



The Global Language of Business

GS1 Architecture Principles

sets out the architectural principles that underpin the GS1 system

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Preamble

The GS1 system is the most widely used supply chain standards system in the world and comprises the standards, guidelines, solutions and services created in formalised and collaborative GS1 processes. This document sets out the architectural principles that underpin this system.

The objectives of this document are:

- to inform and guide all those involved in the development and maintenance of the GS1 system by providing a shared understanding of the principles of the *GS1 System Architecture*; and
- to provide to users of the GS1 system, and anyone else with an interest in the subject, an insight into the foundational ideas that inform the design of the system.

This document, the *GS1 System Architecture* document and the *GS1 System Landscape* together create the framework within which developers are enabled to preserve the coherence and integrity of the GS1 system.

The full benefits of the GS1 system can only be obtained when the GS1 standards, guidelines, solutions and services, respect the architecture and the principles. Setting the target any lower, or diluting it, diminishes the value of the system. The most effective way of achieving this is for all involved in development of the system to understand the architecture principles and how the GS1 system benefits from abiding by them.

Additionally draft deliverables are reviewed against the principles as an integral part of the systems development processes. This results in a rigorous assessment of whether developments are consistent with the principles. If they are not, a dialogue about the specific divergences takes place between the Architecture Group (or one of its members) and the work group responsible for the deliverables. If divergences remain after this dialogue, the deliverables may still be put to the Board Committee for Standards for ratification. Deviation from one or more of the architecture principles does not disqualify a development of the system because other factors, commercial or geopolitical for example, may be more important. However it is the responsibility of the Architecture Group to make the Management Board (or its designated sub-committee) aware of any deviations from the principles so that they can take them into account as part of their ratification decision.

The principles should remain stable, although the *GS1 System Architecture* might change.

The Principles

Conformance

Claims are often made that an implementation of GS1 standards or solutions “conforms to the GS1 system”. Similar claims are made by Solution Providers about their products and services. These claims might affect purchasing and supply decisions and choices of solution partners.

Standards and solutions should be defined in a way that makes it possible to assess, practically and without ambiguity, whether or not an implementation is conformant as claimed. It will often, but not always, be desirable to include criteria for assessing conformance as part of the standard.

Consistency

Consistency shall be guaranteed within each layer and between each layer of the GS1 system. In other words GS1 shall ensure consistency in architecture across the GS1 system including guidelines, solutions and (where relevant) services.

The most fundamental element of the *GS1 System Architecture* is the data architecture. Data standards that have integrity and relate coherently form the foundation for consistency in the remainder of the GS1 system.

The GS1 system development processes should include a step which confirms, in a rigorous way, that new standards, guidelines, solutions and services are consistent with the GS1 system Architecture. In order for the full choreography of business processes to operate unhindered, the GS1 system has to be consistent across all the processes, both information and physical.

Demonstrable business value

The GS1 system shall support business processes, be tied to trading partner needs and demonstrate its business value.

GS1 standards must be created pragmatically, only in response to business requirements coming from trading partners, where there is a genuine intention to implement. The definition of the standards is driven by the business needs of trading partners. No one company, industry, or geography should dominate the definition of the standards, to the disadvantage of others in the value chain.

Deprecation

As time passes, more standards, guidelines, solutions and services are added to the GS1 system. There is a danger that the system becomes cluttered with unneeded components. This might happen because a standard, guideline, solution or service:

- has been superseded by a better way to achieve the same function within the GS1 system (see “*Non-duplication*” and “*Forward looking*”).
- has been added to the system in a decision that, in retrospect, turns out to be wrong
- has never been implemented

Having choices of standards tends to detract from interoperability and unnecessary choices are to be avoided. Therefore every effort should be made to deprecate and ultimately remove unneeded GS1 system components in support of the principles of interoperability and simplicity.

