN attributes
- ☐ Put away and picking logic enforces FEFO or lot control rules
- ☐ Validation rules reject shipments with missing or invalid attributes
- ☐ Traceability data supports audits, recalls and regulatory reporting

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8.8 Returns and Reverse Logistics Checklist

Confirm backend systems support safe and compliant returns processing.

- ☐ Returned items are validated against original transactions using batch/lot or serial data
- ☐ Expiration dates are evaluated to determine restock vs disposal
- ☐ Fraud detection leverages serialised or batch level validation
- ☐ Safety and regulatory rules are enforced during disposition decisions
- ☐ Inventory updates reflect correct post return status

8.9 Recall, Compliance and Traceability Checklist

Ensure systems can execute targeted and auditable recalls.

- ☐ Batch/lot or serial identifiers are captured at POS and across supply chain events
- ☐ Backend systems can identify affected inventory precisely
- ☐ Recall blocking can be enforced at POS and fulfilment
- ☐ Integration with traceability platforms or EPCIS is supported where required
- ☐ Regulatory reporting workflows are tested and documented

8.10 Analytics, Reporting and Governance Checklist

Validate that enriched data is governed and used effectively.

- A centralised data lake ingests enriched transaction and inventory events
  - ☐ Analytics platforms support batch/lot, expiry or serial level reporting
  - ☐ Dashboards track waste, sell through, recall scope and supplier performance
  - ☐ Governance policies define:
    - ☐ Required vs optional AIs
    - ☐ Retention periods

- Privacy controls for serialised identifiers

- ☐ Exception workflows exist for missing or invalid barcode data
- ☐ Machine learning use cases are identified, such as:
  - Predictive replenishment
  - Shelf-life optimisation
  - Recall risk modeling
  - Markdown effectiveness