Global 2D Programme - Foundational FAQs
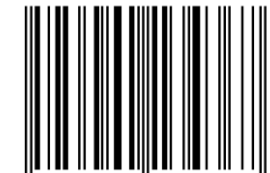## Updated 31 December 2021

Why should I switch from EAN/UPC (1D) barcodes to 2D barcodes?

1D barcodes have limitations that do not allow them to unlock solutions to important business needs. Due to these limitations, organisations have started to use 2D barcodes to enable better solutions for traceability, supply chain visibility, consumer engagement, recall readiness, waste prevention and others.

1D barcodes, such as EAN/UPC, are only capable of carrying a product identifier known as the Global Trade Item Number® (GTIN®). 2D barcodes are capable of carrying additional data, such as expiration date, batch/lot number, serial number, and more. Having this data in the barcode adds value by allowing the information to be automatically captured and acted on.

Some 2D barcodes, like QR Code using GS1 Digital Link, can carry additional data while connecting consumers and other users to online resources and experiences. In addition to carrying more data, 2D barcodes are likely to be smaller than their 1D counterparts and also include features, like built-in error correction that add to their reliability.

1D barcode example	2D barcode examples	
9 526000 134367	(01)09526000134367 (17)301231 (10)ABC123	https://www.example.com/01/09526000134367/10/ABC123
EAN/UPC Product identifier only	**GS1 DataMatrix** Product identifier + more data	**QR Code with GS1 Digital Link** Product identifier + more data + web connectivity

Is the EAN/UPC barcode going away?

No, EAN/UPC and other 1D barcodes, such as GS1 DataBar, are not going away. 1D barcodes will coexist with 2D barcodes for as long as there are uses for them. If there is no need to add data beyond the Global Trade Item Number (GTIN) to the barcode (e.g., batch/lot number or expiry date) or enhance consumer engagement through connecting to online resources, a 1D barcode (EAN/UPC) may still be used.

At a minimum, the GTIN must be in every barcode on-pack that is intended for scanning by consumers or at retail point-of-sale.

What is the difference between the Future of On-Pack Coding Programme and the "Global 2D Programme"?

The Future of On-Pack Coding Programme was initiated by GS1 in 2019 to study the issues raised by global communities relating to the need to have more information on product packages. This programme developed tools and collateral based on findings from around the world. This includes a key learnings library of pilots and proofs of concept from around the world that utilise 2D barcodes for a variety of use cases.

The Global 2D Programme is the next phase of work that focuses on driving education, developing technical guidance and supporting adoption of 2D barcodes – especially in retail and at the point-of-sale.

Do I have to keep 2 barcodes on my product for a transition period? If so, how long?

When using a 2D barcode, a 1D barcode, like the EAN/UPC, is still needed on-pack for a transition period. This is because not all systems are currently capable of scanning and processing 2D barcodes. This is partly because 2D barcodes cannot be scanned by linear scanners that have been used for 1D barcodes – optical scanning technology is needed. Fortunately, optical scanners are becoming more common in retail, but a substantial percentage of linear scanners are still in use. For the systems that already have optical scanners, additional updates may be needed to process and use the data the barcodes hold.

POS systems must be updated to scan 2D barcodes and process, at minimum, the GTIN. Until these updates have been made across all retailers, a dual-marking transition period with a 2D barcode and the existing EAN/UPC barcode is required. This will ensure that advanced use cases can be implemented by retailers who have upgraded their hardware and software while the existing price lookup function will still work for retailers who have not.

Industry has set the ambitious goal of retail POS scanners globally being capable of scanning and processing 2D barcodes by the end of 2027. For those determining which barcode to use on products, they would be able to continue to use a 1D barcode or select from standardised 2D barcode options.

Transition Period	Ambition for 2027
Dual-marking transition phase EAN/UPC **and** a 2D barcode	EAN/UPC **or** a 2D barcode

What does the 2D ambition date of 2027 include?

The industry-defined goal is to enable the use of 2D barcodes, in addition to existing 1D barcodes, at retail point-of-sales across the globe by the end of 2027.