Elimination of non-conformance

GS1 should assist end users to eliminate exceptions and variances from the GS1 system in their implementations, and the *GS1 System Architecture* is a reference point against which cases of non-conformance can be identified.

When new standards are developed or existing standards changed, or when the GS1 system is introduced to a new user community, it can sometimes be difficult for all users or potential users to

achieve full conformance immediately. This is often due to investment in legacy systems. In these cases GS1 should help users achieve full conformance, for example by providing realistic migration plans, use cases and/or costed business justifications, as part of the deployment support materials delivered with a standard

If exceptions or variations are allowed to persist it is harder to upgrade to the next version of the standard from which the deviations were allowed. Sunrise dates by which conformance should be achieved should therefore be considered.

Extensibility

The *GS1 System Architecture* shall ensure extensibility of the standards, of the tools for implementations, and of the implementations themselves. Extensibility is a necessity for all GS1 system components in order to cater for new and/or more efficient business processes and for the expanding user community. By creating a strategy that applies to all areas of GS1 system, the standards and their implementations can consistently be applied.

Forward looking

The *GS1 System Architecture* shall be forward-looking and support adaptable, flexible solutions. It shall provide for migration strategies and backward compatibility.

The GS1 system needs to anticipate change so that proper planning can take place. This will minimise the extra cost of implementing changes. The *GS1 System Architecture* must take into account potential future business requirements and technology which is imminent.

Backward compatibility is the ability to have a component of the GS1 system replace an older component, such that implementations of the newer version are able to interoperate with implementations of the previous version(s). In order to protect investments in existing implementations, changes to the GS1 system should be backwardly compatible where possible. When a non-backwardly compatible GS1 system component is created, it must be demonstrated to provide significant improvement and be more flexible in order to support future business requirements, some of which might not yet be known.

Where appropriate for major changes to the GS1 system, and especially for those that are not backwardly compatible, a migration plan should be prepared, including:

- an analysis of the current environment
- costs and benefits of making the change
- a plan to manage all the affected areas during the migration process with minimum disruption
- versioning and sunrise and sunset dates

The GS1 system is not static. The *GS1 System Architecture* shall enable users to adapt to changes without introducing divergences by enabling flexible solutions at all levels.

Global multi-sector standards

Standards should be developed to be applicable to the broadest possible range of contexts. For example, what is initially expressed as a local requirement for a country or industry sector can be developed into a global standard, applicable if and as appropriate in every country and sector.

Meeting requirements that arise from a global perspective must be balanced against the need to meet local requirements. There is also the requirement for both to come together at the same time. Standards should be developed to meet all requirements in a mutually consistent and balanced way.

GS1 identification keys

Unique identifiers are the keys to accessing information about business objects. The GS1 system is founded on keys whose values are unique within their designated domains and which unambiguously identify business objects when applied in a GS1 system conformant context. The keys bring value by permitting secure and portable identification across EANCOM, GS1 XML, GDSN,

GS1 barcodes, EPC/RFID and the Internet, and by connecting the physical flow of goods and services to the flow of information.

Keys that are relevant in the GS1 system are divided into four classes. Class 1 keys provide full interoperability across trading partner interfaces while, at the other end of the axis, class 4 keys are not considered part of the GS1 system at all. This classification is explained in the part of the *GS1 System Architecture* dealing with the "Identify" layer and will not be expanded further here. However the principle regarding the use of the keys in GS1 standards is as follows:

1. Use of class 1 or class 2 identification keys as primary identification is mandatory for an implementation to be conformant with the GS1 Core System.
2. All GS1 standards, guidelines, solutions and services are designed to use class 1 identification keys as the primary identification for business objects. Where a GS1 standard permits both class 1 and class 2 identification keys, the standard shall indicate a preference for class 1, because class 2 keys might introduce restrictions or process rules that are not fully aligned with GS1 models.
3. The GS1 system may permit the use of class 3 and/or class 4 keys as additional means of identification. Such use shall also be considered conformant to the GS1 Core System only when class 1 or class 2 identification keys are the primary identification.
4. The GS1 system may recognise the use of class 3 keys for primary identification in some of its parts. Such use shall be considered conformant to the GS1 Extended System but not to the GS1 Core System.
5. Although it is technically possible to use class 4 keys within some GS1 system components, this is not considered part of the GS1 system.

Interoperability

Interoperability is the capability of different systems to exchange data based on a shared understanding of business processes, to read and write in compatible formats and use compatible protocols. If competitors' products are not interoperable (due to causes such as patents, trade secrets or coordination failures) the result may be a monopoly, market failure, or costly inefficiency.


The *GS1 System Architecture* should promote interoperability. This can be achieved in four ways: through product engineering, industry/community partnership, access to technology and intellectual property, and implementation of standards.

GS1 system components and any underlying processes that are developed must strive to be interoperable in their design, development, and implementation to enable the widest adoption and usage by the GS1 community.

The *GS1 System Architecture* should support the integration of information and physical flows into trading partners' systems, so that as far as possible the business process can be supported by automated machine-to-machine messaging, providing a seamless flow of information through to the end user.

Non-duplication

The goal of the GS1 system is to establish one and only one way to perform a given function in a GS1 system conformant way. Therefore, the *GS1 System Architecture* should avoid duplication. When this is achieved, conflicting demands from different trading partners are avoided in GS1 system conformant transactions and the integration of information and physical flows is supported.

 **Note:** When migrating to new and better ways to achieve existing functions, some form of duplication is inevitable. The impact is mitigated if these new and better ways are backwardly compatible (see "[Forward looking](#)") and superseded standards are deprecated (see "[Deprecation](#)").

The GS1 system must be applicable to any supply chain, independent of who assigns, receives, and processes the information.

Non-significance

GS1 identification keys shall be defined in a way that is non-significant.

Non-significance means that the value of the key conveys no useful information apart from uniquely identifying a business object within the domain specified for that key. A GS1 identification key is non-significant when it does not embed business information about the business object it identifies; information about the entity is instead associated with the key. Often this means that the key is used to retrieve information about the business object from a database.

Embedding information into a key severely limits the capacity of the key space (or else requires a very long key) and, more importantly, leads to severe problems if the nature or structure of the embedded information ever needs to change. Furthermore it can cause unnecessary costs if trading partners need to take account of the embedded meaning in their own processes.

The value of a GS1 identification key shall convey no information about the business object it identifies but the keys do have internal structure that is used to ensure uniqueness despite decentralised assignment. The structure can provide information about the organisations involved in the key's allocation which could be helpful, for example, in routing information requests regarding the key.

Open supply chains

The GS1 system shall be developed to suit open supply chains.

An *open* supply chain is one in which the complete set of trading partners (including service providers) is not known in advance and changes continually. This is because:

- trading partnerships change so that new relationships have to be accommodated
- an organisation may be unaware of the destiny or provenance of its products and other relevant entities because it is unaware of the trading relationships of its trading partners.

GS1 standards that are applied at the interfaces between trading partners are defined outside the context of any particular trading relationship. This provides interoperability without the need for organisations on each side of the interface to negotiate in advance.

At the heart of this, the GS1 identification keys provide identification that is not dependent on any particular business relationship or process. Identification of trade items, services, locations, assets and other business objects can be communicated to anybody anywhere in the world without any limitation and without requiring qualification by one of the parties. This means that identification is portable across the entire trading partner base including into unforeseen relationships and processes.

Overall value/Overall cost

As new GS1 system components are developed and deployed, the overall cost of implementation needs to be considered and the GS1 Architecture should achieve the best overall value for the total supply chain.

Savings in one part of the supply chain could result in a tripling of effort and/or cost elsewhere in the same supply chain. Every effort should be made to investigate the impact of a GS1 system component, especially with respect to implementation and maintenance, and costs and benefits should be spread equitably across participants in different stages of the supply chain.

