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Consumer Product Goods

Proof of Concept: C-IoT and GS1 Digital Link—Increased Supply Chain Value for All

About GS1

GS1® is a neutral, not-for-profit, global organization that develops and maintains the most widely used supply chain standards system in the world. GS1 Standards improve the efficiency, safety, and visibility of supply chains across multiple sectors. With local Member Organizations in over 110 countries, GS1 engages with communities of trading partners, industry organizations, governments, and technology providers to understand and respond to their business needs through the adoption and implementation of global standards. GS1 is driven by over a million user companies, which execute more than six billion transactions daily in 150 countries using GS1 Standards.

About GS1 US

GS1 US®, a member of GS1 global, is a not-for-profit information standards organization that facilitates industry collaboration to help improve supply chain visibility and efficiency through the use of GS1 Standards, the most widely used supply chain standards system in the world. Nearly 300,000 businesses in 25 industries rely on GS1 US for trading-partner collaboration that optimizes their supply chains, drives cost performance and revenue growth while also enabling regulatory compliance. They achieve these benefits through solutions based on GS1 global unique numbering and identification systems, barcodes, Electronic Product Code-based (EPC®)-based RFID, data synchronization, and electronic information exchange. GS1 US also manages the United Nations Standard Products and Services Code® (UNSPSC®).

About GS1 CPG US

Over 40 years ago, CPG retailers helped implement a single standard for product identification—the barcode. What started as a way to speed up store checkout has since become the global language of business. Today, improved supply chain visibility, accurate product information, product traceability, and food safety—made possible by GS1 Standards—are enabling the seamless, omni-channel shopping experience that trading partners, regulators, and consumers are demanding from the CPG sector.

About GS1 Digital Link

GS1 Digital Link has the opportunity to transform the way in which data concerning products, shipments, and assets pass between business partners, consumers, patients, and clinicians. Current labeling can become an efficient, empowering platform that enables limitless linked information, reduced data latency, and more. GS1 Digital Link provides the ability to encode additional detail about a product that can then be used to serve up richer product experiences for brands, retailers, and consumers. It is data carrier-agnostic and has the potential to work with all barcodes as well as with RFID, NFC, and other data carriers that do not require a line of sight to be scanned. GS1 Digital Link promises a single line-of-sight barcode per product/pack that can provide value to consumers, retailers, and brands.

1. Executive Summary

GS1 Digital Link is a standard that makes it possible to create one barcode that performs multiple functions, reducing the need to add further data carriers to any item while simplifying B2B and B2C data sharing. How could GS1 Digital Link work in real-world settings? What value could it deliver to brands, retailers, and consumers?

The GS1 US Digital Link Proof of Concept (POC) team set out to demonstrate how a single barcode can perform multiple functions. They chose to use GS1 Digital Link as the enabling format for two main reasons. First, unlike existing proprietary solutions, GS1 Digital Link is based on open, royalty-free, global standards that avoid vendor lock-in. Second, the technologies associated with GS1 Digital Link—the World Wide Web and the GS1 System of Standards—are mature and well proven.

During the POC, users across different supply chain use cases were able to scan a GS1 Digital Link-embedded barcode and retrieve brand-created product information, retailer-specific created product content, product recall and expiry date information, allergen and nutritional information, safety information, and more.

The team tested use cases from the point of manufacture to consumer post-purchase, including:

1. Distribution Center
2. Retail Store Backroom
3. Retail Store Shelf and Point of Sale (POS)
4. Consumer at Home

2. Background

During 2017, GS1 US research led to a hypothesis that GS1 has a role in the Consumer Internet of Things (C-IoT) space, given that:

- A globally unique, persistent identity has a role in consumer interaction beyond the point of purchase
- Standards have a role to play in the messaging between a thing and a consumer
- Standards have a role to play post-purchase

Basing further research around this hypothesis throughout 2018, GS1 US, partnering with the GS1 Global Office and key industry stakeholders, proved the hypothesis true.

The Role of GS1 in C-IoT

The team looked at core and advanced business drivers, as well as architecture components of C-IoT, and determined that GS1's continued focus in the C-IoT area should remain centered on the GS1 identify, capture, and share mission, and the application of that mission to C-IoT.

This led to industry support to do a proof of concept focused on more granular, web-resolvable identity for "things"—a key building block for C-IoT.

