The Global Language of Business

GS1 Lightweight Messaging Standard for Verification of Product Identifiers

specifies requests and responses for Verification of Product Identifiers, especially for pharmaceuticals

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1 Introduction

Within the GS1 system, products are identified at class level via the Global Trade Item Number (GTIN), which serves as a lookup key for associated master data such as details of ingredients, technical specifications, product images, safety data and instructions for use etc. In a number of industry sectors, products are identified at a finer level of granularity, by combining a GTIN with a lot/batch number (to identify instances of a product that belong to a particular production lot/batch) or by combining a GTIN with a serial number that is unique within the GTIN and where the combination of GTIN and serial number (sometimes called SGTIN) identifies exactly one product instance, so that no two objects anywhere in the world should share the same combination of GTIN and serial number. This means that an individual instance level identifier such as the compound key of GTIN and serial number (SGTIN) can be used to record the unique lifecycle history or supply chain path taken by that individual product instance, thus supporting traceability data at the highest fidelity.

However, in the healthcare sector, it is common practice to use a GS1 DataMatrix symbol that encodes four data elements (GTIN, Serial Number, Lot/Batch Number and Expiry Date). It should be understood that in this situation, the combination of GTIN + Serial Number is a unique product instance identifier and that Lot/Batch Number and Expiry Date serve as data attributes of that unique identifier. They can be used by offline processes such as stock control, which may only need to check the expiry date or batch/lot number. Additionally, they can serve as additional factors within a product identifier verification check, to test whether they agree with the values recorded by the respective brand owner or manufacturer.

Finer grained identification of products assists traceability and unique instance identification via a serial number enables each individual object to be tracked or traced individually across the supply chain from the point of production to the final stakeholder in the supply chain and potentially as far as the point of dispensing to a consumer or patient.

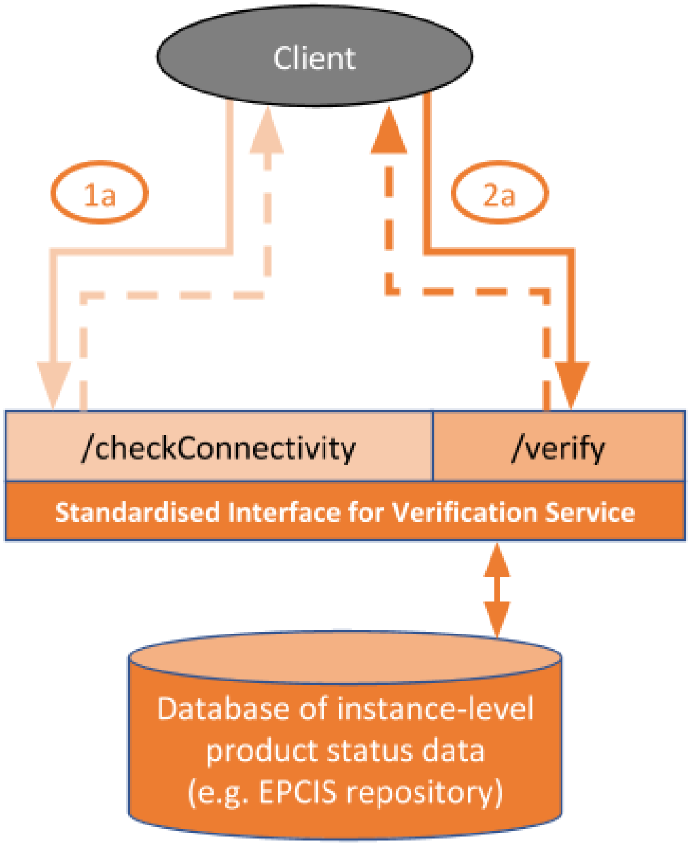
Fine grained identification is also helpful for authentication of the product identifier, as a basic check of authenticity with the brand owner. This may include plausibility checks, such as asking the brand owner questions such as the following:

- Is this batch number plausible for this product GTIN?
- Does this combination of GTIN and Serial Number (SGTIN) correspond to a product that was actually commissioned by the brand owner / manufacturer?
- Is this expiry date plausible for this combination of GTIN and batch number?
- For this combination of GTIN and Serial Number, does this batch number and expiry date agree with the information recorded by the brand owner / manufacturer at the time of production?

This standard is intended to provide a simple standardised lightweight messaging framework for asking such verification questions and receiving actionable information that immediately enables the requesting party to determine whether to accept, reject or quarantine a product instance, based on such an authentication check of the product identifier and associated data. It defines a verification request message and a corresponding response message. The verification method is defined in section *4* of this standard. Additionally, section *3* of this standard defines a method for checking connectivity with a verification service, which could be used before making verification requests.

Figure 1-1 shows how a client can interact directly with a known verification service, using the `checkConnectivity` method (1a) or the `verify` method (1b).

Figure 1-1 A client may interact directly with a known verification service using the checkConnectivity method defined in section *3* or the verify method defined in section *4*.


Client
1a
2a
/checkConnectivity
/verify
Standardised Interface for Verification Service
Database of instance-level product status data (e.g. EPCIS repository)

In situations where the client does not know in advance which verification service to use for a specific GTIN, the client may make use of resolver infrastructure developed for GS1 Digital Link Web URIs, as shown in *Figure 1-2*. A resolver has its own internal database of redirection, which it uses to match against the GTIN within the GS1 Digital Link Web URI, in order to provide a redirection pointer to the appropriate verification service, depending on information configured by the respective brand owner of that GTIN.

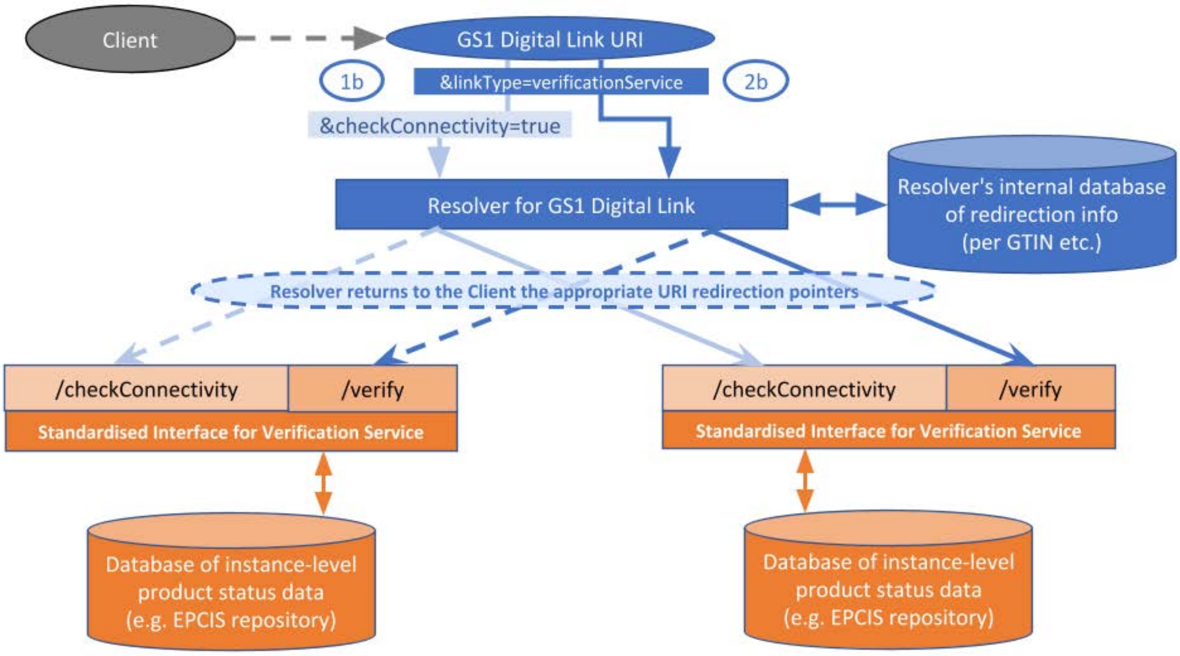
Resolvers for GS1 Digital Link URIs can provide referral links to various kinds of information and services specified by the brand owner. In order to indicate that the client wants to interact with a verification service, the client specifies within the URI query string a linkType value equal to 'verificationService'.

