GS1 Serialisation Team

Serialisation Strategy

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1. Introduction

There is a requirement for the unique identification of individual instances of items in the market, related to business needs like anti-counterfeiting, authentication, or regulations demanding the unequivocal identification of items e.g. pharmaceuticals. Ever increasing computing capabilities, lower cost of data storage and networking facilities tend to facilitate the adoption of serialisation.

The purpose of this document is to highlight the potential benefits arising from the serialisation of trade items, to describe some of the standard and implementation challenges to overcome and to issue a series of recommendations.

2. Definition and Scope

The definition of serialisation used in GS1 is “the unique identification of each one in a large set of entities.” In other words it refers to identification of an instance rather than a class.

GS1 has a number of standards enabling the identification of individual items and the sharing of information about these items. Several of these standards have been available for many years. For example, the SSCC was first released in 1989, enabling the identification of individual logistics units in physical distribution and in associated EDI messages such as Despatch Advice (also known as Advanced Shipping Notice). Other examples include the unique identification of locations and assets.

The scope of this document focuses mainly on trade items, with references to identification of locations, assets, documents, services or parties being made only to add context to the analysis. Batch (lot) numbering is not serial numbering because individual instances are not given their own identity. However this paper does include a consideration of batch numbering because some people regard it to be a more cost-effective level of control. The GS1 strategy on serialisation has to address the possibility that in some business contexts identification of individual items is not appropriate.

3. Business opportunities

The following section highlights some of the key business opportunities that users may consider when adopting serialisation within the use of the GS1 System.

Serialisation of trade items at all levels of packaging configurations, from the smallest consumer unit or unit of use up to the carton, the pallet or the container, maximises the potential benefits. This is not to say that mass-serialisation is universally recommended. The business requirements and the costs have to be taken into account in the decision to serialise particular types of trade items.

3.1. Supply chain management processes

In some sectors, some supply chain processes are based on the serialised identification of items. One example is the picking of goods and preparation of shipments for assemblies of electronic equipment made to order. The serialisation of each component facilitates the shipment preparation process and enables the accurate management of the after sales services. Another example is the receiving of goods in the book sector. The serialisation of books and the use of RFID enable the automatic count of the number of items of the same type and this facilitates the matching between the order and the delivery.

3.2. Traceability

In logistics, traceability refers to the capability for tracing goods along the distribution chain on a batch number or serial number basis. Traceability is important in many sectors where it makes recalls possible or in the food industry where it contributes to food safety and to the control of the freshness of products.

The identification level of the items in the context of a traceability application is determined by the trading partners. The decision to trace items at batch or at serial level is influenced by a series of factors such as the commercial value of the items, health and safety considerations, regulations that might be imposed by governmental bodies and the business benefits derived from the implementation of traceability processes. Some business processes cannot be done without traceability.

3.3. Anti-counterfeiting

Counterfeiting and product piracy constitute a serious and ever growing problem for legally run businesses and owners of intellectual property rights. Counterfeiting is not specific to any industry but affects a large number of sectors. They include the music, software, luxury goods, pharmaceutical industry, automobile industry and fast moving consumer goods industry. According to the International Chamber of Commerce[1], "[…] counterfeiting and piracy are growing exponentially in terms of volume, sophistication, range of goods, and countries affected - this has significant negative economic and social impact for governments, consumers and businesses [...]."

Even though it seems that there will not be one silver bullet solution against illicit trade, industries and academia see mass-serialisation among the most promising single countermeasures.

If each legitimate product carries an RFID tag or a bar code with a serialised GTIN that is read at various points in the supply chain, counterfeit items can be more readily identified because such items could have either no serialised GTINs, serialised GTINs outside of the range of those assigned by the legitimate brand owner, or serialised GTINs that are duplicates of authentic products. Serialisation allows to provide a trace of the path followed by objects in the supply chain and to detect anomalies.

[1] *International Chamber of Commerce (ICC) (2004). The fight against piracy and counterfeiting of intellectual property. Policy Statement. Submitted to the 35th ICC World Congress, Marrakesh, 7 June 2004*

3.4. After sales services

Providing a serialised GTIN at item level will help to improve after sales services ensuring a much more efficient service for customers. Product returns, complaints and warranty services can be done without today's required paper receipt. An RFID tag or bar code attached to the product acts as a lifelong sales slip and makes conservation of paper tickets obsolete. A unique and quick identification of the returned item will reduce waiting times and improve the customer service quality significantly. It will also facilitate the return of an item or request for after sales services in another store than the one where the item was purchased.

Warranty documents and receipts are used in today's repair and maintenance processes but these documents are very difficult for the customer to retain with the product. With the unique serialisation of products, individuals responsible for repairing the defective product can easily obtain repair and maintenance records, invoice the appropriate party, and rewrite warranty information accurately.