Different regions of the world will move at different paces towards the ambitions goal of transitioning from 1D to 2D barcodes. The Global 2D Programme is working with global communities to coordinate these activities and provide updates on the progress being made.

What is the difference between the 2D barcode options (Data Matrix, GS1 DataMatrix, QR Code)?

GS1 DataMatrix, Data Matrix, and QR Code are types of 2D barcodes that are all approved for use within GS1 system for specific applications. At this time, they **are not** approved for open supply chain use at retail point-of-sale (POS). If using one of these barcodes on a retail POS product, a 1D barcode will be needed until the transition period is complete. See the transition FAQ above for more detail.

All three barcode types are capable of encoding GS1 Application Identifiers (AI) like GTIN, batch/lot number, and expiration number. How those AIs are encoded into the barcode change how they can be used. GS1 DataMatrix uses a syntax, or data format, called GS1 element string. QR Code and Data Matrix use the GS1 Digital Link URI syntax. Note the differences in the human readable text by the barcodes below that show how the data is encoded.

GS1 DataMatrix	QR Code	Data Matrix
(01)09526000134367 (17)301231 (10)ABC123	https://www.example.com/01/09526000134367	https://www.example.com/01/09526000134367
Uses GS1 element string syntax	**Uses GS1 Digital Link URI syntax**	

- **GS1 DataMatrix** use GS1 element string syntax that is seen in other GS1 barcodes, like GS1-128. This data format is heavily used throughout the supply chain to support getting important data where it is needed in healthcare, with fresh foods, on logistic units and a variety of other places. It does not offer the easier web compatibility of QR Code and Data Matrix to enhance consumer engagement.

- **QR Code and Data Matrix** use of GS1 Digital Link URI syntax puts GS1 data into a web compatible format that allows the information to be used for traditional supply chain applications, like price lookup, while also connecting to online resources. Note that the human readable text below the barcode images matches the website address format that is used every day. This allows GS1 Digital Link in QR Code and Data Matrix to combine GS1 identifiers with the benefits of the web.
  - **QR Code** is the current preference for consumer engagement because the default camera application on a mobile device is able to automatically scan the QR Code and connect the user to the website or other resource.
  - **Data Matrix** can also be used to connect users to the web, but not all mobile device cameras can automatically process the barcode type at this time. One benefit cited on Data Matrix over QR Code is that Data Matrix tends to be the smaller of the two.

Which 2D barcode should I use?

Organisations looking to implement 2D need to select a data carrier and syntax based on their business needs and stakeholder capabilities. GS1 recommends actively engaging with partners to ensure the path forward is collaborative and the solutions are capable and compliant.

Capable

- Is the data carrier capable of encoding a GS1 data syntax/format?
- Can the data carrier be created and/or applied at the speed and quality required for the use case?
- Are those intended to interact with the barcode able to process it?

Compliant

- Does the barcode meet regulatory requirements?
- Is the barcode approved for standardised use for your application?

Collaborative

- Have the data, data carrier, packaging, scanning hardware/software and receiving systems capability to store/use data all been considered?
- Have all internal and external stakeholders been brought together to agree on and enable the transition to the future solution? Stakeholders can include local GS1 Member Organisations, industry/trading partners, and solution providers. These stakeholders may include those involved with label design, printing, scanning, data storage, processing, etc.

What is GS1 Digital Link?

The GS1 Digital Link standard extends the power and flexibility of GS1 identifiers by defining how to encode the GS1 system of standards into web addresses (URIs/URLs), thus making them natively connected to the web. That means that GS1 identifiers, such as the GTIN, are now a gateway to consumer-facing information that strengthens brand loyalty, improved supply chain traceability information, business partner APIs, patient safety information and more. The opportunities are limitless!

Where a URL typically points to a single, specific website, the GS1 Digital Link URI syntax enables connections to all types of business-to-business and business-to-consumer information. If you are adding a QR Code to a product, using the GS1 Digital Link standard in barcodes means it will provide a URL for people to scan and also carry GS1 identifiers – the same identifiers relied upon throughout industry. More information is available at the [GS1 Digital Link Landing Page](#).