A resolver will redirect to the appropriate verification service for that GTIN and the client will usually automatically retry the request at the location specified by the resolver; that request will respond.

The role of the resolver or lookup directory is to provide redirection so that instead of the client maintaining its own lookup table mapping every GTIN to a specific URL of a verification service, a resolver or lookup directory provides up-to-date redirection information.

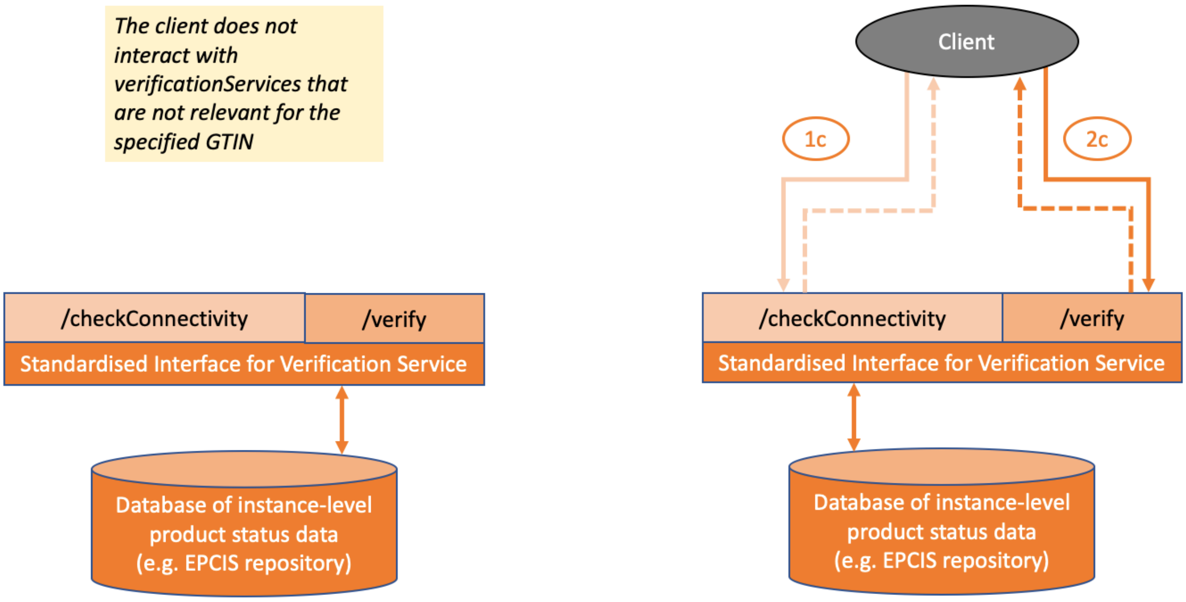
In order to distinguish between the two methods (checkConnectivity and verify) defined for the standardised interface, the client either appends &checkConnectivity=true to the GS1 Digital Link URI - or does not.

Figure 1-2: A client may use the resolver infrastructure for GS1 Digital Links to be redirected to the appropriate verification service for a specific GTIN, as specified by the respective brand owner.


Client
GS1 Digital Link URI
1b
&linkType=verificationService
2b
&checkConnectivity=true
Resolver for GS1 Digital Link
Resolver's internal database of redirection info (per GTIN etc.)
Resolver returns to the Client the appropriate URI redirection pointers
/checkConnectivity
/verify
Standardised Interface for Verification Service
Database of instance-level product status data (e.g. EPCIS repository)
/checkConnectivity
/verify
Standardised Interface for Verification Service
Database of instance-level product status data (e.g. EPCIS repository)

After a resolver for GS1 Digital Link Web URIs has returned an appropriate redirection pointer to the client to a target URL for either the `checkConnectivity` or `verify` method at a specific verification service, the client then retries their query using the target URL provided by the resolver. This is shown in *Figure 1-3*

Figure 1-3 Following on from the step illustrated in *Figure 1-2*, when a resolver for GS1 Digital Link URIs has returned a target URL to the client, the client retries their HTTPS query by interacting directly with whichever is the appropriate verification service for that GTIN.


The client does not interact with verificationServices that are not relevant for the specified GTIN
Client
1c
2c
/checkConnectivity
/verify
Standardised Interface for Verification Service
Database of instance-level product status data (e.g. EPCIS repository)
/checkConnectivity
/verify
Standardised Interface for Verification Service
Database of instance-level product status data (e.g. EPCIS repository)

It is important to note that the verification requests and responses do not flow through a resolver; the resolver merely redirects to an appropriately formatted URL at the verification service and the client retries their query there, using that target URL indicated in the redirection response from the resolver.

Figure 1-4 and *Figure 1-5* provide further examples of how the initial GS1 Digital Link Web URI is reformatted to return the target URLs of the `checkConnectivity` and `verify` methods of the appropriate verification service (depending on the specific GTIN value appearing in the GS1 Digital Link URI - and possibly depending on other factors, such as the value of the `context` parameter and even expiry date [to handle partitioning of referral links to deal with mergers and acquisitions]).

Although this standard was driven by an urgent need from a US regulation affecting the pharmaceutical sector, it has been developed as a generic lightweight framework that should promote re-use and extension for other product sectors (e.g. food, components in technical industries) and for use in all geographic regions. Specifically, the `context` parameter within each verification request serves as a reference to a bundle of input parameters for the product identifier and selected master data attributes, as well as an interpretation (or reference to an interpretation) of the true/false response. The response also supports the provision of additional information, such as current status or disposition (e.g. 'recalled').

The term “lightweight” is intended to convey the streamlined, purpose-built nature of this standard, and has no impact either on its normative character or on its versatility across multiple sectors and regulatory jurisdictions for future applications that choose to leverage it.

1.1 Verification of Product Identifiers for pharmaceuticals

Under the Drug Supply Chain Security Act (DSCSA) § 582(c)(4)(D), beginning November 27, 2019, wholesaler distributors are required to verify the product identifier including Standardized Numerical Identifier (SNI) of products returned to them before the returned products can be placed into inventory for resale. DSCSA defines verification as the process of “determining whether the product identifier affixed to, or imprinted upon a package or homogeneous case corresponds to the [SNI] … assigned to the product by the manufacturer or the repackager….” [§ 581(28)]

“Verification” or “verify” means “determining whether the product identifier affixed to, or imprinted upon on a package or homogeneous case corresponds to the [SNI] … assigned to the product by the manufacturer or the repackager….” [§ 581(28)]. A manufacturer who receives a verification request from a repackager, wholesale distributor, or dispenser must respond to that request within 24 hours (or such other time the Food and Drug Administration (FDA) establishes) [§ 582(b)(4)(C)]. A repackager also has 24 hours to respond [§ 582(e)(4)(C)].

Supply chain parties are expected to exchange information in “a secure, interoperable, electronic manner in accordance with the standards established under the guidance issued pursuant to paragraphs (3) and (4) of subsection (h), including any revision of such guidance issued in accordance with paragraph (5) of such subsection.” Sec. 203, [§ 582(g)(1)(A)]. “The form and format of exchanges shall comply with widely recognized international standards development organization.” Sec. 203, [§ 582(h)(4)(A)(i)].

The Drug Supply Chain Security Act (DSCSA) defines the requirements for Standards in section:

> (h) Guidance Documents.--
>
> (4) Standards for interoperable data exchange.--
>
> (i) identifies and makes recommendations with respect to the standards necessary for adoption in order to support the secure, interoperable electronic data exchange among the pharmaceutical distribution supply chain that complies with a form and format developed by a widely recognized international standards development organization.

