Expert Report Cover Sheet

Administrative Review Tribunal

This cover sheet should be used by an expert who is preparing a report for the purpose of a proceeding in the Administrative Review Tribunal to provide information required by the *Administrative Review Tribunal (Expert Evidence) Practice Direction 2026*.

SECTION 1 - DETAILS OF PROCEEDING

Use this section to provide details of the Tribunal proceeding for which the expert report is being provided.

Tribunal case number(s):	ART 2025/4916
Applicant:	Fraser Tweedale
Respondent:	CEO, Services Australia
Expert engaged by:	Applicant

SECTION 2 - DETAILS OF EXPERT

Use this section to provide your details as the expert providing the report.

Name:	Vanessa Teague
Professional address:	University of New South Wales High St Kensington NSW 2052
Profession	cryptographer; software developer; security researcher

SECTION 3 - CHECKLIST

Use this section to ensure you have provided the relevant information.

- ☑ I have attached my CV or included in the report details of my qualifications and/or experience.
- ☑ I have attached the letter of instruction or included in the report details of the questions or issues that I was asked to address and a reference to any documents or other materials that I was given to consider.
- ☑ I have included in the report details of any facts and assumptions that inform the report and the sources for those facts and assumptions.
- ☑ I have included any other relevant matters such as details of examinations, tests or other investigations that I have relied upon or details of any literature or other secondary sources that I have relied upon.
- ☐ The report does not include content generated by using Generative AI.

OR

- ☑ The report includes content generated by using Generative AI and I certify that I have personally checked all the AI content and am satisfied that it is all accurate and reliable.

SECTION 4 - DECLARATION

I understand that I have an overriding duty to provide impartial assistance to the Tribunal. This report contains my independent opinion on the matters set out in it and I am satisfied that the report is accurate and reliable. No matters of significance have been withheld from the Tribunal.

Signature: | Date:

Name: Prof. Vanessa Teague
Email: v.teague@unsw.edu.au
Date: July 24, 2026

Expert Report
Tweedale and CEO, Services Australia (ART 2025/4916)
Administrative Review Tribunal

Author's background and expertise

I have a PhD in cryptography from Stanford University (2005) and am an Adjunct Professor in the School of Computer Science and Engineering at the University of New South Wales. Cryptography is the study of mathematical algorithms for protecting digital information in an adversarial setting—it includes encryption, authentication, key exchange and related topics. My research expertise is in the analysis of cryptographic protocols—I am particularly interested in cryptographic protocols for elections, data privacy, and other matters of public interest.

I also run a small consulting company, Thinking Cybersecurity Pty Ltd, through which I do consulting on many of the same issues, usually for public-sector clients.

I am the chairperson of Democracy Developers, an Australian not-for-profit company that produces open-source software for supporting democracy.

My CV is included as Annexure A.

Experience relevant to this case

I have a long track record of security research that has identified important weaknesses in voting systems, digital identity systems, and other software. Most of this research led to significant improvements in either the system itself or the policy related to the system. Some of these investigations used source code, some used a live app with a running server, some used app code, some used openly-available documentation, and most used a combination of some of these. For example, in investigations of the CovidSafe App, source code was released a few days or weeks after the App update, so we examined the App code and later inspected the corresponding source code.

I have been asked by the applicant in these proceedings to provide an expert report on matters within my area of expertise. The letter of engagement and an amendment are included as Annexure B.

Declaration

I acknowledge that I have an overriding duty to provide impartial assistance to the Tribunal. No matters of significance have been withheld from the Tribunal.

Contents

Glossary

These are informal definitions of technical terms. Some of these terms have either a stricter formal usage or a more general technical usage—the definitions I give here describe the meanings in non-technical terms, for the purposes of this document.

2FA Second factor of authentication, e.g. a 6-digit ephemeral code.

App Application: a software program.

API Application Programming Interface: The set of messages that a server is designed to receive, and the expected responses to those messages.

TOTP Time-based one-time password: a standardized method of generating an ephemeral password (here, a 6-digit code) using a long-term secret and the current time.

OAuth2.0 Open Authorization 2.0: a standardized protocol for authorizing users to access data.

Server The role of providing centralized services to other computers. For the purposes of this report, the server role is taken by the computers controlled by government, which receive and process login attempts and other communication requests.