In parallel to the C-IoT research, another GS1 US research project, Beyond the U.P.C.*, was underway to vet the appetite of industry to accommodate 2D data carriers at POS. The research uncovered business drivers regarding the need to move beyond the class-level U.P.C. barcode to a more robust data carrier capable of holding more granular or precise identity for a product or thing.

The Beyond the U.P.C. research identified as the top six drivers for moving beyond the U.P.C. at POS:

1. Inventory Accuracy

2. Improved Consumer Engagement

3. Freshness/Waste Prevention

4. Returns Management

5. Product Authenticity

6. Traceability

These business drivers further solidified the GS1 US C-IoT hypothesis and support for this proof of concept.

3. GS1 Digital Link Proof of Concept (POC)

GS1 US collaborated with the GS1 Global Office (GS1 GO) and GS1 partners—one brand, one retailer, and one technical solution provider—to determine the use cases for this POC. Together, the team drew out a supply chain flow from back office to consumer post-purchase at home. From this flow, the team identified key use cases that they felt could be improved with the ability to link to product information that relies on additional information, such as batch/lot number, serial number, and/or expiration date, to more uniquely identify a product.

Based on the goals and objectives set for the POC, the team selected use cases and established a plan to demonstrate the use cases based on the GS1 Digital Link standard.

3.1. Goals of the GS1 Digital Link POC

The high-level goals of the GS1 Digital Link POC were to:

- Show the value of more granular identity across the retail ecosystem and across physical and digital commerce

- Show relevance and develop a value proposition for each stakeholder, including suppliers, retailers, consumers, and technical providers

- Demonstrate the ability of standards to increase value today and to set the foundation for more advanced use cases into the future

- Define and share next steps and increase industry support for needed changes that are identified through the demo

In addition to these initial goals, the team wanted to expand into more detail and added the following:

- Demonstrate the ability for GS1 Digital Link to address multiple needs, such as:
  - App-free enhanced customer engagement
  - Enhanced functionality through an app using a single data carrier to meet multiple needs of the consumer, retailer, or manufacturer
  - Access to context-dependent information
  - Concept of public/private information—that is, not all information retrieved needs to be available to all supply chain participants
  - Simplified data exchange between business partners
  - Reduction and potential elimination of the need for more than one on-pack data carrier

- Demonstrate business use cases that have potentially high ROI for brands and retailers while providing value to consumers, showing how the implementation of standards reduces cost for all

- Document for each demo
  - Current state
  - Future state using GS1 Digital Link
  - Future state high-level requirements
  - What you get, what you don't get
  - Pros/cons of different choices made regarding requirements, etc.
- Document for overall learnings and considerations for commercializing

3.2. Objectives and Enablers

Objective: Complete an end-to-end demonstration of how a more granular and web-resolvable identity could enable and advance business processes across the supply chain and consumer journey.

Enablers:

- **GS1 Digital Link standard**—for encoding more granular levels of identification (batch/lot, serial number, etc.) and other critical information (such as expiry date) in web-linked barcodes.
- **Test Resolver Service (web service)**—for connecting the web-linked barcodes to a variety of important information, including product data, brand marketing collateral, instructions for care or use, and retailer promotions.

3.3. Participants

Two CPG industry stakeholders and one technical solution provider participated in the POC under the guidance of GS1 GO and GS1 US:

- Procter & Gamble (P&G)—the manufacturer/brand
- Walmart—the retailer
- Avery Dennison—the technical solution provider

Each participating company had a key participant who attended all face-to-face meetings and status calls. The brand and retailer gave key input to help select use cases they felt held the highest potential ROI in using GS1 Digital Link. In addition, Procter & Gamble selected two products, Align and Tide, to use in phase one demos.

The GS1 US technical solutions provider, Avery Dennison, created demo test systems mirroring the focus areas selected to demonstrate each use case. This included printing of labels with embedded GS1 Digital Link Uniform Resource Identifier (URI) and an RFID tag, helping demonstrate additional future GS1 Digital Link potential.

3.4. Use Cases Demonstrated

With goals set, the team identified use cases and agreed on how systems would interconnect using GS1 Digital Link.

The demos focused on four key areas in a typical supply chain flow. The team chose a subset of use cases from each area to prove the value of embedding a standard URI format that contains more granular product identity on the saleable unit, or on a shipping unit, utilizing a selected data carrier.