This standard specifies requests and responses for Verification of Pharmaceutical Products, including but not limited to the Verification of Saleable Pharmaceutical Returns in the context of DSCSA requirements and the Healthcare Distribution Alliance (HDA)’s Verification Router Service (VRS) requirements.

1.2 Positioning within the GS1 Architecture

This standard is a new addition to the “Share” layer of GS1 standards. At a high level, the request/response is a form of transactional messaging, albeit without a direct link to existing GS1 EDI standards.

This is the first GS1 standard to include JSON as a message response syntax; it is also the first GS1 “Share” standard to leverage the new GS1 Digital Link (Web URI) standard for the request syntax.

This standard can also be viewed as a very minimal kind of Checking Service in the sense that given a serialised product identifier and other parameters as input, it triggers an authentication check to be performed on the product identifier and the result that is returned is actionable information that enables a decision to be made about how to handle the product instance and whether it should be quarantined or destroyed or actually remains viable for onward distribution and sale or dispensing.

1.3 Relationship to EPCIS

This standard is independent of EPCIS and does not require the use of EPCIS, although users are encouraged to implement EPCIS to capture their supply chain events and to leverage the EPCIS query interface to retrieve the data required to respond to a request for product verification.

Although EPCIS event data can record the commissioning or decommissioning of products, as well as current disposition (such as 'recalled') and instance/lot master data (such as 'expiry date'), it does not provide a sufficiently lightweight or convenient interface to perform a simple verification check of product identifiers at batch or serial level.

Current standardisation work already underway on EPCIS / CBV v2.0 includes development of a JSON/JSON-LD data binding (as a more lightweight alternative to XML) and a REST web interface for query and capture (as a simpler alternative to SOAP-based Web Services). However, provision of a dedicated lightweight interface for authentication of product identifiers is outside of the scope of the current EPCIS/CBV 2.0 standardisation work. This standard for lightweight messaging for authentication of product identifiers therefore fills that gap and does not duplicate functionality being developed in EPCIS/CBV v2.0. It also ensures that a GS1 standard for such lightweight messaging is available quickly to meet the urgent needs of the US DSCSA requirements, long before EPCIS / CBV v2.0 is scheduled for ratification, while also being designed in a way that promotes re-use and extension globally and across other product sectors.

1.4 Relationship to GS1 Digital Link

This standard is the first GS1 technical standard to make use of the new GS1 Digital Link syntax in order to enable a basic automated authenticity check of a serialised product identifier and the associated expiry date and batch number via a lightweight web-based request/response message pair, initiated by a simple HTTP/HTTPS GET request and returning a lightweight machine-readable response message formatted in JavaScript Object Notation (JSON).

GS1 Digital Link is primarily concerned with providing simple on-demand access to consumer-facing master data and related services about things identified using GS1 identifiers at any level of granularity (e.g. products identified by GTIN, GTIN+Lot, GTIN+Serial, GTIN+Consumer Product Variant, as well as locations identified by GLN, assets identified by GRAI or GIAI etc.), with the ability to provide a response that is either human-readable (e.g. a web page formatted for humans) and/or machine-readable (such as a block of structured data formatted in JSON / JSON-LD or XML), such that it can be consumed by computer software (also including search engines, smartphone apps etc.).

Section *3* of this document provides a brief introduction to the GS1 Digital Link syntax, as it applies to product instances identified by the combination of GTIN, Batch/Lot, Serial Number and Expiry Date.

The GS1 Digital Link infrastructure includes resolvers, which function as redirection services to redirect to various web addresses specified by the respective licensee of the GS1 identification key (such as the brand owner for a specific GTIN) for various types of service or information.

Resolvers are being defined and developed for GS1 Digital Link for general use for various purposes, including support of this standard. A resolver for a GS1 Digital Link is simply a redirection service that redirects one Web URI to one or more other Web URIs or URLs, nominated by the respective brand owner; in this sense, they play a similar role to the HDA Lookup Directory concept.

A GS1 Digital Link resolver is already operational at id.gs1.org and can be configured with a number of typed redirection links by each licensee of a GS1 identification key. One of these typed links can point to the relevant service for verification of product identifiers, as nominated by the respective brand owner.

A `context` parameter enables additional context to be provided within each `linkType` value. In this specification, the value of `linkType` is set to `verificationService` and the value of `context` may be set to `dscsaSaleableReturn` to ensure that the verification service that receives the request understands that it should use the appropriate configuration, rules and interpretation for the US DSCSA regulations regarding verification of Saleable Returns of pharmaceuticals. In future, the value of `context` may be set to other values in order to reference other configurations and rules to support product identifier authentication checks for other product sectors or other regions or for commercial / non-regulatory purposes.

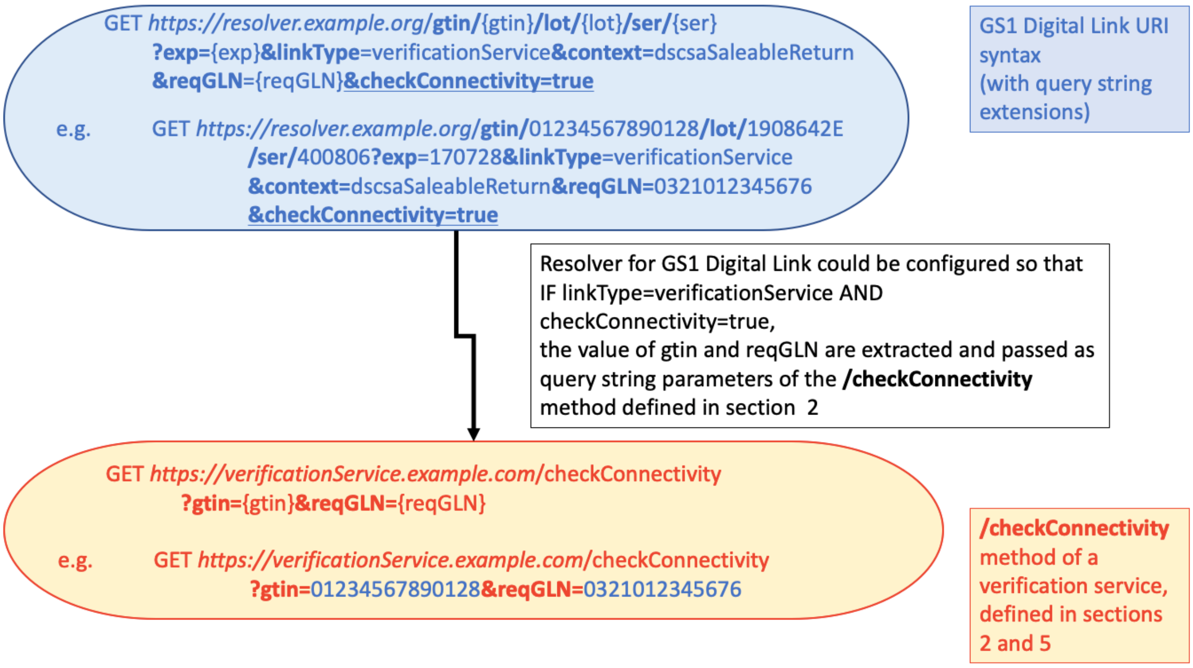
This standard does not mandate the use of the GS1 Digital Link resolver at id.gs1.org; the messaging and URI structure can equally well be used by other lookup directories that perform a similar role; the only difference is a different domain name or hostname instead of id.gs1.org.

References throughout this document to a 'resolver for GS1 Digital Links' also apply to any redirection service or resolver service that conforms to the GS1 Digital Link specification for resolver. This might also include lookup directories aligned with the HDA Lookup Directory specification.

