MINISTRY OF HEALTH
MANATŪ HAUORA

New Zealand Government

COVID-19

Contact Tracing QR Code Specification

Data format and implementation specification

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1 Introduction

This document is a technical specification for the data format used to generate a *COVID-19 Tracing QR code* (QR code). This specification is published as a draft that will be updated to reflect new requirements as the emerge.

1.1 Purpose

This standard has been produced as part of the COVID-19 epidemic 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 data format and implementation adopted by the Ministry of Health is documented and open, such that other organisations wishing to make use of the same QR code have a reference.

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.

The Ministry has opted to make use of unique QR codes posted at the entrance to public venues, businesses, and other places where the risk of transmission is high.

Members of the public can scan these QR codes with a compatible app on their smartphone to record they have been at that place. 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.

1.2 Scope

This specification covers only the data format and suggested implementation of the QR code.

Information about the data collected to support contact tracing, and the standards required, are covered in a separate document.

1.3 Definitions

Contact tracing is the process used by public health units and the national close contact service to track down people who may have been exposed to COVID-19 through contact with a suspect, confirmed or probable case during that person's infectious period.

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.

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

1.5 Revision history

21 May 2020	Published as draft specification
25 May 2020	Minor fix to QR code example

2 Background

In New Zealand, a nationwide state of emergency was imposed in response to the COVID-19 pandemic. 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 and eliminating COVID-19.

2.1 Contact tracing process

Contact tracing starts with a phone call from the public health unit or national close contact service. 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.

2.2 Check-in to locations

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.

Together with the Ministry of Business, Innovation and Employment (MBIE), the Ministry of Health is working to deliver a digital check-in solution for the public to record a visit to a business or other public place.

This check-in solution is based on a scannable QR code that a business can generate on a poster and place at the entrance to their premises. Customers and visitors can scan this QR code on their smartphone installed with a compatible mobile app as they enter, to record they have been there.

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

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, e.g. 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 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 individuals 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. This format is outlined in the remaining sections of this specification.

3 Specification

The QR code is made up of several attributes, encoded in a specific format.

3.1 Attributes

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 at the entry to 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 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 code is scanned, the following rules should be evaluated to confirm the code 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.

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.

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 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:eyJ0eXAiOiJlbnRyeSIsImdsbiI6IjAwMDAwMDAwMDAwMDAiLCJvcG4iOiJLYWlrxY1
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: