

## 1. Why Track-&-Trace?

As the global digital ecosystem known as the *'data-driven economy'* picks up pace, *'Track-&-Trace'* is rapidly becoming critical for any business. Data is increasingly being gathered, organised and exchanged by a network of vendors for the purpose of deriving value from the accumulated information, including tracking of *'Key Performance Indicators'* (KPIs), Logistics, Production-Control, Accounting, Reconciliation, Security and AI-driven decision support systems.

Central to any *'Track-&-Trace'* operation are machine-readable optical codes. Typically these are attached to the item to be tracked, and scanned and logged every time the item arrives at any destination where a *'Standard Operating Procedure'* (SOP) implementing *'track-and-trace'* is in effect. This *'scanning'* function reads the optical code, (*typically using just the camera on a smartphone, or via a dedicated scanner*), and logs the optical code, and typically also logs the time and location of the scan, as well as the ID of the scanner operator. This logged data then usually drives any number of real-time enterprise applications.

Clearly, *'Track-&-Trace'* is here to stay, and is increasingly becoming the core on which a business builds its operations.

## 2. Why DotCode?

DotCode is a type of optical code for *'Track-&-Trace'* and is an internationally defined standard – meeting with industry standards & regulatory requirements for product identification & serialisation.

The DotCode standard is in the public domain, so its codes can be freely generated without having to acquire any licenses, or pay any royalties.

Whilst QR-Codes are often used for *'Track-&-Trace'*, they are not an appropriate technology for at least two big reasons:

## 2.1 Security

- QR-Codes have become such a standard that scanners for QR codes are built into every mobile phone.
- This sounds great, but the problem is that a hacker targeting your customers, can easily place fake labels containing the address of a fake web-site that looks just like your web-site, onto your products.
- Any scans of such fake labels will forward your unwary clients to the fake web-site, where the hackers can masquerade as you and collect your customers private details and steal their money.
- The damage to your brand image and customer relations would be incalculable.
- There is nothing you can do to protect your clients when using QR-Codes as:
  - a) A shopper cannot tell by looking at a QR-Code that it was created by a hacker and contains a fake web-site link.
  - b) As a company you have no control over which scanner software is used to scan the fake labels on your products - After scanning a fake label, all QR-Code scanner software will blindly forward your unwary clients to a fake web-site.
- DotCode in sharp contrast to QR-Code is always read using a proprietary scanner which can implement a vast range of security policies to validate a label, and can guarantee that the shopper or scanner user will only ever be forwarded to a legitimate service point.

## 2.2 High-Speed Product Marking

- Ideally you want to use the same optical code throughout your supply chain which includes manufacturing, warehousing, logistics and retail.
- Ideally manufactured items should be labelled as they progress along a production line, rather than manually adding labels afterwards – especially where large volumes are involved.
- This means that labelling needs to be done reliably at high speed, as products pass a point on the production line.
- At such speeds, it is not possible to reliably print QR-Codes onto items flying past without smudging lines and dots – making it unreliable to read.
- From the outset, DotCode was intended for industrial, high-speed marking with continuous ink-jet or laser ablation so that DotCode can easily be (a) **printed** and (b) **etched** directly onto manufactured items at high speed.

- DotCodes have been used to great success for ‘*on-pack serialisation*’ in the European tobacco industry where fast-paced production environments (often producing up to 1,000 packs per minute) require a high-speed product marking solution.
- DotCode does not require the use of continuous lines or precise spacing (Unlike other 2D codes). Because of this, they can be reliably applied with high speed code printing technologies including industrial ink-jet printers for labels, and laser coders including CO2 and fibre lasers for engraving.
- DotCode is designed to tolerate missing, extra or poorly-placed dots without sacrificing reading integrity, and employs an error-correction-code to be more resilient to damaged optical codes.
- All of the above makes DotCodes well suited to industries with high-speed production lines, where DotCode facilitates “*item-level serialisation*”, allowing products to be tracked throughout global supply chains.

DotCode has a variable size, dot matrix symbology that encodes data in an array of nominally disconnected dots arranged within a regular grid of possible locations. The overall symbol shape is adjustable from rectangular, to nearly square shaped symbols.

A DotCode symbol size is theoretically unlimited. DotCode has an exceptionally high data capacity, up to 3,500 alphanumeric characters.

DotCode can be printed in a wide range of colours to compliment an owners brand.

DotCode can be printed so compactly (using lasers) that it can effectively be invisible to the human eye for secret marking applications. Such ‘invisible’ codes can be read back using a microscope or high-definition camera.

### 3. Why Zaheen-Tech?

When a business selects its ‘*Track-&-Trace*’ technology, the decision is not about purchasing mere products – it is about making a key architectural decision affecting critical business infrastructure. This decision needs to be made with long-term requirements in mind, and not just to satisfy the short-term requirements of any single project.