Focus Area	Demonstrate	
Distribution Center	• **ASN** • **Product state** • **Hazmat information**	
Retail Store—Back Room	• **Reduce counterfeit product** • **FIFO/Date for product rotation** • **Expired product** • **Recalled product** • **Hazmat/safety**	
Retail Store—Shelf/POS	• **Recall by batch vs. all** • **Recall POS stop sale by batch** • **Expired product stop sale**	
Consumer—at Home	• **Product description** • **Promotions** • **Recall status** • **Sustainability** • **Hazmat/safety**	• **SmartLabel** • **Expired status** • **FAQ** • **Social media**

3.5. Data Carriers Selected

This POC **used multiple data carriers** to show that GS1 Digital Link can work with a variety of them.

• **QR Code**—The team selected the QR code as the primary data carrier for the POC use cases because it is the most relevant data carrier for direct consumer engagement in which GS1 Digital Link URI can be embedded. The POC demonstrated that this capability can be extended by an application to access user-selected information.

• **RFID**—The POC used RFID in specific use cases to demonstrate that a data carrier does not have to be line of sight to benefit from the GS1 Digital Link standard. This demonstrates additional future potential specifically around in-store processes, such as product recall.

• **GS1-128**—GS1-128 was utilized to demonstrate use cases involving shipping or receiving of cases of product to demonstrate how the GS1 Digital Link standard can also bring value.

4. Parameters and Build-Out

4.1. Sample Data Set

To meet the Proof of Concept goals, two P&G products were selected:

1. Align Probiotic

2. Tide Detergent

Labels were printed for each product using different data carriers depending on the use case:

• **QR Codes** were used throughout all use cases other than shipping and receiving a product case.

• **RFID** was embedded into the QR codes and GS1-128 labels to demonstrate additional efficiencies for specific use cases, such as recall.

• **GS1-128** was used on the shipping and receiving use cases.

4.2. Key Data Elements (KDEs)

The POC used these data elements to more granularly, or precisely, identify the products required to enable the use cases:

• Global Trade Item Number® (GTIN®)

• Batch/Lot Number

• Serialized GTIN

• Expiry Date or, in the case of Tide, Production Date

4.3. Web Pages and Data

The P&G products selected both had readily available web pages and were currently using SmartLabel® for nutrients and allergens.
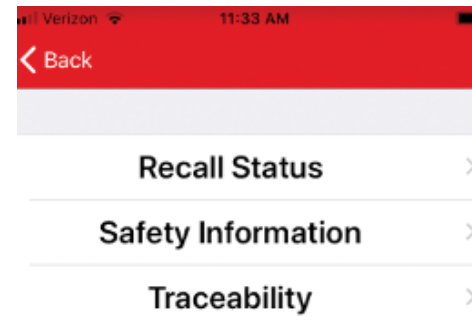
To enable the demos, the team used a test resolver service where links to web pages and information that would be used for the use case demos were set up.

The consumer had access to customer-facing information, such as the brand's product information page and allergen/nutrient information. The retailer had access to some additional links, such as safety and recall information, as well as information linked for shipment confirmation or inventory management.

The screen shot below shows the menu for the demo's test mobile app. These are the links implemented that end consumers could access.
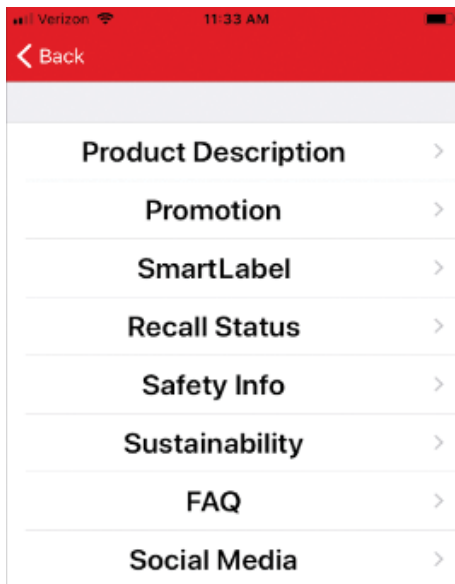
The screen shot below shows the links implemented that retail associates could access.

