



The Global Language of Business

Retail 2D barcode scanning Tier 1 (baseline) preliminary results

February 2022



GS1 has commissioned global, consistent and impartial testing of barcode scanner systems to benchmark and improve their ability to meet the needs of industry. Retailers will need to plan to welcome multiple types of barcodes through the POS and the scanners will need to be able to recognise them. These scanner tests are designed to support and enable that future. Comprehensive Tier 1 baseline testing of scannability of 1D and 2D barcodes that contain only the Global Trade Item Number (GTIN) data is being executed in a lab environment. This testing is performed on six commercial retail point-of-sale (POS) systems from four different manufacturers. While a formal report with additional details will be provided in March, the key preliminary findings from this first phase of testing are:

- 2D barcodes are reading at retail scanning speeds.
- All [retail](#) barcode sizes (smallest to largest) have performed equally well.
- There are no scanning performance differences between QR Codes and Data Matrix barcodes.

Tier 1 baseline preliminary results and final report

At the time of this preliminary report, the Tier 1 GTIN only encoded barcode baseline testing is underway but has not yet completed. This is a summary of initial observations from the data collected to provide an early view of key findings. The Tier 1 final report will be available in March 2022. The final report will include the encoded data, x-dimension, quality measurements and scanner data collected.

Linear (1D) barcodes test performance

Strong results for all linear barcodes (i.e., EAN-8, EAN-13, UPC-A, UPC-E and GS1 DataBar Omnidirectional) have been recorded on all scanners, largely due to over 45 years of EAN/UPC scanning history and the accompanying scan algorithm optimisations that have occurred over the last decades. With few exceptions, all 1D barcodes decoded correctly on all tests. No appreciable delay was identified with any barcode size, orientation or scanning speed. Only EAN-8 showed any decode issues, and these issues were isolated to one scanner system. GS1 DataBar Omnidirectional saw performance reductions only at the highest scan speeds.

Test Lab Setup

The [Automatic Identification Lab at the University of Memphis](#) is partly funded by GS1 Global Office. The lab uses commercial scanning and printing equipment that has been donated by Solution Providers. Scanning tests are performed via robotic control to provide for consistency and repeatability. University students and staff set up and conduct experiments in strict accordance with test plans developed by GS1. For more information on the testing methodology, see the [executive summary of the 2D barcode scanning test plan](#).

Technical tools to assist the Global Migration to 2D

In addition to the technical testing summarised here, GS1 is developing additional tools and guidance in collaboration with global partners and Solution Providers. The [GS1 GitHub](#) includes open-source code for parser and translator tools, as well as GS1 Digital Link tools.

Two dimensional (2D) barcodes – Data translation

The four 2D barcodes being tested in Tier 1 are GS1 DataMatrix and GS1 QR Code encoded with GS1 element string syntax along with Data Matrix and QR Code encoded with GS1 Digital Link URI syntax. A key goal of the testing is to understand if translating GS1 Digital Link URI data structures to GS1 element string syntax adversely affects the overall scanner decode time. To accomplish this, three of the six scanner systems' software were updated by the manufacturers to include a first generation GS1 Digital Link URI parser/translator. Comparing those systems with and without the parser/translator, testing showed that the additional intelligence of the parser/translator had no appreciable delay in scanning decode time.

Two dimensional (2D) barcodes – Scanning test performance

A key retailer requirement is to **not slow down the point-of-sale**. Testing has therefore been focused on determining scan speed in relation to typical items per minute (IPM) measurement for POS. Through an initial investigation with retail experts, retail speeds are in the range of 40 IPM to a maximum of 70 IPM. For reference, the Guinness World Record for the [fastest time to scan and bag 50 items by a team of two](#) is 48.15 seconds (~62 IPM), achieved in 2014.

All test lab POS scanners were capable of meeting these IPMs for the 2D barcodes tested in Tier 1. These speeds are equivalent to a constant throughput of products spaced between 150-250 mm (6-10 inches) apart.

Important notes

The barcodes used in Tier 1 testing contain the GTIN only. Further Tier 2 testing will include scanning of barcodes with additional data, which is expected to have an impact on decode time and readability. The testing will carefully investigate the potential effects of enabling multiple decode algorithms for multiple symbologies within barcode scanners.

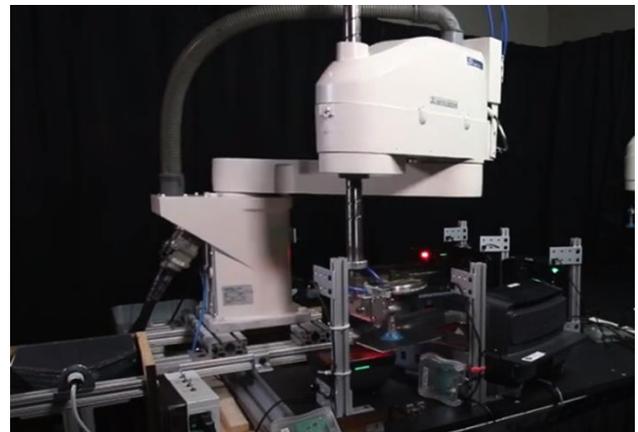
Once there is significant Tier 2 data, deeper engagement with scanner manufacturers is essential to clarify what barcode scanner models (legacy imager-based scanners and new scanners) will be able to reliably meet performance expectations. It is also expected that there will be algorithmic optimisations for 2D barcodes that will further improve scanner performance over time for both legacy and new scanners.

Tier 3 testing will include scanning of different barcodes side-by-side to understand scanners' ability to extract the relevant information from co-located barcodes.

Test profiles that provide details on how the tests are being conducted have been shared with the participating scanner manufacturers and they have validated the test methodology is comprehensive for retail lab tests. Real world scanning pilots (e.g., in retailer test facilities) is required to understand the human and environment impacts on throughput (e.g., items per minute).

What can retailers do to help support this work?

- Provide to GS1 benchmarks for target items per minute (IPM) scanning throughput to ensure that the 40 to 70 IPM range is aligned with retail POS productivity expectations.
- Research your 2D readiness
 - Identify and inventory your 1D only (laser) and 2D (camera-based) scanners from warehouse to POS
 - Connect with your hardware and software Solution Providers to investigate 2D scanning and collaborate on potential uses of additional on-pack data
 - Test retail systems to establish baseline capabilities for next steps
- Support the 2D journey by conducting pilots in your stores or retail test labs
 - Identify the business use case opportunity
 - Identify the potential retail products
 - Connect with stakeholders (GS1, solution providers, and other partners) to collaborate on an initial pilot
 - Share the results to enable your learnings to help industry adoption
- Join the [2D in Retail MSWG](#)



University of Memphis, GS1 AIDC test lab 1

[Contact](#) the GS1 Global Office for questions on the test plan.