3.5. Electronic Article Surveillance

RFID-based Electronic Article Surveillance (EAS) is a technological method for deterring and detecting theft of goods. RFID-based EAS tags (based on the EPCglobal Gen 2 standard) are fixed to an item's packaging or to the item itself. The goal of RFID-based EAS is to combine the known benefits of RFID such as increased supply chain visibility, improved inventory tracking and process productivity along the supply chain including the retail sales floor with the advantages of an EAS system (item level theft deterrence, detection, and protection).

Upon receipt of goods in a store, an inventory check occurs and all items' SGTINs are added to a database. Upon an item being sold, the number is removed from the database prior to it leaving the store. At the exits of the store, a detection system sounds an alarm or otherwise alerts the staff when it senses tags carrying numbers that have not been removed from the inventory database.

With legacy EAS systems, no actionable intelligence is provided when the alarm sounds; the only information that is known is that an EAS tag has passed the pedestals. With RFID-based EAS, when an alarm is activated, there is visibility not only that an item has passed the pedestals but additionally which particular item has activated the alarm as well as visibility to the quantity of items passing through the pedestals at that moment.

4. Challenges

There are a number of challenges to consider in the context of serialisation, including:

- Should everything be serialised?
- How do we create fully interoperable solutions?
- Will the solution(s) be scalable?
- When goods change ownership in supply chains, who is responsible for serialisation and related data management?
- Serialisation leads to higher privacy risks

4.1. Business need

Should GS1 make serialised identification of trade items mandatory in all of the GS1 System? This is a question that must, according to GS1 principles, be answered by the user community on the basis of its business needs. It is very likely that the increasing demand for better control and more visibility in trade and industry will mean that there will be a trend towards greater use of serialisation. But it is also fairly certain that cost justification for instance identification of all traded units will not be possible for many years. In the meantime, the task of GS1 is to make sure that serialised identification of trade items can co-exist with identification of trade item classes without disrupting users of the system or causing unnecessary costs.

4.2. Standard approach

Companies contemplating the opportunity to serialise trade items for specific applications may consider using proprietary solutions for the coding conventions and/or the data carrier representation of the serial numbers. Although this approach may seem adequate in the short term, it will usually lead to problems in the longer term. As a matter of fact, closed loop applications often become open loop applications after some time. It is therefore strongly advised to use a standard data content (e.g. GS1 keys, application identifiers) and data carrier (e.g. GS1 standard bar codes or RFID/EPC) approach for serialisation right from the start. This approach will fulfil the needs in the short term and greatly facilitate the extension of the applications to open use in the future.

4.3. Mandatory versus optional serialisation

Trade item serialisation is not mandatory in the GS1 System. The GTIN is defined to identify classes of trade items, not individual instances, although it can be qualified by an Application Identifier (21) to enable serialisation. Other keys, namely GRAI for returnable assets and GDTI for documents include a serial element which is optional.

However certain functions supported by the GS1 System are only possible if the entities concerned are identified at the instance level. The identification of logistics units, each of which is usually intended to be part of a specific transaction and the association of each one with corresponding delivery notification is only possible with serialisation. Some specific types of distribution might have been satisfied by identification of classes of logistics units, but in the interests of creating one standard that meets the needs of the majority, the GS1 System has been designed to require instance identification in this domain.

The RFID/EPC standards require serialisation. In theory, RFID/EPC tags carrying the GTIN or the GTIN and batch number could work. However they would offer only a limited set of functionalities, such as reading items one by one as they travel on a conveyor belt. This option is thus not currently available in the standards.

EPCIS is primarily based on serialised identifiers. However, when EPCIS was designed, it was speculated that non-serial identification could be useful in some circumstances. EPCIS has a specific event type for non serialised identifiers, the Quantity event. The EPCIS functionalities available without serialisation are very limited.

It is important to note that EPCIS and other EPCglobal network tools are data carrier agnostic. An EPCIS event might arise by recording data from an RFID tag or from a bar code for example.

The answer to the Mandatory versus Optional serialisation question should be driven by User requirements first. Once the needs are clearly understood, the decision on which standards to use and whether to serialise or not can be made.

4.4. Serialisation management

The party assigning the GTIN is not necessarily the same as the party assigning the serial number to some instances of the item. Goods change ownership in the supply chain and the business requirements of the successive parties may be different or the carrier of the identifier may have been damaged or lost. This issue has been the subject of a change request (number 09-206) and is being addressed by a "GSMP Serial Number Replacement or Supply" working group.

Given the fact that there may be different parties assigning the serial numbers, one principle should be maintained above all: the combination of GTIN/serial number must be globally unique on all occasions, regardless of who assigns them. This principle should guide further standards development to reach consensus on a solution that can satisfy the need for efficient identification and support the various initiatives around anti-counterfeiting, traceability, etc.

In the case where the party assigning the GTIN is providing the serialisation, management of the serial number to ensure the uniqueness required by the GS1 System is their responsibility. As with the GTIN and the GLN, allocation rules will need to be established in order to provide guidance on how and when serial numbers are assigned, changed, etc. This identified gap should also be included in the efforts of the appropriate standards development team to develop the appropriate rules to support real-world applications.

Some examples of potential serial number allocation rules could include:

- General allocation policies of serial numbers
- Possible reuse of serial numbers

In addition, guidelines could be developed to assist users with the assignment of serial numbers. These guidelines should include directions on the following issues:

- Use of leading zeros
- Non-significance of the serial number
- Alpha-numeric versus numeric serial number

4.5. Data management

Serialisation is not an objective in itself. It is an enabler for a series of applications that will need to access and process data related to the serialised items. The GS1 EPCglobal EPCIS, ONS and forthcoming Discovery Services standards will likely be the essential tools to address this need.

Serialisation increases data volume. This owes on the one hand to an increase of items identified as individual objects instead of a bulk. On the other hand applications relying on serialised data may result also in a higher number of items to be identified, in additional read points or in higher recording frequencies.

- Trends to greater granularity

The number of different items does not change when items are serialised. However, when items are serialised it may happen that a lower hierarchy level of items becomes of interest to be identified at certain read points which would not have been identified before.

- Average quantity of a product at a reading point
  This factor is relevant as trade items with the same GTIN will in the non-serialised environment be treated as one single (identical) trade item information while in a serialised environment the trade item will differ in its serial numbers and thus need to be treated as separate (different) trade item information.

- Number of reading points within the supply chain
  For purposes of higher transparency, granularity in tracking & tracing, to avoid shrinkage, to combat counterfeiting, etc., additional reading points might be implemented in the supply chain.

- Reading frequency at the reading point
  Warehouses and sales shelves are examples where technologies like RFID would make a permanent inventory possible.

Serialisation will inevitably lead to an increase of the data volume available to business applications. Redundant or useless data should be discarded in order to keep the data volume at a manageable level. Various techniques can be used to control the flow of data by setting appropriate filtering parameters in the RFID reading process or by discarding unnecessary data through the Application Level Event standard interface.

The sharing of relevant data between trading partners can be greatly facilitated by implementing EPCIS compliant data repositories instead of sending the information peer to peer.

4.6. Initiatives other than GS1

Other standard organisations are looking at serialisation from different perspectives, e.g. ITU, ISO, IETF, Ubiquitous ID. GS1 should selectively and proactively participate in these developments. It is unlikely that GS1 will ultimately become the one and only serialisation system in the world. It is therefore important, not only to be aware of what's going on, but to participate and contribute upfront in the design of global systems. It is necessary for GS1 to get involved, to influence and to possibly lead initiatives related to serialisation involving external standard bodies or private organisations

5. Strategic Direction / Recommendations

Considering the large number of business opportunities that will increasingly be implemented and bring benefits to user companies, serialisation will become an important part of the GS1 System in the future. Most applications will rely on serialisation. The following strategic directions and recommendations are provided:

1. User companies should consider the potential benefits of applications that require or might require the serialisation of trade items. These applications include supply and inventory management processes, traceability, anti-counterfeiting, after sales services, electronic article surveillance.

2. Migration strategies towards serialisation should be devised.

3. GS1 should develop serial number allocation rules. In addition, GS1 should develop standards related to the distributed allocation of serial numbers and to the serialisation done by other parties than the brand owner.

4. GS1 should develop guidelines to assist users with the assignment of serial numbers.

5. GS1 should develop guidelines to assist users with the sharing of data based on the capture of serialised identifiers.

6. GS1 should be involved, influence or lead collaborative initiatives with external standard bodies addressing the serialisation of trade items.

7. The solutions designed to support serialisation should be technology agnostic.

Appendix A: List of abbreviations

EDI	Electronic Data Interchange
EPC	Electronic Product Code
EPCIS	EPC Information Services
GDTI	Global Document Type Identifier
GLN	Global Location Number
GRAI	Global Returnable Asset Identifier
GSMP	Global Standard Mangement Process
GTIN	Global Trade Item Number
IETF	Internet Engineering Task Force
ISO	International Organization for Standardization
ITU	International Telecommunication Union
ONS	Object Naming Service
RFID	Radio Frequency Identification
SGTIN	Serialized Global Trade Item Number
SSCC	Serial Shipping Container Code