4.4. Steps Taken to Build Demos

The technical solution provider partner, Avery Dennison, took the following steps to build out the test demo environment:

- Setup links required to enable the use cases in the test resolver service to support targeted products for the POC
- Created cloud-based inventory, including product status, location, expiration date, and production date
- Created a user interface to enable inventory to be sorted by location, expiration date, and product status
- Utilized EPCIS event movement from manufacturer, retail store, retail floor, and POS
- Constructed and printed product labels
- Developed a demo mobile app to scan QR codes and link to relevant information based on use case for either consumer role or retail associate role
- Developed a mobile app for RFID reader for inventory, which could locate recalled or expired product
- Enabled connection to test resolver instance from apps installed on smart device and RFID reader

5. Results

5.1. Findings

This POC proved that a variety of data carriers can be used to glean value from the GS1 Digital Link standard. It also proved that the GS1 Digital Link can enable multiple experiences because it is based on the existing GS1 Standard of application identifiers to provide more granular or precise identity in the URI format defined by GS1 Digital Link.

With these findings, the team revisited and evaluated their original goals for the POC.

5.1.1. Value of More Granular Identity to All Stakeholders

Show the value of a more granular identity across the retail ecosystem and across physical and digital commerce.

By embedding a GS1 Digital Link URI in a data carrier, the team demonstrated the additional value enabled when more unique, or granular, product identity is embedded into the data carrier itself. Linking the physical and digital product delivers value to the brand, retailer, consumer, and GS1 US solution partner.

The main data carrier of choice for this POC was the QR code with an RFID inlay, which was used for multiple use cases, including point of sale. The following are among the findings related to this goal:

- For recalled and expired product use cases, the POC demonstrated enhanced value as follows:
  - Avery Dennison used a test POS system that supported RFID checkout. The RFID inlay along with GS1 Digital Link supported additional capabilities to check for recalled or expired product at the point of consumer purchase. The same could be accomplished via QR code at checkout with image scanners. The key enabler is the ability to store more unique, or granular, levels of identification in a data carrier that also can be scanned at POS.

  - The POC demonstrated the ability for a retailer to identify the location of recalled goods at the batch/lot number level using an RFID reader. On-shelf product consisting of more than one batch/lot number makes it difficult to only pull batches affected by the recall. Using this approach allows an associate to detect if the affected batch is on shelf. Taking it one step further, the associate can then scan each product to only pull those recalled. Even without the RFID inlay, the recall process is improved.

  - The POC demonstrated the ability for retail associates to also scan products that are currently being visually inspected to pull expired products from the shelf. With GS1 Digital Link URI embedded with batch/lot number and/or expiry date, the visual aspect of trying to find and read expiry dates on products becomes faster and more accurate. An associate can simply scan the QR codes on each product and be notified if it has expired. Even at POS, this can be used to stop the sale of an expired product or simply offer a discount to the shopper for soon-expired or expired products.

- For **safety use cases**, the POC demonstrated enhanced value as follows:
  - The POC demonstrated the ability for a store employee to access clean-up information by scanning the product QR code, providing immediate access to the most current information to better ensure safety. This is a safeguard for all stakeholders in the supply chain, including the consumer.

  - The POC demonstrated other safeguards for the consumer at home by providing access to SmartLabel via GS1 Digital Link URI. This removes the need to have a proprietary QR code that can only access SmartLabel information, which requires additional data carriers to provide other experiences. Of course, this use case is also applicable to pre-purchase research.

5.1.2. Value to Multiple Stakeholders

Show relevance and develop a value proposition for each stakeholder, including suppliers, retailers, consumers, and technical providers.

The use cases demonstrated value to multiple stakeholders—including the brand, retailer, and consumer, as well as technical solution providers.

- The recall and expiry date use cases demonstrated potential for both suppliers and retailers to reduce waste, driving down costs by improving current, more manual, processes. Such processes typically require all products (versus just affected batches) to be pulled, particularly for recalled products.

- The use cases also demonstrated opportunity for technical solution providers to assist with solutions that provide new opportunities to both brands and retailers utilizing GS1 Digital Link. For example, the ability to scan a data carrier at POS that has GS1 Digital Link URI opens up new opportunities to gather more intelligent data at point of sale or to offer automated discounts based on expiry date.

- All use cases demonstrated positive consumer impact, whether it was stopping sale of a recalled product before the store could pull it, providing access to promotions and where to buy the product, or providing access to the latest safety or nutritional information. All of that is possible via a single on-pack data carrier, which reduces consumer confusion as to which code to scan for what. Currently, some products may have four or more symbols on pack for a consumer to figure out. This drives consumer loyalty.

