MINISTRY OF HEALTH
MANATŪ HAUORA

New Zealand Government

COVID-19

Contact Tracing QR Code and NFC Tag Specification

HISO 10067:2021

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1 Introduction

This document is a technical specification for the QR codes and NFC tags to be used with the NZ COVID Tracer app.

1.1 Purpose

This standard has been produced as part of the COVID-19 pandemic response in New Zealand.

The standard is consistent with the Ministry of Health COVID-19 case definitions and contact tracing process description, and forms part of the data and digital response to COVID-19 in New Zealand.

The purpose of the standard is to ensure that the QR code and NFC tag specifications used by the NZ COVID Tracer app are documented and open to all implementers.

Fast and efficient contact tracing is recognised as a critical component in the response to the COVID-19 pandemic. One of the tools to support this process is allowing members of the public to record where they have been, so if they are contacted by a contact tracer they have an accurate record of their movements.

Members of the public can scan these QR codes with a compatible app on their smartphone to record they have been at that place. In October 2021 support for compliant NFC tags was added as an alternative method to record a diary entry. Having different options for recording a visit allows for people with different accessibility needs to use the app.

These recorded locations can then be shared with the Ministry of Health if the person tests positive for COVID-19, or be notified of a potential exposure to the virus through being at the same location and same time as a confirmed case.

This specification is published to allow suppliers to produce QR code posters and manufacture and distribute NFC tags that work with the NZ COVID Tracer app, while ensuring that the user experience is consistent and of high quality.

This will enable businesses to use the technology to make recording a visit easier for their customers.

1.2 Scope

This specification covers technical specifications of the QR code and NFC tag used with the NZ COVID Tracer app.

Information about the data collected to support contact tracing, and the standards required, are covered in separate document **HISO 10085:2020 COVID-19 Contact Tracing Data Standard**.

1.3 Definitions

Close contact means a person who has been exposed to a suspect, confirmed or probable case of COVID-19 during the infectious period, without personal protective equipment.

Contact tracing is the public health process to find people who may have been exposed to COVID-19 through contact with a case during that person's infectious period, so that they can isolate and get tested.

NFC stands for *near field communication* – a smartphone technology that allows contactless data exchange over short distances using radio frequency technology.

QR code stands for *quick response code*, a two-dimensional barcode designed for consumer use with smartphones.

SDK stands for *Software development kit*. This includes a range of things such as libraries, documentation, code samples, processes and guides that developers can use and integrate into their own apps

1.4 Reference documents

Contact Tracing App Privacy Impact Assessment
HISO 10085:2020 COVID-19 Contact Tracing Data Standard
COVID-19 Contact Tracing Integration Platform Specification
ISO/IEC 14443-3:2018/AMD 1:2021
ISO 9001 – Quality Management Systems
ISO 1401 – Environmental Management
ISO 27001 - Information Security Management
OHSAS 18001 – Occupational Health & safety Management systems

1.5 Revision history

21 May 2020	Published as draft specification
25 May 2020	Minor fix to QR code example
22 October 2021	Added NFC tag specification

2 Background

Contact tracing is one of the pillars of the public health response to COVID-19, along with border control, testing and case isolation. A comprehensive contact tracing system will enable rapid identification and isolation of new cases and is central to breaking the chain of transmission of COVID-19.

2.1 Contact tracing process

Contact tracing starts with a case being contacted by a public health representative. The person is provided with advice on self-isolation and their health and wellbeing is checked. The person receives daily follow up during the isolation period.

Key to contact tracing is getting information about the contacts of persons with COVID-19 to identify the source of the infection and make close contacts aware of the risk and the need to get tested and self-isolate.

One of the tools to support contact tracing is helping members of the public to record where they have been, so if they are contacted by a contact tracer, they have an accurate record of their movements.

2.2 NZ COVID Tracer

The NZ COVID Tracer app has been operational in New Zealand since May 2020. It allows users to create a private digital diary of their movements, primarily by scanning QR codes containing name and address details and a unique Global Identification Number (GLN) for the venue visited.

This app aids case investigation by allowing a case to upload this digital diary, and it aids contact tracing by allowing notifications to be sent to people who have been exposed to COVID-19. These privacy-preserving notifications are enabled through the broadcast of GLN and exposure time for locations of interest.

The capability to add a diary entry equivalent to scanning a QR code by tapping an NFC tag was added to the NZ COVID Tracer app in August 2021. Businesses can display Near Field Communications (NFC) tags in addition to QR codes. This provides an alternative for consumers to address the following issues in scanning QR codes:

- Scanning QR codes can be difficult for people with some accessibility needs – for example, framing the QR code correctly within the camera view of the app can be difficult for people with low vision, and holding the device steadily at the correct angle can be difficult for some people with a physical impairment. NFC tags may be more accessible for some of these people.