The team developing the GS1 Digital Link resolver prototype at id.gs1.org are carefully examining HDA requirements and draft specifications for Lookup Directories, to ensure that equivalent functional capabilities can be supported by the GS1 Digital Link resolver at id.gs1.org, including the ability to handle redirection to multiple verification services for the same GTIN concurrently, in order to deal with specific issues when mergers and acquisitions of companies and brands require concurrent operations over a period of time during the changeover period while products with the same GTIN from the previous brand owner and new brand owner coexist within the supply chain but can be distinguished e.g. by different expiry dates and may require redirection to one or other verification service endpoint, accordingly.

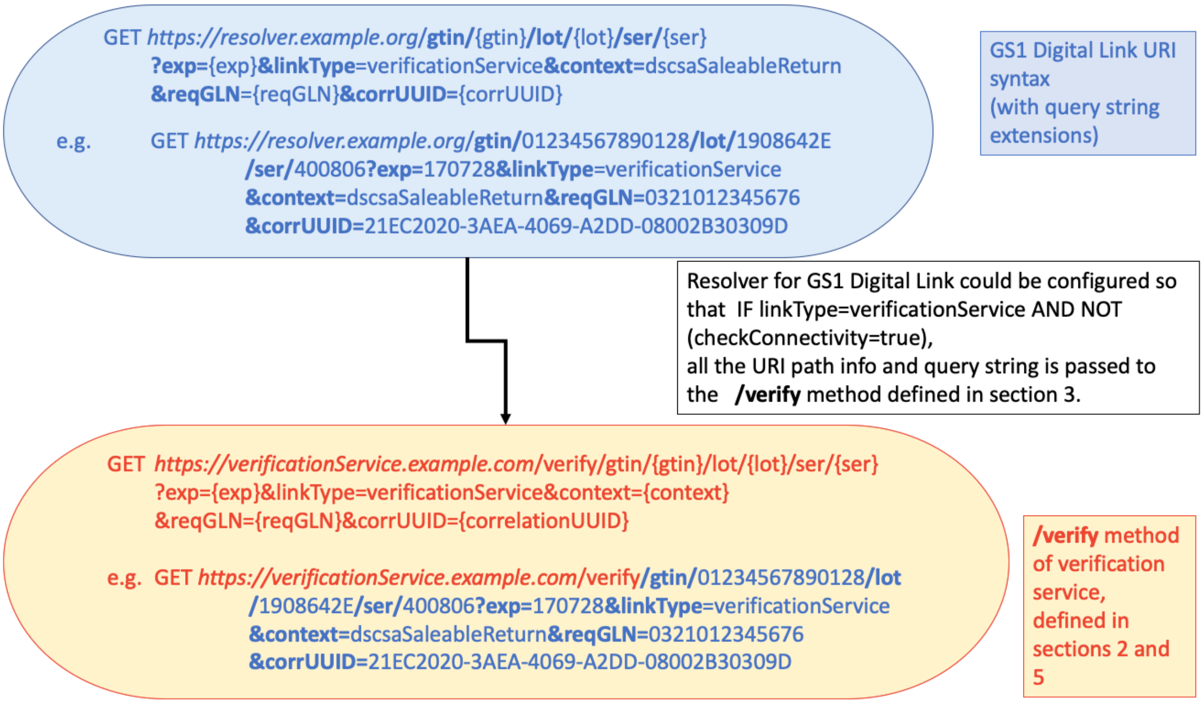
Figure 1-4 and *Figure 1-5* illustrate how GS1 Digital Link Web URIs could be redirected to corresponding URIs for verification service implementations, both for the connectivity check (*Figure 1-4*) and for the actual verification request (*Figure 1-5*).

Figure 1-4: A resolver can be configured to redirect the GS1 Digital Link URI to the `checkConnectivity` method of a specific verification service when `linkType=verificationService` and `checkConnectivity=true` are both present in the URI query string.


GET https://resolver.example.org/gtin/{gtin}/lot/{lot}/ser/{ser}
?exp={exp}&linkType=verificationService&context=dscsaSaleableReturn
&reqGLN={reqGLN}&checkConnectivity=true
e.g.
GET https://resolver.example.org/gtin/01234567890128/lot/1908642E
/ser/400806?exp=170728&linkType=verificationService
&context=dscsaSaleableReturn&reqGLN=0321012345676
&checkConnectivity=true
GS1 Digital Link URI syntax (with query string extensions)
Resolver for GS1 Digital Link could be configured so that IF linkType=verificationService AND checkConnectivity=true, the value of gtin and reqGLN are extracted and passed as query string parameters of the /checkConnectivity method defined in section 2
GET https://verificationService.example.com/checkConnectivity
?gtin={gtin}&reqGLN={reqGLN}
e.g.
GET https://verificationService.example.com/checkConnectivity
?gtin=01234567890128&reqGLN=0321012345676
/checkConnectivity method of a verification service, defined in sections 2 and 5

In *Figure 1-4* and *Figure 1-5*, the hostnames *resolver.example.org* and *verificationService.example.com* are fictitious, for illustrative purposes, to make clear that the resolver is not expected to implement the `verify` or `checkConnectivity` methods; those are to be implemented by a verification service. In some situations, a solution provider may implement a resolver or lookup directory and a verification service co-located on the same domain name or hostname but this is not always the case.

Figure 1-5 . A resolver can be configured to redirect the GS1 Digital Link URI to the `verify` method of a specific verification service when `linkType=verificationService` is present in the URI query string but `checkConnectivity=true` is absent.



```
GET https://resolver.example.org/gtin/{gtin}/lot/{lot}/ser/{ser}
    ?exp={exp}&linkType=verificationService&context=dscsaSaleableReturn
    &reqGLN={reqGLN}&corrUUID={corrUUID}

e.g.    GET https://resolver.example.org/gtin/01234567890128/lot/1908642E
            /ser/400806?exp=170728&linkType=verificationService
            &context=dscsaSaleableReturn&reqGLN=0321012345676
            &corrUUID=21EC2020-3AEA-4069-A2DD-08002B30309D
```

Resolver for GS1 Digital Link could be configured so that IF linkType=verificationService AND NOT (checkConnectivity=true),
all the URI path info and query string is passed to the /verify method defined in section 3.

```
GET https://verificationService.example.com/verify/gtin/{gtin}/lot/{lot}/ser/{ser}
    ?exp={exp}&linkType=verificationService&context={context}
    &reqGLN={reqGLN}&corrUUID={correlationUUID}

e.g. GET https://verificationService.example.com/verify/gtin/01234567890128/lot
         /1908642E/ser/400806?exp=170728&linkType=verificationService
         &context=dscsaSaleableReturn&reqGLN=0321012345676
         &corrUUID=21EC2020-3AEA-4069-A2DD-08002B30309D
```

/verify method of verification service, defined in sections 2 and 5

Figure 1-4 and *Figure 1-5* are intended to indicate that a resolver for GS1 Digital Link URI is capable of redirecting one Web URI to another. Internally, it may enable a brand owner to specify one or more patterns to match valid GS1 Digital Link URIs for a specific set of GTINs or GS1 Company Prefixes, as well as URI templates for the target redirection URLs, which allow values (e.g. for GTIN, reqGLN etc.) to be matched and extracted from the initial GS1 Digital Link URI and substituted within appropriate placeholders of the target URL template, so that the resolver provides the client with the appropriate target redirection URL for that GTIN and other specified parameters, even if the resolver needed to rearrange the GS1 Digital Link URI into a different structure for the target redirection URL.

1.5 Security considerations

✓ **Note** (non-normative):

This standard specifies a standardised interface and a machine-readable response message for performing verification checks on product identifiers. It should be noted that verification of product identifiers is only one element of ensuring security of products; further checks may involve physical inspection of the product and its packaging, including the integrity of any tamper-evident seals.

A verification service performs a check of the product identifier, potentially at the granularity of an individual product instance identified by the combination of GTIN (AI 01) and Serial Number (AI 21). For example, within the context of US DSCSA legislation on verification of saleable returns of pharmaceutical products, the verification checks may include checking that the specific combination of GTIN & Serial Number was actually commissioned by the manufacturer / brand owner and that the lot number and expiry date that were also scanned from the data carrier agree with the lot number and expiry date recorded by the manufacturer / brand owner at the time the GTIN &Serial Number was commissioned.

An implementation of a verification service may use standard HTTP response codes to indicate 'Forbidden' (403), 'Unauthorized' (401) or 'Bad Request' (400).

The request includes a Requestor GLN. It is expected that prior to honouring any requests from a specific previously unknown Requestor GLN, a verification service may require registration by each requestor and the operator of a verification service may appropriate background checks to determine that the requestor is a bona fide stakeholder who has a justification for using the service.

An implementation may also maintain an audit trail of requests and monitor this for unusual patterns of behaviour, including a high frequency of verification requests that result in failure, which may indicate an attempted brute force attack. When this is detected, an implementation may return a 'Forbidden' status for a pre-determined period of time, in order to block or rate-limit suspicious or malicious requests.

2 Connectivity Requests

Prior to performing a verification request, it is possible to perform a connectivity check, to confirm that a web connection exists to the corresponding verification service and that the verification service is online and responding.

✓ **Note** (non-normative):

> The `checkConnectivity` method of a verification service enables a check of connectivity with the verification service and does return appropriate HTTP status codes. If the Requestor GLN (`reqGLN`) was not recognised, the verification service can respond with an `HTTP 401 'Unauthorized'` response, provided that it receives the request. If the Requestor GLN (`reqGLN`) is not permitted to make requests, the verification service can respond with an `HTTP 403 'Forbidden'` response.
>
> In situations where a resolver for GS1 Digital Link Web URIs is used to route the request to the appropriate verification service specified by the brand owner of a specific GTIN, a resolver for GS1 Digital Link will not be able to route the request to the appropriate verification service if the GTIN is invalid or syntactically incorrect. In this situation, it is the responsibility of a resolver for GS1 Digital Link to indicate any syntax error in the client's request, since such a request might never even reach the verification service.

The connectivity check of a verification service is a simple HTTPS GET request in which where the URI path information ends with `/checkConnectivity` and the following two parameters are specified in the URI query string:

- GTIN (for routing purposes)
- Requestor GLN (to uniquely identify the requestor)

✓ **Note** (non-normative):

> The `corrUUID` parameter introduced in section *3* is not required for a connectivity check; it is only required for verification requests, to correlate the response with the request, particularly when the requests and responses are later archived. The resolver makes no use of `corrUUID` but will pass it through if it is specified. A verification service will ignore any parameter that it does not understand, so because the `checkConnectivity` method does not understand `corrUUID`, it will simply ignore it. The REST interface and JSON Schema validation within it uses a 'must ignore' default (open shape validation), rather than the 'must understand' assumption of XSD (closed shape validation).

2.1 Example of a JSON connectivity test

The example below illustrates a sample JSON connectivity test in the context of verification of saleable returns when communicating with a known verification service. The HTTP `Accept:` header with value `application/json` is used to indicate to the verification service that the client would like to receive a response to the connectivity check in JavaScript Object Notation (JSON) format.

```
GET /checkConnectivity?gtin=01234567890128&reqGLN=0321012345676
Accept: application/json
```

The response to such a connectivity check request is an HTTP response containing a JSON body payload formatted as follows:

```
{
"responderGLN":"{responderGLN}"
}
```

If the responder GLN were 012341234567, the following JSON body would be expected in the response if the connection is successful and returns an HTTP 200 status code:

```
{
"responderGLN":"012341234567"
}
```

If no successful connection can be established, appropriate HTTP status codes and helpful descriptions will be returned, as appropriate.

If the Web address of the appropriate verification service for a specific GTIN is not known in advance, the GS1 Digital Link syntax can be used in combination with a resolver for GS1 Digital Link Web URIs, such as the prototype resolver at id.gs1.org, in order to contact the appropriate verification service nominated by the respective brand owner or licensee of the GTIN, by setting the value of `linkType` to `verificationService` and appending &checkConnectivity=true to the URI query string, as shown in *Figure 1-4*.

For example, the resolver for GS1 Digital Link URIs at id.gs1.org could be configured to redirect a request for

https://id.gs1.org**/gtin/**00361414567894**/lot/**1908642E**/ser/**400806**?exp=**170728**&linkType=**verificationService**&context=**dscsaSaleableReturn**&reqGLN=**0321012345676**&checkConnectivity=true**

to

https://other.example.com**/checkConnectivity?gtin=**00361414567894**&reqGLN=**0321012345676**&context=**dscsaSaleableReturn

3 Verification Requests

A product instance can be uniquely identified by the following four data elements:

- GTIN
- Serial Number
- Lot
- Expiry Date

Typically these are encoded within a GS1 DataMatrix symbol, as the following concatenated element strings:

```
(01){gtin}(17){exp}(10){lot}(21){ser}
```

where `{gtin}`, `{exp}`, `{lot}` and `{ser}` are placeholders for the actual values, such as:

```
(01)00361414567894(17)170728(10)1908642E(21)400806
```

The GS1 Digital Link (Web URI) syntax provides an alternative way to express GTIN, serial number, lot/batch and expiry date within a single Web URI format. GS1 element strings can also be translated into a GS1 Digital Link Web URI with the following structure or URI template:

```
https://id.gs1.org/gtin/{gtin}/lot/{lot}/ser/{ser}?exp={exp}
```

or

```
https://other.example.com/gtin/{gtin}/lot/{lot}/ser/{ser}?exp={exp}
```

The URI templates above include four placeholders indicated by curly brackets, indicating where the actual values should be substituted for the actual values of GTIN `{gtin}`, Lot number `{lot}`, Serial number `{ser}` and Expiry Date `{exp}`.

The GS1 Digital Link syntax is simply an alternative way of expressing a concatenation of one or more GS1 element strings but formatted in a way that functions as a web address. It is important to note that the GS1 Digital Link syntax does not require any changes whatsoever to current practices of marking products with GS1 barcodes, whether 1-D or 2-D; pharmaceutical packages will continue to be marked using GS1 DataMatrix symbols that encode the four elements above.

As part of the adoption strategy for GS1 Digital Link, GS1 is currently developing free open source translation functions (in JavaScript, PHP and Java) that will enable translation between GS1 element strings and the GS1 Digital Link / Web URI syntax, in both directions. This can then be included within the software / firmware of barcode scanners or further downstream, within information systems, so that the GS1 Digital Link / Web URI syntax can always be generated on demand, whenever it is required, without requiring any change to how GS1 identifiers are currently encoded and marked on product packaging. In other words, it will be possible to scan a set of four element strings (GTIN, Lot/Batch, Serial Number and Expiry Date) from an existing GS1 DataMatrix barcode on a product package, and have that GS1 element string translated into a GS1 Digital Link Web URI format whenever it is useful to do so.

Note that in the first example, 'id.gs1.org' is the hostname for the prototype GS1 resolver (redirection service) for GS1 Digital Link, while in the second example, 'other.example.com' is a dummy value representing any other hostname, such as the hostname of a resolver or an actual endpoint for a verification service.

We anticipate that the id.gs1.org resolver prototype will redirect to the appropriate server of the responder, but other resolvers (and lookup directories) may be available. However, the structure from `/gtin/` onwards will remain consistent, irrespective of which domain name or hostname is used in the Web URI.

As an actual example of performing these substitutions within URI templates, if the values of the four data elements were:

GTIN (01):	00361414567894
Serial Number (21):	400806
Batch or Lot Number (10):	1908642E
Expiry (17):	170728

then the resulting GS1 Digital Link Web URIs would be:

`https://id.gs1.org`**`/gtin/`**`00361414567894`**`/lot/`**`400806`**`/ser/`**`1908642E`**`?exp=`**`170728`

or something like:

`https://other.example.com`**`/gtin/`**`00361414567894`**`/lot/`**`400806`**`/ser/`**`1908642E`**`?exp=`**`170728`

By default, making a web request for such a GS1 Digital Link Web URI may often redirect to a consumer-facing product description page or to a list of all available links for services and information about that product, as specified by the respective brand owner. However, it is also possible to specify a value for an extra parameter, `linkType` within the URI query string, in order to request a specific type of information or service.

An HTTPS GET request can be made to request verification of a given serialised product by specifying `linkType=verificationService` and by specifying the verification context (e.g., DSCSA Saleable Return), as well as the following details of the request, supplied via the URI query string:

- Correlation UUID (universally unique identifier, uniquely generated by the requestor)
- Requestor GLN (to uniquely identify the requestor)
- Context (indicates objective or purpose for the verification request)

Although a Web request typically returns a synchronous response, both the request and corresponding response may later be archived for audit purposes. It is for this reason that both share the same Correlation UUID, in order that each request may be matched with the corresponding response, even when archived.

The Requestor GLN may be used by a verification service as an input to an access control decision, where access may only be granted to recognised values of Requestor GLN; requests with unrecognised values of Requestor GLN may be redirected to a registration page (via an `HTTP 403 'Forbidden'` response), through which the requestor can register for access, by providing appropriate credentials and justification.

The `context` parameter is a general parameter for use in conjunction with any `linkType` parameter. It has meaning within that link type. Within a `linkType` value of `verificationService`, it provides a verification service with context about the request, indicating a particular profile, which may indicate whether the verification should be performed in accordance with the rules and semantics of a specific jurisdiction or regulatory requirement (as is the case for `context=dscsaSaleableReturn`) or for other purposes, such as verification purely for commercial reasons. The `context` parameter therefore provides flexibility to use the same Lightweight Messaging Framework to support different verification requirement profiles.

The full GS1 Digital Link Web URI templates for a verification request are therefore generated by adding the following additional parameters to the URI query string:

```
&linkType=verificationService
&context={context}
&reqGLN={Requestor GLN}
&corrUUID={Correlation UUID}
```

This results in the following URI templates:

*https://id.gs1.org**/gtin/**{gtin}**/lot/**{lot}**/ser/**{ser}**?exp=**{exp}**&linkType=**verificationService**&context=**{context}**&reqGLN=**{Requestor GLN}**&corrUUID=**{Correlation* UUID}

or

https://other.example.com/**gtin/**{gtin}**/lot/**{lot}**/ser/**{ser}**?exp=**{exp}**&linkType=**verificationService**&context=**{context}**&reqGLN=**{Requestor GLN}**&corrUUID=**{Correlation UUID}

Figure 1-5 showed how a resolver for GS1 Digital Link URIs could be configured to redirect a GS1 Digital Link URI with these additional parameters in the query string (and the absence of the checkConnectivity=true parameter) to the verify method of the appropriate verification service specified by the respective brand owner and licensee of that GTIN.

Note: that some of these parameters (e.g., Correlation UUID) are explicitly required for the dscsaSaleableReturn context, but may not be relevant to other uses of this lightweight standard in other sectors or regulatory jurisdictions.

The examples below use the previous example values for GTIN, Lot number, Serial number and Expiry date, together with the following example values for Requestor GLN, Correlation UUID and context:

linkType:	verificationService
context:	dscsaSaleableReturn
Requestor GLN:	0321012345676
Correlation UUID:	21EC2020-3AEA-4069-A2DD-08002B30309D

After substituting these values into the full URI templates above, this results in GS1 Digital Link Web URIs such as:

https://id.gs1.org**/gtin/**00361414567894**/lot/**1908642E**/ser/**400806**?exp=**170728**&linkType=**verificationService**&context=**dscsaSaleableReturn**&corrUUID=**21EC2020-3AEA-4069-A2DD-08002B30309D**&reqGLN=**0321012345676

or

https://other.example.com**/gtin/**00361414567894**/lot/**1908642E**/ser/**400806**?exp=**170728**&linkType=**verificationService**&context=**dscsaSaleableReturn**&corrUUID=**21EC2020-3AEA-4069-A2DD-08002B30309D**&reqGLN=**0321012345676

By making a simple HTTPS GET request for such Web URIs, the requestor would be redirected to the respective brand owner's verification service (provided this is known to a resolver for GS1 Digital Link Web URIs), which could then use the translation functions to convert back into the corresponding element string and process the verification request and issue an appropriate response.

4 Verification Responses

JSON syntax will be used to respond to all verification requests.

Verification Responses **SHALL**, at a minimum indicate...

- Responder GLN
- Correlation UUID indicated by the requestor in the original Verification Request
- Whether the request was verified (`true`) or not verified (`false`)
- Where NOT verified, indication of the **reason for non-verification** via the value of the `verificationFailureReason` parameter using one of the following code values:

Code value	**Meaning**
"No_match_GTIN_Serial"	No match between GTIN and Serial Number *(For a serialised product, if GTIN and Serial do not match, there is no need to check whether Lot or Expiry also match)*
"No_match_GTIN_Serial_Lot_Expiry"	No match between (GTIN and Serial Number) and Lot Number and Expiry Date
"No_match_GTIN_Serial_Lot"	No match between (GTIN and Serial Number) and Lot Number
"No_match_GTIN_Serial_Expiry"	No match between (GTIN and Serial Number) and Expiry Date
"No_reason_provided"	No reason provided

Future combinations of GS1 Keys / Application Identifiers will need to be defined in subsequent application standards and will result in extensions to this table in a future minor revision.

OPTIONAL additional information may be provided via the `additionalInfo` parameter. The value of the `additionalInfo` parameter is not a free text description; it expects a code value from the following table:

Code value	**Meaning**
"Recalled"	The product has been recalled

4.1 Examples of a JSON verification response

4.1.1 Response following successful verification

The example below illustrates a sample JSON response to a request for verification of saleable returns with Correlation UUID 21EC2020-3AEA-4069-A2DD-08002B30309D, following **successful verification without providing additional information**:

```
HTTP 1.1 200 OK
Cache-Control: private, no-cache
Content-Type: application/json

{
"verificationTimestamp": "2018-08-14T23:29:00.000-08:00",
"responderGLN": "0312231245676",
  "data" : {
     "verified": true
  },
  "corrUUID": "21EC2020-3AEA-4069-A2DD-08002B30309D"
}
```

4.1.2 Response following failure verification

The example below illustrates a sample JSON response to a request for verification of saleable returns with Correlation UUID 21EC2020-3AEA-4069-A2DD-08002B30309D, following **failure of verification**:

```
HTTP 1.1 200 OK
Cache-Control: private, no-cache
Content-Type: application/json

{
"verificationTimestamp": "2018-08-14T23:29:00.000-08:00",
"responderGLN": "0312231245676",
  "data" : {
     "verified": false,
     "verificationFailureReason": "No_match_GTIN_Serial_Expiry",
     "additionalInfo": "recalled"
  },
  "corrUUID": "21EC2020-3AEA-4069-A2DD-08002B30309D"
}
```