5.1.3. Value for Today and a Foundation for the Future

Demonstrate the ability of standards to increase value today and to set the foundation for more advanced use cases in the future.

The use cases demonstrated value that can be accomplished today. More importantly, implementing GS1 Digital Link helps create a foundation that can support more advanced use cases. In short, it provides a "glide path" to the future.

- By embedding GS1 Digital Link into a data carrier, a consumer or retail associate can scan the code with a phone camera or in an app designed to use GS1 Digital Link and connect to multiple types of information **today**.

- A GS1 Digital Link data carrier, such as QR code, can be added alongside the U.P.C. to help reduce the need for other product package symbols without impacting POS U.P.C. scans **today**.

- Once a data carrier with GS1 Digital Link URI is on the package, the foundation is set for additional use cases that may require POS system hardware and/or software upgrades to enable such options as stopping expired and/or recalled products at point of sale, a more advanced **future** use case. POS systems can be enhanced to capture more advanced information about what is sold. In turn, that can enable more precise recall notifications.

- For those using, or planning to use, RFID, the POC demonstrated that RFID works with GS1 Digital Link, providing additional value for **future**, more advanced use cases.

5.2. In Summary

In today's world, brands, retailers, and consumers are limited to the information embedded in data carriers, whether this means class-level or application identifiers included in other GS1 data carriers, such as GS1 DataMatrix, GS1-128, or RFID.

The GS1 Digital Link POC demonstrated how companies can remove this limitation. Doing so enables them to support additional use cases, providing a path to link to additional sources of information about a product using a standard URI format.

6. Next Steps

This POC demonstrated that utilizing a standard URI format with GS1 data elements (application identifiers) can provide a more granular, or precise, on-pack product identity. It also showed that multiple use cases can be enabled, providing value to stakeholders throughout the supply chain. This is the essential role of standards: Enhanced Value For All.

Building on the knowledge and insight gleaned from this POC, participants felt some important next steps should include:

1. A pilot between a brand and retailer to enable one or two products with GS1 Digital Link URI to demonstrate commercial use in a selected part of the supply chain process. Product and process to pilot are TBD.

2. Document return on investment (ROI) examples alongside key business use cases where GS1 members see the highest potential for GS1 Digital Link to make an impact.

3. Look at returns processes across brands and retailers and document how GS1 Digital Link might help in this area, focusing on return fraud use cases and how to help prevent fraud.

7. Conclusion

Standards play an essential role in driving accuracy, increasing efficiency, and reducing costs across multiple industry stakeholders. GS1 Digital Link is built on existing and available web technology, providing a means of implementation that will scale and support interoperability. Without this standard, industry will continue to see a proliferation of proprietary solutions that confuse and frustrate consumers. Just as important, brands and retailers will be looking to proprietary solutions to improve critical areas, such as recall processes, which are becoming so costly that many insurance companies are refusing to provide coverage.

8. Additional Resources

- **GS1 Digital Link v1.1 ratified standard** is the global GS1 Digital Link standard with full technical details around the standard.

- **GS1 Digital Link: GS1 US Implementation Guideline** is the implementation guideline relevant in the United States when used alongside the GS1 Digital Link standard itself, providing clarity for technical implementations.

- **Find a GS1 US Solution Partner** provides access to and information about GS1 US-certified solution partners who may be able to assist with your GS1 Digital Link needs.

- **Powering the Future of Retail** is GS1 US research focused on industry readiness to support 2D data carriers at retail point of sale. This research has led to a GS1 US "Sunrise 2027" initiative for all retailers to be able to read 2D data carriers at POS and includes next steps around the Sunrise 2027 initiative as companies consider how to get started, including a high-level, use case-driven decision tree.

- **GS1 Digital Link Proof of Concept video** showcases key use cases implemented for this POC, demonstrating the power of GS1 Digital Link to enable multiple use cases throughout the supply chain via a single data carrier.

- GS1 US is participating in the GS1 MO Future of On-Pack Coding workgroup. The vision of this group is to provide an informed, forward-looking approach for stakeholders to consistently and efficiently implement on-pack coding that enables products or objects to serve as unambiguous sources of information, built on top of foundational standards for continued interoperability between trading partners. More will be forthcoming on this important initiative.

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