- Scanning QR codes with the NZ COVID Tracer app requires a user to first open the app, which may be inconvenient. Tapping an NFC tag can allow for much quicker check-in without needing to launch the app.

The NFC functionality uses the existing data content of QR codes and does not compromise the privacy and security of the app.

2.3 Rationale for approach

The Ministry evaluated several options for the implementation of a scannable symbol within a limited time frame. The criteria for the decision was based on the following factors (in no particular order):

- Make use of a standard and well supported symbol, well understood by the development community.
- Make use of a widely recognised symbol by the general public, to reduce confusion and inconsistency in communications and language.
- Make use of a standard and well supported data parser to extract data from the symbol, so manual parsers or special SDKs are not required by parties implementing the standard.
- Mitigate where possible any risks of user-generated input in the symbol causing parsing errors, eg, special characters, macrons, and emoji.
- Provide opportunities to interoperate with third party developers and existing in-market solutions.
- Provide forward-compatibility and interoperability with other international solutions that may eventuate.

The Ministry also considered the following requirements when choosing the behaviour of a QR code or NFC tag scanner implemented on a smartphone:

- The solution must not require a network request to be made at scan-time, such that it is feasible to track an individual through that network request.
- It must be possible for a user to review the locations they have checked-in to without needing to share any information with a central system.
- The solution must avoid making it possible for a third party to reconstruct an individual's movements, unless the user explicitly consents to that information being shared.

This led the Ministry to conclude that the most appropriate solution was a Quick Response (QR) code, using a Base64 encoded JSON object as a plain string. A plain text prefix is included to make the purpose recognisable to a casual observer.

In September 2021 this solution was extended to add support for using NFC tags.

The data format contained with the QR code and NFC tag is outlined in the remaining sections of this specification.

3 Specification

This section provides the technical details of QR codes and NFC tags, covering the data attributes, format, encoding, and physical attributes for NFC tags.

3.1 Data attributes

The content of the QR code and NFC tag is made up of several data attributes, encoded in a specific format.

The following table describes the attributes present in the JSON dictionary. Attribute names are abbreviated to reduce character requirements, while maintaining readability.

All these attributes are derived from records created by a business using Business Connect, a service offered by MBIE. Business Connect is powered by the New Zealand Business Number (NZBN).

All attributes are mandatory and the GLN must exist in the NZBN. QR codes must not be generated without a corresponding record in the NZBN.

Name	Type	Format	Description
`typ`	enum string	Alphanumeric Max 6 characters	Describes the purpose of the code, limited to one of the following values: • `entry`
`gln`	string	Numeric Max 13 characters	A Global Location Number (GLN) that uniquely identifies the location. The GLN is 12 digits in length plus a check digit. The check digit confirms the GLN is valid, using the **GS1 calculation**.
`opn`	string	Alphanumeric Max 35 characters	The Organisation Part Name. Names longer than 35 characters will be truncated
`adr`	string	Alphanumeric Max 90 characters	The address of the location. Address lines are separated by a newline character. Address formatting must align to government standard for addresses. Addresses longer than 90 characters are truncated. Address elements may be omitted for brevity if they don't reduce precision for a casual reader.
`ver`	string	Alphanumeric Max 6 characters including prefix	A positive integer-based version number of this JSON spec, prefixed

			with `c19:` to denote it is used for COVID-19 response.

3.1.1 Attribute: `typ`

This attribute denotes the purpose of the QR code in the context of the COVID-19 use case. At present there is only one recognised value, `entry`, which denotes the code is to be scanned when entering a premises. In future iterations of this spec this attribute may be extended to include other uses such as exit or checkpoint.

3.1.2 Attribute: `gln`

This attribute contains the GLN of a location, which is obtained by a business user through the Business Connect Platform. A GLN represents a sub-location of a business, and ties back to their New Zealand Business Number (NZBN). For example, a nationwide coffee store chain may have a sub-location for each of their café locations. The chain itself has a single NZBN, and each location has its own GLN.

3.1.3 Attribute: `opn`

This attribute is the Organisation Part Name (OPN) that is attached to the GLN. This name is created by a business when they use Business Connect. This name should be a customer-friendly name, and recognisable by a user as the place they visited. It may contain the trading name, and other details to make it recognisable.

This field is limited to 35 characters.

3.1.4 Attribute: `adr`

This attribute is the physical address of the location, where a person would reasonably recognise as the entrance. It should conform to **ISO 19160-1:2015 Addressing Part 1: Conceptual Model**. There is a limit of 90 characters in this attribute so elements of the address may be omitted if required to fit the length constraint provided the address is still readable and understandably by a casual observer.