What additional data will be available at retail point-of-sale?

The data that is encoded in barcodes and used at point-of-sale will vary based on what use cases are being enabled. At minimum, retail point-of-sale (POS) must be able to process the GTIN from a barcode.

Following is a sample list of applications and the additional data that is commonly used to support industry's retail POS use cases.

	Retail POS use case categories	Possible supporting data
	Traceability – product authentication, ingredient sourcing info, supply chain visibility, consumer trust	GTIN + batch/lot number, serial number, country of origin
	Sustainability – recycling info, enables circular economy, waste prevention, farm-to-fork	GTIN + expiration or best before date

	Retail POS use case categories	Possible supporting data
	Inventory management – maintain FIFO, inventory accuracy, availability and location insight, avoid waste, ensure freshness	GTIN + batch/lot number, serial number
	Variable measure – account for differences in count, weight, or dimension changes, encode price	GTIN + count of Items, net weight, price, expiration or best before date
	Safety – brand integrity, prevent sale of expired or recalled product, fight counterfeiting	GTIN + batch/lot number, expiration or best before date, serial number
	Consumer engagement – access to brand authorised info, promotions, recipes, opportunities to engage with the brand	GTIN + use of GS1 Digital Link URI

How will having multiple barcodes on the package and 2D codes with more data impact scanning at the checkout?

Early results from pilots and implementations of 2D barcodes at POS have shown that scanning of 2D barcodes is just as straightforward, efficient, and fast as scanning EAN/UPC barcodes. Through the Global 2D Programme, extensive testing is being conducted to provide insight into 2D performance. These tests will answer prioritised questions from global communities, such as:

- How quickly can different barcodes be scanned with accuracy?
- How does encoded data (amount, type) impact scan speed and accuracy?
- If there are multiple barcodes on-pack (such as an EAN/UPC and a QR Code), how well do scanning systems find the information?
- How should barcodes be placed in relation to each other for optimised scan results?
- How does the number of barcode types being looked for by a scanning system impact relative scanning performance?

How much space will be required on the package for a 2D barcode?

The amount of space required for a 2D barcode depends on what type of barcode is used, how much data is encoded, and if any modifications must be made based on the packaging material or shape.

The GS1 General Specifications contains the minimum and maximum sizes allowed for 2D barcodes used on products scanned at retail point-of-sale in section 5.12.3.1. The below table shows barcodes at their minimum and maximum sizes based on the standards defined in the GS1 General Specifications.

Barcode Type	Encoded Data	Minimum Size	Maximum Size
GS1 DataMatrix	GTIN	(01)09526000134367	(01)09526000134367
GS1 DataMatrix	GTIN, sell-by date, batch/lot number	(01)09526000134367 (16)301231 (10)ABC123	(01)09526000134367 (16)301231 (10)ABC123
QR Code	GTIN	https://www.example.com/01/09526000134367	https://www.example.com/01/09526000134367

Since the size of the barcode will be determined based on the barcode type, amount of data, and other factors, there is not a single answer to what exact size to plan for. As mentioned in the FAQ on deciding which barcode to use, it is also recommended that partners are involved to ensure the barcode design, size, and quality are capable of serving their purpose.

To ensure that barcodes meet quality needs, it is highly recommended to adopt a barcode verification program. Verification is a process where the barcode is graded based on standardised parameters to determine the likelihood it will scan correctly. Verification can help companies understand the quality of their barcodes, whether trading partners can scan them, and what needs to be done to improve them.

What are current adoption levels for optical scanners?

As reported in report "The Global Market for Stationary POS Scanners" by VDC Research (November 2019), the installed base for 2D stationary POS scanners in the U.S. is over 50% and by 2023 the installed base will be 70% as the marketplace purchases almost entirely 2D optical technology. The report also indicates that global retailers are allocating on average 14% of IT budgets on POS systems.

VDC forecasts that by 2023, most **worldwide** retailers will be able to consume 2D barcodes at the point-of-sale. Keep in mind, upgrading POS systems from linear to optical scanning also requires upgrading and integrating the backend systems and infrastructure components that drive POS.