How GS1 Standards Support Product Tracing, Critical Tracking Events and Key Data Elements

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Executive Summary

The Institute of Food Technologists (IFT), in its 2009 *Traceability (Product Tracing) in Food Systems Technical Report,* defined Critical Tracking Events (CTEs) as "those events that must be recorded in order to allow for effective traceability of products in the supply chain;" these are "those instances where product is moved between premises, is transformed, or is otherwise determined to be a point where data capture is necessary to trace a product."

In its report, IFT also identified and recommended Key Data Elements (KDEs), which can be linked to CTEs and used to support product tracing. These include:

- Physical location that last handled the product, whether the manufacturer or not, and, if applicable, contact information for the broker who handled the transaction
- Incoming lot numbers of product received
- Amount of product manufactured or shipped
- Each physical location where cases were shipped (including individual retail and foodservice locations)
- Lot number(s) shipped to each location
- When (date/time) product was received and/or shipped
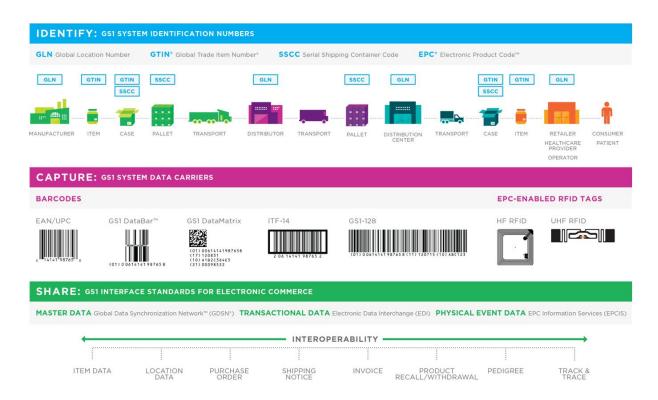- Ingredients with corresponding lot numbers

To most efficiently identify, trace and track CTEs and KDEs, and share this information with multiple parties, businesses need to use a single, global, open system of supply-chain standards. The GS1 System of standards is the most widely used such system in the world; about 1.5 million businesses use GS1 standards to identify, capture and share product information within their own facilities and as it moves from trading partner to trading partner to consumer.

With GS1 standards as a foundation, addressing CTEs and KDEs is achievable. Users may only need to add a small amount of data, such as batch/lot numbers in machine-readable formats, or expand how and when data is captured as products are received, processed and shipped to retail and foodservice customers.

GS1 Visibility Standards for Product Tracing

The GS1 System is an integrated suite of global standards that provides supply chain visibility through the accurate identification, capturing, and sharing of information regarding products, locations, assets, and services. Using GS1 identification numbers, companies and organizations around the world are able to globally and uniquely identify *physical things* like trade items, physical locations, assets, and logistic units as well as *logical things* like corporations or a service relationship between distributor and operator. When this identification system is leveraged to share product information such as product master data, transactional data and/or physical event information, the connection is made between these physical or logical things and the information the supply chain needs about them. These are the foundational elements supporting Critical Tracking Events and Key Data Elements.

It"s a powerful three-step process: companies must identify products and locations using a standardized product identification and standardized location identification method. Additionally, companies must capture the standardized identification in a common approach – barcodes and/or EPC-enabled RFID tags are shown in the above illustration. Finally, once companies are using a common language to identify and capture product data, the information must be shared in a standardized format, ensuring data completeness and accuracy.

1.1.   Identify: Globally Unique Identification

The GS1 System provides globally accepted identification numbers to support a common language for the communication of product information from company to company. The GS1 identification number for products is the GS1 Global Trade Item Number $^{®}$ (GTIN$^{®}$). For decades, this GS1 identification number has facilitated the sharing and communication of product information among supply chain partners. Moreover, it has provided the foundation for innovative improvements in supply chain management for many American industries, including the impressive and well-documented advances in the retail and grocery industries.

GS1 identification numbers provide the link between a product and the information pertaining to it. When a company assigns a GS1 identification number to a product (Global Trade Item Number or GTIN in illustration above), they define a set of standardized information about the product (e.g., size, weight, product type, etc.). The GS1 System specifies information standards for products. Standardized information about *products* includes core data like selling unit and product dimensions. Standardized information about *commercial entities* includes core data like location information about a warehouse or restaurant (Global Location Number or GLN in illustration above). Once defined by the company, the standardized product information can be stored and shared with trading partners.

GS1 Identification Numbers include:

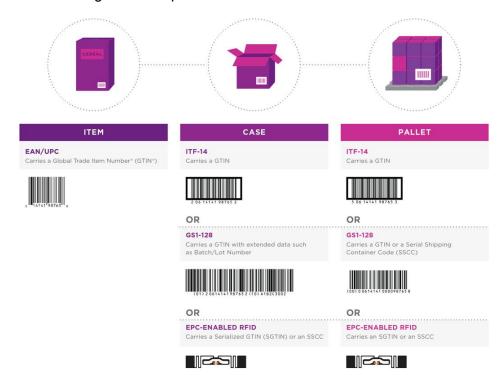| GS1 Identification Number	GS1 Identification Number Title	Type of Supply Chain Information
GTIN	Global Trade Item Number	*trade item*
	Global Trade Item Number plus Lot Number	*specific lot of trade item*
	Serialized Global Trade Item Number (SGTIN)	*specific individual trade item*
GLN	Global Location Number	*location or trading partner*
SSCC	Serial Shipping Container Code	*specific logistics unit*

1.2.   Capture Product Information

The GS1 System uses the U.P.C. and other barcode symbologies and Electronic Product Code (EPC)-enabled RFID tags to encode GS1 identification numbers.