Multiple lines are separated by a newline character (`\n`).

3.1.5 Attribute: `ver`

The version of this standard in use, including a text-based prefix to denote the object is aligned to this standard. A positive integer-based version number of this JSON spec, prefixed with `c19:` to denote it is used for COVID-19 response.

The current version number is `c19:1`.

3.2 Format

The JSON payload is encoded using Base64 to limit the character space in the QR code to alphanumeric characters.

After the JSON payload is encoded, a prefix of **NZCOVIDTRACER** is prepended, separated by a colon, to make the content of the code recognisable to a casual observer scanning the code without a compatible smartphone application.

3.3 Encoding

To encode the attributes the JSON object is converted to a string representation. All extraneous whitespace and other formatting should be stripped during this process (excluding whitespace within the attribute values). This JSON string is then encoded using Base64.

The function for compiling the data format from attributes to the encoded string in pseudocode is:

```
prefix = “NZCOVIDTRACER:”                    # static prefix
attributes = {“typ”: “entry”, ... }          # object that can be serialised to JSON
json_string = json_stringify(attributes)     # serialise object into JSON string
base64_string = base64_encode(json_string)   # base64 encode JSON string
encoded = prefix + base64_string             # prepend prefix to base64 string
```

Note: when encoding the Base64 string, ensure the target charset is set to UTF-8 to account for macrons and other special characters that may be present, otherwise the JSON may be invalid when decoded.

The value of **encoded** is what is encoded into the QR code, and the value retrieved when the QR code or NFC tag is scanned.

3.4 Decoding

To decode, prefix characters are discarded (the length of **NZCOVIDTRACER:** including the semicolon), and the remaining string is Base64 decoded and parsed as JSON. This is best done by discarding anything before and including the semicolon character, rather than from a fixed character.

Note: when decoding the Base64 string, ensure the source charset is set to UTF-8 to account for macrons and other special characters that may be present, otherwise the JSON may be invalid.

The corresponding pseudocode for this operation is:

```
encoded = “NZCOVIDTRACER:eyJ0…<snip>…fQ==”    # value obtained from QR code scan
from = index_of(“:”, encoded)                 # find the position of the last : char
base64_string = substring(encoded, from)      # discard chars prior to and including :
json_string = base64_decode(base64_string)    # decode base64 into JSON string
attributes = json_parse(json_string)          # parse JSON string into dictionary
```

The **`attributes`** value contains the attributes defined in the earlier table.

3.5 Scanning

When a QR code or NFC tag is scanned, the following rules should be evaluated to confirm the content is appropriately formatted.

1. The characters up to the first semicolon are equal to **`NZCOVIDTRACER:`**. These characters are then discarded.
2. The remaining characters can be decoded as valid Base64
3. The resulting string can be parsed as valid JSON
4. The resulting object has an attribute **`ver`**
5. The **`ver`** attribute has a value starting with **`c19:`**
6. The integer value of the **`ver`** attribute denotes the version of this specification the remaining attributes in the JSON object take.

3.6 QR code parameters

QR codes have several parameters that govern the output.

3.6.1 QR code error correction level

- Level L: Approx 7% correction capability
- Level M: Approx 15% correction capability
- Level Q: Approx 25% correction capability
- Level H: Approx 30% correction capability

The error correction capability is used to restore data if the code is dirty or damaged. Raising the level improves error correction capability but also increases the amount of data required, and therefore the overall size of the QR code.

3.6.2 QR code version

Each QR code symbol version has the maximum data capacity according to the amount of data, character type and error correction level. Larger data requires a larger QR code.

To improve the reliability of scanning, and the support for low-DPI printers, the following considerations should be taken for the generation of the QR code:

1. The output size of the QR code should not be scaled up or down. This may cause aliasing (or fuzzing) of the pixels representing the code, causing the image recognition to fail
2. The size of the individual 'dots' should be large enough to be printed by a low-DPI printer. If the code is too small, and therefore the 'dots' are too fine, a low-quality printer will not be able to print the dots properly, causing data to be missed.

3.7 NFC tag configuration

NFC tags have special requirements that must be met.

3.7.1 NFC tag record slots

NFC tags are structured using record slots, which readers can use to retrieve data and act upon it.

Compliant NZ COVID Tracer NFC tags contain exactly the following two records, and no other records.

Record 0
This record holds a specifically formatted URL that the NZ COVID Tracer app is configured to interpret (using Universal Linking).

This URL must be `https://tracing.covid19.govt.nz/scan#data=<data-payload>` where `<data-payload>` is the encoded value described in this document.

Note the use of a fragment `#data=` rather than a query parameter. In the case where an NFC tag is scanned and the NZ COVID Tracer app is not installed, the operating system will instead load the URL in the default browser. By using a fragment for the data payload this value is not sent to the server, avoiding a possible privacy disclosure.

Record 1
This record contains the static value `nz.govt.health.covidtracer` which is the bundle identifier of the NZ COVID Tracer app.

3.7.2 NFC tag performance

Compliant NZ COVID Tracer NFC tags must be reasonably performant, so that users can expect that they will behave consistently when tapped to meet a minimum level of customer experience.

NFC tags must have sufficient memory

Tags must have at least 300 bytes of data to fit the information from an NZ COVID Tracer QR code poster.

NFC tags must be sufficiently powerful

Tags must be readable with most compatible phones from a minimum of 20 mm away, when placed on a non-metallic surface.

NFC tags must be of sufficient quality

Tags must have physical rather than printed aerials.

Tags must be quality checked for defects before being distributed. A report must be provided demonstrating the manufacturer's quality assurance processes.

NFC tags must comply with ISO standards

Tags must comply with the following ISO standards:

- ISO/IEC 14443 Contactless Card
- ISO/IEC 18092 NFC Interface and Protocol
- ISO/IEC 21481 NFC Interface and Protocol 2

Proof of compliance must be provided on request.

3.7.3 NFC tag security

NZ COVID Tracer has high standards for privacy and security, and NFC tags must meet these high standards.

NFC tags must be locked after encoding

Tags must have a locking mechanism which is activated after encoding.

NFC tags must not read from the user's device

Tags must not be able to read any information from the user's device.

3.7.4 NFC tag recognisability

NFC tags must use approved visual design

NFC tags must use a consistent and approved visual design so that users can visually recognise these as NZ COVID Tracer tags.

NFC tags must show name of location

The tag must have the name of the location, as contained in the QR code poster, printed on it.

This must be the same location name that is encoded in the tag.

NFC tags may show QR code for location

The tag may contain a QR code for the location so that it can be used to check in whether or not a user's phone supports NFC, but this is not required.

If the tag is printed with the QR code for the location, this must contain exactly the same data that is encoded in Record 0 of the NFC tag.

If shown, the QR code must be for the same location whose name is printed on the tag. The QR code must be of a sufficient size to be printed correctly, with no rounding of the component squares, and be consistently readable by the NZ COVID Tracer app on most compatible devices.

3.7.5 NFC tag physical characteristics

NFC tags must be hygienic

NFC is a contactless technology, but users may touch their devices to the tag. Tags must be able to be wiped down without damaging the ink.

NFC tags must be non-toxic

Tags must not have glue that is toxic.

NFC tags may have tactile indicators

Tags may have tactile indicators to indicate to blind users where to hold their phone to tap in.

These must also be able to be wiped down.

NFC tags must be robust

Tags should be sufficiently strong to withstand a reasonable amount of wear and tear over a number of months.

3.8 QR code and NFC tag examples

Taking a fictional souvenir shop in *Kaikōura* as our example, since it contains some special characters:

The formatted JSON dictionary would be

```
{
        "typ":"entry",
        "gln":"0000000000000",
        "opn":"Kaikōura Souvenirs and Gifts",
        "adr":"Level 1\n123 Main Street\nKaikōura",
        "ver":"c19:1"
}
```

Minifying this structure gives:

```
{"typ":"entry","gln":"0000000000000","opn":"Kaikōura Souvenirs and
Gifts","adr":"Level 1\n123 Main Street\nKaikōura","ver":"c19:1"}
```

Base64 encoded, with the prefix yields:

```
NZCOVIDTRACER:eyJ0eXAiOiJlbnRyeSIsImdsbiI6IjAwMDAwMDAwMDAiLCJvcG4iOiJLYWlrxY1
1cmEgU291dmVuaXJzIGFuZCBHaWZ0cyIsImFkciI6IkxldmVsIDFcbjEyMyBNYWluIFN0cmVldFxuS2Fp
a8WNdXJhIiwidmVyIjoiYzE5OjEifQ==
```

This encoded into a QR code using Version 13 (69x69), a 3px module width, and M Level error correction yields the following output:

An NFC tag would have the following structure only:

Record 0	Record 1
https://tracing.covid19.govt.nz/scan#data= NZCOVIDTRACER:eyJ0eXAiOiJlbnRyeSIsImdsbiI6IjAwMDAwMDA wMDAwMDAiLCJvcG4iOiJLYWlrxY11cmEgU291dmVuaXJzIGFuZCBH aWZ0cyIsImFkciI6IkxldmVsIDFcbjEyMyBNYWluIFN0cmVldFxuS 2Fpa8WNdXJhIiwidmVyIjoiYzE5OjEifQ==	nz.govt.health.covidtracer