5 Open API Schema (including JSON) for Verification Request & Response

```
{
   "openapi": "3.0.0",
   "info": {
      "version": "1.0.0",
      "title": "GS1 Verification Messaging Standard",
      "contact": {
         "name": "GS1",
         "url": "https://www.gs1.org",
         "email": "gsmp@gs1.org"
      },
      "description": "This the API specification for peer-to-peer communication between Verification Router Services or VRS"
   },
   "servers": [{
      "url": "https://vrs.example.com/gateway/placeholder"
   }],
   "paths": {
      "/checkConnectivity": {
         "get": {
            "tags": [
               "Test"
            ],
            "description": "Test connection to endpoints",
            "parameters": [{
                  "name": "gtin",
                  "in": "query",
                  "description": "Global Trade Item Number",
                  "required": true,
                  "schema": {
                     "$ref": "#/components/schemas/gtin"
                  }
               },
               {
                  "name": "reqGLN",
                  "in": "query",
                  "description": "Requestor GLN",
                  "required": true,
                  "schema": {
                     "$ref": "#/components/schemas/gln"
                  }
               },
               {
                  "name": "context",
                  "in": "query",
                  "description": "Verification Context",
                  "required": true,
                  "schema": {
                     "$ref": "#/components/schemas/context"
                  }
               }
            ],
            "responses": {
               "200": {
```

```
               "description": "A response code of 200 means the request was successful and
details about the response can be found in the body of the response. Only a 200 response
will issue a JSON payload.",
               "content": {
                  "application/json": {
                     "schema": {
                        "$ref": "#/components/schemas/ConnectivityCheckResponse"
                     }
                  }
               }
             },
             "400": {
               "description": "Bad Request.  The request was not formatted properly.
Please verify the request conforms to the specification, and re-issue the request in the
correct format."
             },
             "401": {
               "description": "Unauthorized.  The request was not allowed because the
request did not pass authentication."
             },
             "403": {
               "description": "Forbidden.  The request was valid, but the server is
refusing to provide a response because the requestor lacks permission."
             },
             "404": {
               "description": "Not found.  The requested resource does not exist."
             },
             "405": {
               "description": "Method Not Allowed.  The request method is not supported."
             },
             "408": {
               "description": "Request Timeout.  The server timed out waiting for the
request."
             },
             "500": {
               "description": "Internal Server Error.  System failed to process the
request because of an error inside the system."
             },
             "502": {
               "description": "Bad Gateway.  The server was acting as a gateway or proxy
and received an invalid response from the upstream server.  Indicates that one server tried
to use another VRS system and that system was down."
             },
             "503": {
               "description": "Service Unavailable.  System is undergoing maintenance or
is otherwise temporarily unavailable for API queries."
             },
             "504": {
               "description": "Gateway Timeout.  The server, while acting as a gateway or
proxy, performed multiple retries but did not receive a timely response from the upstream
server specified by the URI (e.g. HTTP, FTP, LDAP) or some other auxiliary server (e.g.
DNS) it needed to access in attempting to complete the request."
             }
          }
       }
     },
     "/verify/gtin/{gtin}/lot/{lot}/ser/{ser}": {
       "get": {
```

```
    "tags": [
      "Verification"
    ],
    "description": "Verify a saleable return",
    "parameters": [{
        "name": "gtin",
        "in": "path",
        "description": "Global Trade Item Number",
        "required": true,
        "schema": {
          "$ref": "#/components/schemas/gtin"
        }
      },
      {
        "name": "lot",
        "in": "path",
        "description": "Lot/Batch Number",
        "required": true,
        "schema": {
          "$ref": "#/components/schemas/lotNum"
        }
      },
      {
        "name": "ser",
        "in": "path",
        "description": "Serial Number",
        "required": true,
        "schema": {
          "$ref": "#/components/schemas/serialNumber"
        }
      },
      {
        "name": "exp",
        "in": "query",
        "description": "Expiry",
        "required": true,
        "schema": {
          "$ref": "#/components/schemas/expiryDate"
        }
      },
      {
        "name": "linkType",
        "in": "query",
        "description": "Typed Link",
        "required": true,
        "schema": {
          "$ref": "#/components/schemas/linkType"
        }
      },
      {
        "name": "context",
        "in": "query",
        "description": "Verification Context",
        "required": true,
        "schema": {
          "$ref": "#/components/schemas/context"
        }
      },
               {
                  "name": "reqGLN",
                  "in": "query",
                  "description": "Requestor GLN",
                  "required": true,
                  "schema": {
                     "$ref": "#/components/schemas/gln"
                  }
               },
               {
                  "name": "corrUUID",
                  "in": "query",
                  "description": "Correlation UUID",
                  "required": true,
                  "schema": {
                     "$ref": "#/components/schemas/uuid"
                  }
               }
            ],
            "responses": {
               "200": {
                  "description": "A response code of 200 means the request was successful and
details about the response can be found in the body of the response. Only a 200 response
will issue a JSON payload.",
                  "content": {
                     "application/json": {
                        "schema": {
                           "oneOf": [{
                              "$ref": "#/components/schemas/PositiveVerificationResponse"
                              },
                              {
                              "$ref": "#/components/schemas/NegativeVerificationResponse"
                              }
                           ]
                        }
                     }
                  }
               }
            }
         }
      }
   },
   "components": {
      "schemas": {
         "gln": {
            "type": "string",
            "minLength": 13,
            "maxLength": 13,
            "example": "9071404000002",
            "pattern": "^\\d{13}$"
         },
         "gtin": {
            "type": "string",
            "minLength": 8,
            "maxLength": 14,
            "example": 175304202,
            "pattern": "^\\d{12,14}|\\d{8}$"
         },
         "lotNum": {
            "type": "string",
            "description": "Lot number for the asset to be verified",
            "example": "LZ109B15"
         },
         "serialNumber": {
            "type": "string",
            "description": "Serial number for the asset to be verified",
            "example": "XYZ12345AB"
         },
         "expiryDate": {
            "type": "string",
            "description": "Date of expiry for the item to be looked up in format YYMMDD",
            "minLength": 6,
            "maxLength": 6,
            "example": "170728",
            "pattern": "^\\d{6}$"
         },
         "uuid": {
            "type": "string",
            "description": "Globally Unique Identifier (UUID)",
            "example": "59bc5c88-15f7-49a7-9687-73b05d2c50a4",
            "pattern": "^[a-fA-F\\d]{8}-[a-fA-F\\d]{4}-4[a-fA-F\\d]{3}-[89abAB][a-fA-F\\d]{3}-[a-fA-F\\d]{12}$"
         },
         "timestamp": {
            "type": "string",
            "description": "A timestamp to millisecond precision, with an explicit timezone indicator (+/-hh:mm) relative to UTC",
            "example": "2018-08-14T23:29:00.000-08:00",
            "pattern": "^[0-9]{4}-(0[1-9]|1[0-2])-(0[1-9]|[1-2][0-9]|3[0-1])T(2[0-3]|[01][0-9]):[0-5][0-9]:[0-5][0-9]]\\.[0-9]{3}(Z|((\\+|\\-)((0[0-9]|1[0-3]):([0-5][0-9])|14:00)))"
         },
         "linkType": {
            "type": "string",
            "enum": [
               "verificationService"
            ],
            "example": "verificationService"
         },
         "context": {
            "type": "string",
            "enum": [
               "dscsaSaleableReturn"
            ],
            "example": "dscsaSaleableReturn"
         },
         "positiveVerificationStatus": {
            "type": "boolean",
            "description": "Please refer to the rules defined for the context for further details of what constitutes successful verification.  If verification succeeds, use true.",
            "example": true,
            "enum": [
               true
            ]
         },
         "negativeVerificationStatus": {
            "type": "boolean",
            "description": "Please refer to the rules defined for the context for further
  details of what constitutes unsuccessful verification.  If verification fails, use false
  and select a value for 'verificationFailureReason'.",
            "example": false,
            "enum": [
               false
            ]
         },
         "verificationFailureReason": {
            "type": "string",
            "description": "Mandatory if verification failed. Used to indicate which PI
  element(s) did not match, or to indicate that no reason has been provided (at the
  discretion of the responder.  Values: 'No_match_GTIN_Serial': 'No match between GTIN and
  Serial Number', 'No_match_GTIN_Serial_Lot': 'No match between (GTIN and Serial Number) and
  Lot Number', 'No_match_GTIN_Serial_Expiry': 'No match between (GTIN and Serial Number) and
  Expiry Date', 'No_match_GTIN_Serial_Lot_Expiry': ' No match between (GTIN and Serial
  Number) and Lot Number and Expiry Date', 'No_reason_provided'",
            "enum": [
               "No_match_GTIN_Serial",
               "No_match_GTIN_Serial_Lot",
               "No_match_GTIN_Serial_Expiry",
               "No_match_GTIN_Serial_Lot_Expiry",
               "No_reason_provided"
            ],
            "example": "No_match_GTIN_Serial_Lot”"
         },
         "additionalInformation": {
            "type": "string",
            "description": "Optional. Will be used if 'verified' is true to provide
  additional information of the state of the SGTIN, for example, recalled. Instead of
  including an empty string or null, do NOT include this field unless is populated with a
  descriptive, standardised text value. Values: 'Recalled' – Product has been recalled and
  should not be sold. THIS IS NOT A FREE TEXT DESCRIPTION. Additional values will be
  standardised in the future. NOTE THAT EPCIS IS THE PREFERRED MECHANISM FOR INDICATING
  CHANGES IN PRODUCT DISPOSITION (e.g., recalled, stolen, decommissioned).",
            "enum": [
               "Recalled"
            ]
         },
         "ConnectivityCheckResponse": {
            "required": [
               "responderGLN"
            ],
            "properties": {
               "responderGLN": {
                 "$ref": "#/components/schemas/gln"
               }
            }
         },
         "PositiveVerificationResponse": {
            "required": [
               "verificationTimestamp",
               "corrUUID",
               "responderGLN",
               "data"
            ],
            "properties": {
               "verificationTimestamp": {
                  "$ref": "#/components/schemas/timestamp"
               },
               "corrUUID": {
                  "$ref": "#/components/schemas/uuid"
               },
               "responderGLN": {
                  "$ref": "#/components/schemas/gln"
               },
               "data": {
                  "type": "object",
                  "properties": {
                     "verified": {
                        "$ref": "#/components/schemas/positiveVerificationStatus"
                     },
                     "additionalInfo": {
                        "$ref": "#/components/schemas/additionalInformation"
                     }
                  },
                  "required": [
                     "verified"
                  ]
               }
            }
         },
         "NegativeVerificationResponse": {
            "required": [
               "verificationTimestamp",
               "corrUUID",
               "responderGLN",
               "data"
            ],
            "properties": {
               "verificationTimestamp": {
                  "$ref": "#/components/schemas/timestamp"
               },
               "corrUUID": {
                  "$ref": "#/components/schemas/uuid"
               },
               "responderGLN": {
                  "$ref": "#/components/schemas/gln"
               },
               "data": {
                  "type": "object",
                  "properties": {
                     "verified": {
                        "$ref": "#/components/schemas/negativeVerificationStatus"
                     },
                     "verificationFailureReason": {
                        "$ref": "#/components/schemas/verificationFailureReason"
                     },
                     "additionalInfo": {
                        "$ref": "#/components/schemas/additionalInformation"
                     }
                  },
                  "required": [
                     "verified",
                     "verificationFailureReason"
                  ]
```

```
                    }
                }
            }
        }
    }
}
```