Barcodes are machine-readable, which are read by scanning. Scanning speeds data collection and eliminates manual data collection errors, e.g., illegible handwriting and data entry errors. The GS1 System enables users to design applications that automatically process GS1 data captured from approved barcode symbologies. Additional information such as best-before-dates, serial numbers, and lot numbers may also be encoded into barcodes.

EPC-enabled RFID tags, which are typically applied to products during the manufacturing process, consist of a microchip attached to an antenna, allowing for wireless capture of the number. The product"s EPC number incorporates a GTIN and a serial number, making it possible to track and trace an individual item with greater accuracy and intelligence.

Below is an example of how the GS1 identification numbers are used with bar codes and EPC-enabled RFID tags for each product level.

ITEM	CASE	PALLET
EAN/UPC Carries a Global Trade Item Number® (GTIN®)	**ITF-14** Carries a GTIN	**ITF-14** Carries a GTIN
(barcode) 6 14141 98765 8	*(barcode)* 2 06 14141 98765 2	*(barcode)* 5 06 14141 98765 3
	OR	**OR**
	GS1-128 Carries a GTIN with extended data such as Batch/Lot Number	**GS1-128** Carries a GTIN or a Serial Shipping Container Code (SSCC)
	(barcode) (01) 2 06 14141 98765 2 (10) A1B2C3002	*(barcode)* (00) 0 0614141 0000098765 8
	OR	**OR**
	EPC-ENABLED RFID Carries a Serialized GTIN (SGTIN) or an SSCC	**EPC-ENABLED RFID** Carries an SGTIN or an SSCC
	(RFID tag)	*(RFID tag)*

1.3.   Share Product Information

The GS1 System provides three standardized approaches for sharing information and to support the concepts of Critical Tracking Events and Key Data Elements. Companies can implement one method or a combination of all three depending on what information they want to capture and share with trading partners.

1. *Master Data* - Master data enables „one source of truth" for specific product information. This type of data also typically exists to describe locations, and parties. The GS1 standard that supports master data is the Global Data Synchronization Network® or GDSN®. With GDSN, trading partners always have the latest information in their systems, and any changes made to one company's database are automatically and immediately provided to all of the other companies that do business with them.
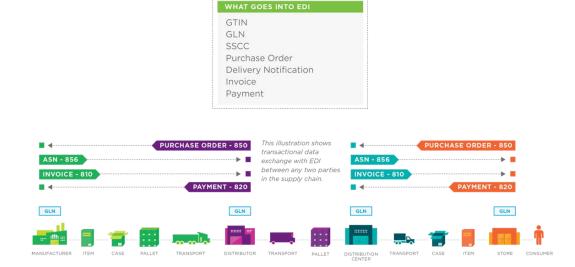
PRODUCT MASTER DATA WITH GDSN®

2. *Transactional Data* - Transactional data provides evidence of the completion of a business transaction, such as the completion of a transfer of ownership (purchase and sale) or a transfer of custody (shipping and receiving). GS1 standards that support transactional data include Electronic Data Interchange (EDI) and Extensible Mark-up Language (XML) Business Message Standards.

TRANSACTIONAL DATA WITH EDI

3. *Physical Event Data* – Physical events are actual observations made in the physical world of products or other assets. Each observation captures *what* was observed, *when* it was observed, *where* it was observed, and *why* it was observed (that is, what was the business context in which the observation took place). Often physical event data is generated as the result of automatic identification, such as scanning a bar code or reading

an RFID tag. The GS1 standards that support physical event data are EPC Information Services or EPCIS and the Core Business Vocabulary (CBV).

The GS1 System provides a comprehensive platform for companies to *identify* products and other business entities, *capture* visibility data, and *share* this data with trading partners to achieve global supply chain visibility. It is a solid foundation for supply chain traceability and other visibility-driven business processes and applications. The following table summarizes these standards:

Visibility Data Type	Data Standards	Interface Standards
Physical Event Data	Electronic Product Code Information Services (EPCIS) schema EPCIS Core Business Vocabulary	EPCIS Capture EPCIS Query Discovery
Transactional Data	eCOM/EDI	AS2
Master Data	Item Business Message Std Party Business Message Std	Global Data Sync Network (GDSN) EPCIS Master Data

Identification Standards:
   GS1 General Specification (GTIN, SGTIN, SSCC, GLN, GRAI, GIAI, etc)
   EPC Tag Data Standard

2.   Traceability and the GS1 System

"Tracing" refers to the business process of discovering and acting upon the path that a product or other asset takes through the supply chain. The path through the supply chain, or "trace," is the data history that accumulates as an asset moves through the supply chain. This data history includes both physical observations of the asset (visibility data, as defined in the previous section) and business transactions that pertain to that asset.

At each step in the supply chain for a given product there may be generated a physical event, a business transaction, or both simultaneously. All of these data may be relevant in a traceability scenario where the business goal is to understand what happened in the supply chain.

By definition, a trace is comprised of data that is created by multiple parties in a supply chain. In order for a trace to be understood by any party, all parties must adhere to standards. The GS1 System provides global standards for physical events and for business transactions, as well as for the supporting master data; these standards support the potential implementation and use of KDEs and CTEs.

2.1. Levels of Product Tracing

2.1.1. Granularity of Product Identification: Product-level, Lot/Batch-level, and Serialized

GS1 standards provide a choice as to the granularity of product identification, as summarized in the following table:

Granularity	GS1 Identification Number	Comments
Product-level	GTIN	All product of a given type (10 count cases of green beans) are marked identically. It is possible for an information system to tell one product from another (e.g. a 10 count case of green beans from a 24 count case of green beans), but not to distinguish two of the same product type (two separate 10 count cases of green beans).
Lot/Batch-level	GTIN + Lot/Batch number	All product of a given type (10 count cases of green beans) within a given lot/batch are marked identically. It is possible for an information system to tell one product from another (e.g. a 10 count case of green beans from a 24 count case of green beans), and to distinguish two products of the same type from different lots/batches (a 10 count case of green beans from Lot #20100201 and a 10 count case of green beans from Lot #20100204, but not to distinguish two products of the same type from the same lot/batch.
Instance-level (full serialization)	GTIN + Serial number (a combination also known as Serialized GTIN or SGTIN)	Each specific occurrence of a given product (a specific 10 count case of green beans) is marked with a unique serial number, and so the combination of GTIN + serial number is a globally unique identifier for a single product instance, different from all other physical objects in the world.

Reading from top to bottom, each choice gives increased ability to trace products in the supply chain, though at the cost of increased bookkeeping and cost of product marking.

Product-level identification (GTIN) provides the ability to track where different products are used in the supply chain, and to gather data based on counting products. This includes many inventory applications, sales analysis, etc. But at this level, all instances of a given product are indistinguishable, and so the ability to trace products is limited.

Lot/Batch-level identification (GTIN + Lot/Batch number) provides the ability to distinguish products in one lot/batch from another. This is especially useful in business processes that deal with quality issues that tend to occur on a batch-by-batch basis, such as a product recall of a contaminated lot/batch. Lot/Batch-level traceability lets you identify all the places in the supply chain where a given lot/batch has reached, and confirm the quantity of items present from that lot/batch. However, products within the same lot/batch are still indistinguishable, so it is not possible to correlate an observation of a given product instance in one location with a later observation. However, lot/batch level traceability is at least in the short term a very scalable level of identification and a level that much of the industry practices today.

Instance-level, or fully serialized identification (GTIN + Serial number, also known as SGTIN) provides the ability to identify each product instance (e.g., specific can, specific case) individually. This allows each product instance to be traced individually and therefore to precisely match observations at different times in the supply chain. For example, if different instances from the same lot/batch of product are shipped to two different parties, then in a recall situation it is possible to identify specifically which product instances were shipped to Party A and which were shipped to Party B. As recalled goods return to the manufacturer, the manufacturer can now definitively identify which of those instances were originally shipped through Party A and Party B, which in turn can be used to target the action required to complete the recall.

Conclusion

The Institute of Food Technologists" proposal for the use of Key Data Elements and Critical Tracking Events in product tracing has gained wide support. The importance of this work will only grow as a result of increasing regulatory and societal pressures for enhancement of food safety.

From the farm, from ingredient suppliers or packaging suppliers to the finished product delivered at retail or foodservice, GS1 Standards can support the Key Data Element product and location requirements needed to support data capture at Critical Tracking Events. GS1 Standards, already used by more than a million companies globally – including many suppliers, manufacturers, growers, packers, distributors, retailers, foodservice firms, and technology providers – should be leveraged in the implementation of KDEs and CTEs in the food supply chain.

Companies that are not already active with GS1 standards should reach out to the GS1 organizations in their country to learn how they and their customers can improve their product tracing abilities and realize supply-chain efficiencies.

About GS1 US

GS1 US, one of 108 country-based members of GS1, is a not-for-profit organization that brings industry communities together to solve supply-chain problems through the adoption and implementation of GS1 standards. More than 200,000 businesses in 25 industries rely on GS1 US for trading-partner collaboration and for maximizing the cost effectiveness, speed, visibility, security and sustainability of their business processes. They achieve these benefits through GS1 US solutions based on GS1 global unique numbering and identification systems, barcodes, Electronic Product Code-based RFID, data synchronization, and electronic information exchange. GS1 US also manages the United Nations Standard Products and Services Code® (UNSPSC®). www.GS1US.org

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