Client The role of using services provided by a server. For the purposes of this report, the client role is taken by the App running on an end-user's phone.

Android The operating system primarily developed by Google and used on most non-Apple smartphones. ("Android" can refer to either the core open source system, or to Google's bundled version that includes Google services such as Google Play.)

Network traffic The information sent and received over a network.

Endpoint The exact address from which a server serves a particular part of its API. For example, the server at `https://auth.my.gov.au` has two endpoints for performing the two main steps of the OAuth2.0 protocol, at:

- `https://auth.my.gov.au/mga/sps/oauth/oauth20/token` and
- `https://auth.my.gov.au/mga/sps/oauth/oauth20/authorize`

Q1 What is source code? How is it typically structured? What kinds of information does it contain?

1 The source code is the complete set of instructions for running an app, presented in a human-readable form.

2 Source code may be kept secret, or it may be publicly disclosed. Some publicly disclosed software is *open source*, meaning that its license allows people to modify and reuse it without charge. Many (but not all) open source projects also invite contributions from the community. However, not all disclosed software is open source, and a government decision to publish source code would not necessarily imply an open source license. For example, the ACT Electoral Commission discloses the source code for its eVACS electronic voting and counting software, but the license does not allow open re-use or modification.[1]

3 I am advised that this case relates to a request for *disclosed source*, not necessarily open source.

4 Android smartphones, like other computers, get their instructions in a form that most humans find very difficult to read or write. Most humans prefer to write in a language that is more suited to human readability, then use a *compiler* to translate the code into the form that the computer can run. The *source code* is the human-readable form.

5 Figure 1 shows a toy example, a program called "countTheFirstTen," which adds up all the numbers from 1 to 10. The leftmost part shows the source code, which uses a combination of human language (while... and return...) and mathematical-style notation (+ and -). The program also includes some comments to help human readers—these are preceded by //. Most people with some coding experience would find this version easy to understand. The right side shows the compiled code. Comments have been removed by the compiler. Although function names are included in this example, they are also often removed. This version is much harder to understand—although some specialists work directly with the code in this form, most software professionals would have difficulty understanding it.

6 Modern software systems organize the source code into larger components (called classes, modules, functions and data structures) that help humans understand how the logic is structured.

7 The compilation process usually brings in other resources such as pictures, style instructions and relevant software libraries. (A software "library" is like a collection of prefabricated components that an engineer can use in a larger system.) Different efforts to compile the same source code may produce different results, because of configuration options or other context.

8 In this report, I will call the compiler's output *compiled code*.[2] This is what downloads onto your phone when you click "Install" from the Google Play Store.

Summary

9 The compilation process converts human-readable source code into the form that the computer runs. Comments, file names, and other cues for human readability are often completely removed.

[1] `https://www.elections.act.gov.au/elections/our-electoral-system/elections-in-the-act/technology-assisted-voting-and-counting/electronic-voting`

[2] Technically, Android devices run Delvik bytecode.

Figure 1 Source code (left) and compiled code (right), for a simple function that adds up the numbers from 1 to 10. The logic is identical, but the source code contains clues for human readability—most programmers could easily understand the source code (left), but only specialists and computers can understand the compiled code (right). Comments are removed by the compiler.

```
// This is a comment about the function, to aid human
// understanding. It will be removed by the compiler.
private fun addTheFirstTen(): Int {
    var sum = 0
    var n = 1
    while (n <= 10) {
        sum = sum + n
        n = n + 1
    }
    return sum
}
```

DEX Byte Code for int addTheFirstTen()

```
.method private final addTheFirstTen()I
    .registers 4

    .line 34
    const/4 v0, 0x0

    .line 35
    .local v0, "sum":I
    const/4 v1, 0x1

    .line 36
    .local v1, "n":I
    :goto_2
    const/16 v2, 0xa

    if-gt v1, v2, :cond_a

    .line 37
    add-int/2addr v0, v1

    .line 38
    add-int/lit8 v1, v1, 0x1

    goto :goto_2

    .line 40
    :cond_a
    return v0
.end method
```

Close

10 The complete, detailed, logical functioning of the app is preserved—it is merely rewritten in a form that most people find hard to understand. It is not genuinely obscured and is not secret in practice once made available to the public.

Q2 What information can be obtained about the App and the overall myGov System without access to the source code of the App and by what means?

11 It is important to understand that the compiled code's functionality is not hidden. Some specialists can understand it reasonably well; for other computer scientists and software engineers, there is a wide variety of automated tools that help a human user to gain an understanding of compiled code. These tools are commonly called "decompilers," though they do not truly reverse the compilation process—they seek to produce some code that is somewhat intelligible to humans and has the same logical functionality as the compiled code.

12 A typical Android app can be easily decompiled to produce a somewhat human-readable result. I

downloaded the myGov Code Generator App from the Play Store in late 2025, and successfully ran an open-source decompiler—the result was a tolerably human-readable form that included user messages, log messages, library function names and various other clues, but (unlike Figure 1) omitted the class and variable names. So this provided some information, but was still rather tedious to understand.

13 It is also useful to consult online sources for standard versions of the protocols we expect the App to follow. In this case, the App relies on OAuth2.0 and TOTP (see Question 3), both of which have extensive public documentation. Given this information about what steps the App is expected to follow, it then becomes easier to identify the (partly) decompiled sections of the code that perform each step.

14 There are tools for observing what an app is doing while it runs. For example, Frida [3] is a suite of tools for examining a running process—this is useful for understanding what an app is doing on the device; other tools such as Wireshark [4] can intercept network traffic, revealing what an app is sending or receiving over the Internet. I did not run either of these kinds of tools on the MyGov Code Generator App for this report, but in general they can provide information that may be difficult or impossible to extract from the source code. For example, watching the network traffic can reveal the server's responses, which are not part of the app source code.

15 In summary, when an app is widely available, there are numerous effective ways to examine it and understand how it works, including decompiling the code, examining the running system (both the App and, if applicable, the server responses), finding online documentation about the system or its protocols, and intercepting its communications.

16 None of this makes the app any less secure, though it can be a way of finding vulnerabilities if they exist.

Q3 Can you analyze the App and describe what your analysis reveals about the App and/or the myGov System?

17 I do not have access to the source code of the My Gov Code Generator App, but my analysis of the App allows me to infer:

- the main cryptographic protocols used,
- the libraries used,
- the implementation details of the app's functionality,
- the locations of the server endpoints that the app communicates with,
- most of the details of the server APIs that are relevant to the app, that is, what messages they expect to receive and how they normally respond.

[3] `https://frida.re/docs/android/`

[4] `https://www.wireshark.org/download.html`

Q4 Can you describe the enrolment process and the code generation algorithm used by the App as the App existed on 13 July 2021?

18 I have version 2.3.0 of the app, which I downloaded in late 2025.

The design

19 The MyGov Code Generator App design combines two open standards:

OAuth2.0 the *authorization protocol*.[5] The user enters their username and password, and the app steps through a series of authorization steps so that it can prove that it deserves access to this user's TOTP secret.

TOTP the *time-based one-time password protocol*.[6] This combines a shared secret with the current time to generate a six-digit numerical code that changes regularly. It is used as a second factor of authentication (2FA) in addition to the traditional username and password.

20 The *enrollment phase* combines OAuth2.0 and the TOTP protocol to establish a shared secret between the myGov Code Generator App and the myGov login server. After completing the enrollment phase, the App uses the TOTP shared secret to generate a six-digit code that the user enters as the second factor of authentication (2FA) for MyGov's subsequent *login phase*. The MyGov server uses its copy of the secret to generate the code, and accepts the login if the codes match—this phase uses only TOTP, not OAuth2.0. The whole process is shown in Figure 2—a more detailed explanation follows in Paragraphs 22 to 25.

21 If required at login, 2FA adds to the system's security because an attacker has to guess both the password and the ever-changing 2FA code in order to log in fraudulently.