Zaheen-Tech are specialist suppliers of ‘*Track-&-Trace*’ services based on the ‘*DotCode*’ optical code, and can provide a distributed, powerful yet green, scalable, highly-available and secure ‘*Track-&-Trace*’ infrastructure to handle long-term business requirements.

Zaheen-Tech provide two key components to deliver DotCode ‘*Track-&-Trace*’ services to your enterprise; (a) an innovative DotCode Scanner, (b) a powerful, scalable and secure Cloud.

## 3.1 Scanner Technology

The Zaheen-Tech Scanner is a software library with an accompanying software development kit (SDK) that enables any smartphone-app or web-app developer to integrate 'DotCode Scanner' capability into their web-app, Android-app or iOS app.

This enables any organisation to create a vast range of different apps accessible from any user's smartphone or from any browser. These apps can 'scan' a DotCode label and have bi-directional communications with Zaheen-Tech's Cloud infrastructure.

In this way there is universal access to scanner capability for any use-case.

Also, by distributing the scanner as a library rather than as an app – it means that a company is not forced into using a universal app which may not fit the target application well.

It also means that the scanning capability can be added to existing apps that are already in the field. Each app can be customised to fit within an enterprise's rules and branding.

As a DotCode scanner, it can quickly scan any DotCode at any orientation, with perspective and lighting correction, and also log time and location of the scan, as well as the ID of the scan operator and device.

Scanned data can be viewed and processed via a generic set of analytic services running in the Zaheen-Tech Cloud – or it can be forwarded to a client's own IT infrastructure.

The Zaheen-Tech Cloud can set scanning rules for where to forward the scan data – as well as filters to only accept scans under specific constraints e.g. only accept scans of tickets from a specific set of venue gate locations between a specific set of times.

It can use the error-correction-code retrieved from the scanned DotCode to recover data from the code intact, even from blemished, damaged and partially obscured DotCode labels.

In addition to standard scanning of a single DotCode, the Zaheen-Tech Scanner is unique in that, with a single scan, it can scan multiple DotCodes, which are at different locations on a package, with different sizes and orientations, with the DotCodes being interspersed between complex graphics.

Further, the Zaheen-Tech Scanner can be customised to integrate robot-vision capabilities in addition to DotCode scanning.

This would be useful for example if you wanted to identify a blister-pack product, as well as which blisters in the pack have changed status, all with a single scan.

You could use this for example with blister-packs that contain tablets. A single scan could identify the both (a) the type of tablets, as well as (b) how many tablets have been taken and how many remain.

This could be integrated for example, with an app that manages and tracks medicine dispensing protocols.

The Zaheen-Tech Scanner library also has a facility for two-way communication between the scanner app and the Zaheen Cloud, so that messages can be sent from the app to the Zaheen-Tech Cloud, as well as from the Cloud back to the scanner app, so that immediate feedback can be presented to the scanner-app user.

Protection against counterfeit products in your supply-chain is critical, and can be achieved by logging ‘*Track-&-Trace*’ data to create an audit trail of all scans in your supply-chain. This audit-trail can then be combined with business rules to identify in real-time, and scans of forged labels on counterfeit products that try to enter your supply-chain.

For example, if you have two scan points A and B, and you register 2 business rules in the Zaheen-Tech Cloud:

Rule 1: Once a label is scanned at A, it must next be scanned at B.

Rule 2: Once a label is scanned at B, it cannot be scanned at A.

If a legitimate label is scanned at A and then at B. Then that label cannot subsequently be scanned at A.

If subsequently a forgery of that same label is rescanned at A, the forgery will immediately be detected, because that label has already passed through A and reached B, and any repeat scans at A can only be forgeries.

You can create much more complex business rules than this to protect your supply-chain from fake products – which both protects your brand and your revenue streams.

## 3.2 Cloud Infrastructure

The Zaheen-Tech Cloud Infrastructure has been designed to address complex requirements for ‘*Track-&-Trace*’, now and into the future.

It has a distributed architecture, which lends itself well to supporting ‘*Track-&-Trace*’ processes in widely distributed areas, yet with continuity even if networks fail, through local service provision from Edge servers.

This use of edge servers is essential if your scan points are widely separated, such as in retail outlets or warehouses.

It is also extremely secure, to the extent that it is not possible to infect with any kind of virus or trojan.

It is the perfect environment in which to develop a range of data processing apps and services with its low-code development environment.

It also supports 'Enterprise Service Buses' to enable connectivity with legacy IT systems.

Use of UML models in the low-code design environment enables improved collaboration & communications between all stakeholders, and aids in understanding complex systems, which facilitates better decision making, and removes exposure to dependence on key-staff and specific suppliers, past or future.

The Zaheen-Tech Cloud can be deployed using conventional servers, as well as Edge servers and can be configured to be highly-available for mission-critical use-cases, as well as scale performance, all with extreme low-power for a very low carbon footprint.