Re-use of components

Standard data elements should be re-used consistently across different GS1 standards. GS1 should store, reuse and share precise core component and business definitions and their equivalent representations in the GS1 system. The GS1 Global Data Dictionary (GDD) is the storage for this data.

The GDD is accessible and can be used to allow all trading partners and solution providers to have knowledge of and share a common definition of any GS1 system component. Additionally, the GDD provides information on the context(s) in which that component can be used.

Royalty free

To the fullest extent possible, the GS1 System and architectural components shall not require the payment of any type of royalties, fees or other considerations to third parties and shall not impose any conditions or restrictions on the use of any technologies or methods (for further reference, consult our IP Policy on <http://www.gs1.org/ip>).

Scalability

Scalability is the ability of a network or a process to handle growing amounts of work in a graceful manner or to be readily enlarged. Sustainable growth of the GS1 system both in number of users and range of standards is important and therefore the system shall be scalable.

The *GS1 System Architecture* is such that a user can initially use limited parts of it, secure in the knowledge that they can use more and more of it later and that all the parts will be fully interoperable. By allowing for continued growth, the GS1 system can be utilised effectively by the smallest of local companies and the largest of the multinational companies simultaneously.

Security

GS1 services should be provided with appropriate security and GS1 standards and solutions should enable appropriate security to be built into users' implementations. This might relate to access control, authentication, non-repudiation and so on, and apply to physical, logical and commercial security.

The goal is to assure trading partners and solution providers that the storage and handling of data is as secure as is necessary throughout GS1 system-based processes. Each GS1 standard, service or solution should have specific security provisions as appropriate or might not need security provisions at all, but security should always be a consideration during the design phase.

Simplicity

The GS1 system should promote simplicity and standardise interfaces.

In the development of standards, simple or less complex solutions achieving the same results should be favoured because simplicity results in easier implementations. Complexity increases potential failure points, introduces unreliability into the supply chain, and can undermine trust between trading partners.

Every effort should be made to standardise the interfaces of the GS1 system, including at least technology interfaces, business interfaces and process interfaces. Trading partners take advantage of multiple components of the GS1 system. Therefore the *GS1 System Architecture* should create a system that reduces time and effort in development and integration when implementing the various pieces.

Technology independence

The *GS1 System Architecture* should promote technology independence and a layered approach.

The GS1 identification keys are the foundation of the GS1 system. They, and other GS1 data standards, are defined independently of data carrier and information sharing technology in which they are used. Neither the data carrier nor information sharing technology alters the meaning of any GS1 identification key or other structured GS1 data.

The *GS1 System Architecture* is designed on the basis of three layers (identify, capture and share) which assists in establishing a modular approach where individual components of the GS1 system can be defined and documented independently of one another.

Where dependencies arise between individual components of the GS1 system, particularly during development efforts, these should be systematically recorded so that the consequences of a change in a component are known when the change is considered.

Third party standards

The *GS1 System Architecture* encourages normative references to and application guidance from ISO, UN/CEFACT, IETF and W3C. The work of standards bodies other than these four should also be considered and, if suitable, adopted.

Where appropriate, GS1 system components should be propagated through other standards bodies, thereby increasing the impact, effectiveness, adoption, and acceptance of the GS1 system globally.

Vision and mission

The *GS1 System Architecture* shall be fully aligned with GS1's vision and mission. The GS1 vision and mission statements express the reason for the existence of the GS1 system and therefore the *GS1 System Architecture* must always support them. In effect they establish the scope of the GS1 system and so, as new and amended standards are assessed, the *GS1 System Architecture* should only be allowed to encompass what is in scope according to the prevailing vision and mission.

GS1's goal is to simplify commerce globally and locally by connecting the flow of information with the flow of goods. GS1 leads the design and implementation of global standards to improve the supply and demand chain.