6 References and terms

6.1 References

Document	author / year
CBV v 1.2 https://www.gs1.org/sites/default/files/docs/epc/CBV-Standard-1-2-2-r-2017-10-12.pdf	GS1, 2016
EPCIS v 1.2 https://www.gs1.org/sites/default/files/docs/epc/EPCIS-Standard-1.2-r-2016-09-29.pdf	GS1, 2016
EPCIS & CBV Implementation Guideline v 1.2 https://www.gs1.org/docs/epc/EPCIS_Guideline.pdf	GS1, 2016
GS1 Digital Link (also known as "GS1 Web URI Structure Standard") https://www.gs1.org/standards/Digital-Link/	GS1, 2018
GS1 General Specifications v 18.0 https://www.gs1.org/docs/barcodes/GS1_General_Specifications.pdf	GS1, 2018
JavaScript Object Notation (JSON) specification (published as IETF RFC 8259 and ECMA 404) https://tools.ietf.org/html/rfc8259	IETF, 2017 EMCA, 2017
OpenAPI Specification https://www.openapis.org/	Open API Initiative, 2018
Verification Router Service Request and Response Messaging Standard v 1.0	HDA, 2018

6.2 Abbreviations and Terms

Abbreviation	Term
CBV	Core Business Vocabulary, a GS1 and ISO companion standard to EPCIS that specifies vocabulary elements to be utilized in conjunction with visibility event data, in order to ensure a common understanding of data semantics and underpin the interoperability of EPCIS implementations.
context	Parameter within each verification request which serves as a reference to a bundle of input parameters for the product identifier and selected master data attributes, as well as an interpretation (or reference to an interpretation) of the true/false response; for example, "dscsaSaleableReturn" indicates a verification application within the US DSCSA's provision for Verification of Saleable Returns.
DSCSA	Drug Supply Chain Security Act, comprising Title II of the DQSA, outlines steps to build an electronic, interoperable system to identify and trace certain prescription drugs as they are distributed in the United States

Abbreviation	Term
DQSA	US Drug Quality and Security Act, enacted by the Congress of the United States on November 27, 2013, outlines requirements to build electronic systems that identify and trace prescription drugs distributed in the US
EPCIS	Electronic Product Code Information Services, a GS1 and ISO Standard that defines a common data model for visibility data and interfaces for capturing and sharing visibility data within an enterprise and across an open supply chain
FDA	Food and Drug Administration, a federal agency of the United States Department of Health and Human Services
GLN	Global Location Number, a GS1 identification key used to identify physical locations or parties. The key comprises a GS1 Company Prefix, location reference, and check digit
GTIN	Global Trade Item Number, a GS1 identification key used to identify trade items. The key comprises a GS1 Company Prefix, an item reference and check digit
UUID	Universally Unique Identifier, a practically unique, 128-bit number used to identify information in computer systems
HDA	Healthcare Distribution Alliance, the US national organization representing primary pharmaceutical distributors
HTTP	Hypertext Transfer Protocol, an application protocol for distributed, collaborative, hypermedia information systems
HTTPS	Hypertext Transfer Protocol Secure, an extension of the Hypertext Transfer Protocol (HTTP) for secure communication over a computer network, widely used on the Internet
JSON	JavaScipt Object Notation, an open-standard file format that uses human-readable text to transmit data objects consisting of attribute–value pairs and array data types
JSON-LD	JavaScript Object Notation for Linked Data, ia method of encoding Linked Data using JSON.
linkType	Specification of the nature of the information being linked to, to request a specific type of information or service; for example, "`verificationService`".
Requestor	Party that submits a verification request; for example, in the context of "`dscsaSaleableReturn`", a pharmaceutical wholesaler or distributor.
Responder	Party that responds to a verification request; for example, in the context of "`dscsaSaleableReturn`", a pharmaceutical manufacturer or repackager.
REST	Representational State Transfer, an architectural style that defines a set of constraints to be used for creating web services
SNI	Standardized Numerical Identifier, defined by the DSCSA as "a set of numbers or characters used to uniquely identify each package or homogenous case that is composed of the National Drug Code that corresponds to the specific product (including the particular package configuration) combined with a unique alphanumeric serial number of up to 20 characters."
URI	Uniform Resource Identifier, a string of characters that unambiguously identifies a particular resource
VRS	Verification Router Service, potential method to meet the 2019 Saleable Returns DSCSA Requirements, designed to reference a returned pharmaceutical product's GTIN or associated GCP to automatically query the appropriate manufacturer's database and return a response in real-time
XML	Extensible Markup Language, a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable

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