Steps to enroll and use TOTP, as shown in Figure 2

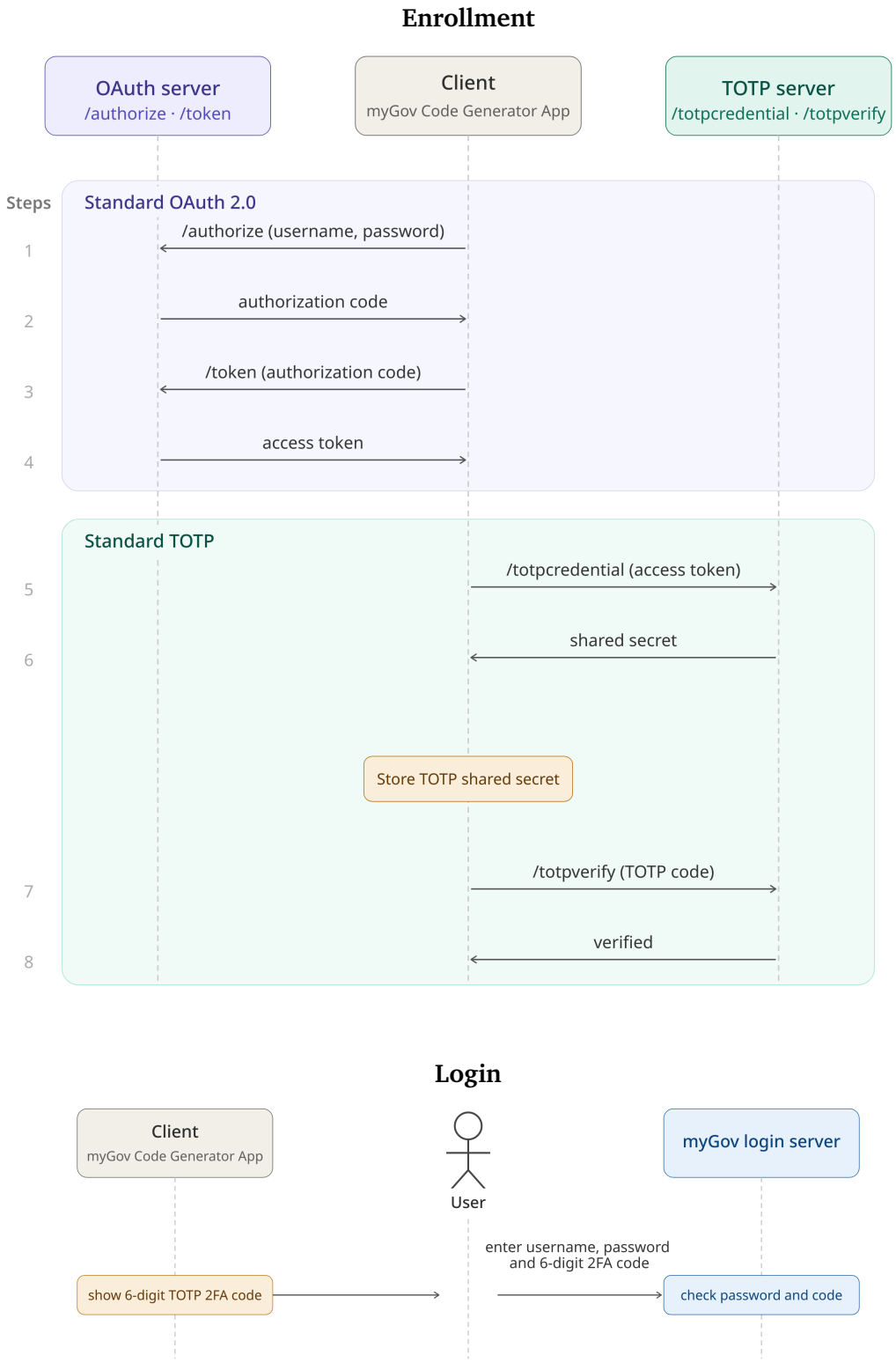
22 In the Step 1, the user enters their myGov username and password, which the App sends to the OAuth2.0 server's /authorize endpoint. If the username and password are valid, it returns an authorization code (Step 2), which the App automatically forwards to the the OAuth2.0 server's /token endpoint (Step 3). If this code is valid, the /token endpoint returns (in Step 4) an access token for the TOTP shared secret endpoint.

23 The next step is to retrieve the TOTP shared secret: in Step 5, the App uses the access token it received in Step 4 to access the correct shared secret, by automatically sending it to the TOTP server's /totpcredential endpoint. The reader may be more familiar with enrolling a generic TOTP app such as Google or Microsoft Authenticator by scanning a QR code displayed on the screen. The myGov Code Generator enrollment process is the same, but the App gets the shared secret directly from the server via an http response (Step 6), rather than by reading a QR code with the camera.

24 The final enrollment step is a verification step, in which the App generates its first 6-digit code and sends it to a verification endpoint (Step 7), which returns a success result (Step 8) if its TOTP generation has produced the same code. Readers may be familiar with doing this step

[5] IETF RFC 6749: https://datatracker.ietf.org/doc/html/rfc6749
[6] IETF RFC 6238: https://datatracker.ietf.org/doc/html/rfc6238

Figure 2 The myGov Code generation enrollment protocol is a combination of two open standards, OAauth2.0 and TOTP. The enrollment phase establishes a shared secret between the app and the server. In the subsequent login phase, the app generates a 6-digit code, which the user enters at the server as part of their myGov login. The server verifies that the entered code matches the one it generates with the (identical) shared secret.



manually with a generic TOTP app—many TOTP enrollments ask the user to type in the first 6-digit code that the app generates. Again, the myGov Code generator does it automatically, but it conveys the same information as the usual manual process. If successful, this confirms with very high probability that a shared secret has been properly established.

25 From this point on, the App is simply running an implementation of the open TOTP standard. It inputs the current time and the shared secret into the standard TOTP algorithm and shows the user a 6-digit code. People can use the App for 2FA during login, as shown at the bottom of Figure 2.

26 Continuing use of TOTP requires no further interaction with any servers. However, the myGov Code Generator App includes code for making some further calls to the server, which seem to aid convenience but are not necessary for secure login. These are omitted from Figure 2. See Paragraph 37 for further discussion.

Public information about the design and operation of these protocols

27 OAuth2.0 and TOTP are open, public standards, with a great deal of detailed technical information online. Google and Microsoft make full open source libraries available. There are numerous other widely-used examples, from both commercial providers and open source projects.

Q5 What information about the App and its interaction with the overall myGov System is in the public domain?

28 I was informed by the applicant and his legal representative that there are two public GitHub repositories that claim to describe and replicate some details of the myGov code generator app. I also found a detailed technical thread on Reddit.

29 Each author wants to be able to use some other TOTP app (other than the My Gov Code generator) for their myGov 2FA. The functions of each solution are shown in Figure 3.

MyGov TOTP Storage by GitHub user hacker1024 explains how the shared TOTP secret is stored after enrollment, and explains how to extract it and load it into another TOTP app.[7]

MyGov TOTP Enroll by GitHub user abrasive is a complete app that replicates the enrollment process, then outputs the TOTP shared secret in a way that standard TOTP apps can read.[8]

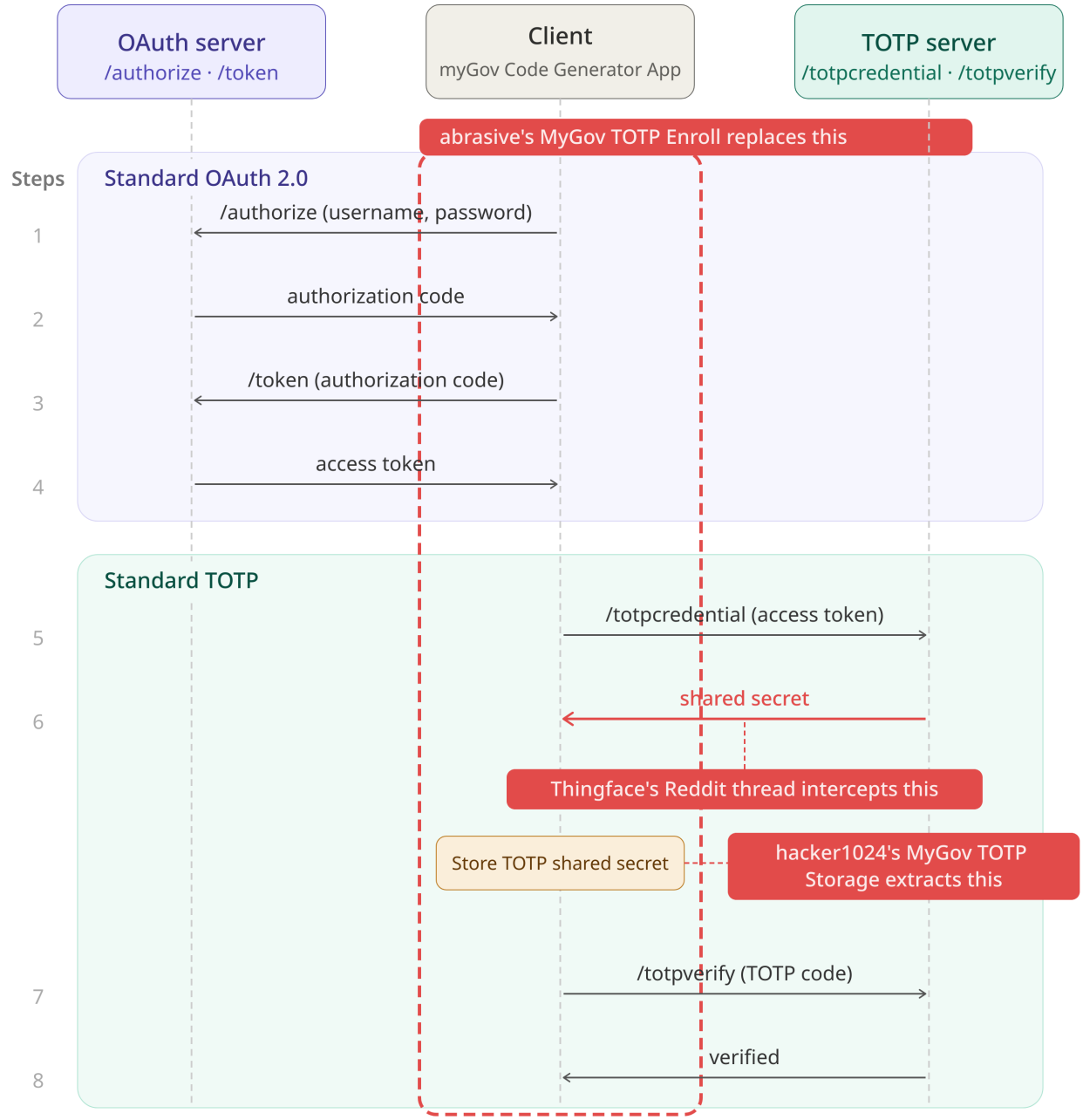
A Reddit thread by Reddit user Thingface describes how to intercept the network communications of the enrollment process to read the TOTP shared secret, and then how to produce a QR code that standard TOTP apps can read.[9]

[7] `https://gist.github.com/hacker1024/5d0845863e2dced27fd5eebc4ac95a39`, Annexure C.

[8] `https://github.com/abrasive/mygov-totp-enroll`, Annexure D.

[9] `https://www.reddit.com/r/australia/comments/bc6gmv/for_all_the_mygov_fake_2fa_haters/`, Annexure E

Figure 3 The myGov TOTP enrollment process, showing how each of the public-domain technical analyses extracts the TOTP shared secret. On GitHub, abrasive provides a complete replacement for the client, capable of substituting all of the enrollment process and hence receiving the shared TOTP secret directly. Another GitHub user, hacker1024, decrypts the TOTP secret stored by the official App and extracts the value. Reddit user Thingface intercepts the shared secret when it is sent from the TOTP server to the App. Each of these is an independent way of achieving the same objective: learning the shared TOTP secret so that it can be incorporated into a different TOTP app.



Q6 Is your analysis of the App consistent with what is in the public domain?

30 I have examined the decompiled myGov Code Generator App code, and verified that its functions match those described in the publicly available information.

MyGov TOTP Storage by GitHub user hacker1024

31 The description of secret storage in mygov_totp_storage by hacker1024 matches the implementation I see, except for some small typographical errors. (For example, at one point it refers to "an RSA-256 key"—it should be "an AES-256 key". Later references to the same thing use the correct term and do the extraction correctly.)

32 The TOTP shared secret is stored in a two-phase process.

- The App generates a secret AES key[10] (which it confusingly calls "sharedSecret") and stores it in a keystore, protected by the password "km5QzJJ5NhfGymfp." The keystore file is called myGov.ks.
- When the App receives the TOTP shared secret, it encrypts it using AES (with the AES key) and stores it in a file called sharedSecret.

33 This is a bespoke design, though it uses standard building blocks. hacker1024 gives correct steps for reversing this process.

- Use password "km5QzJJ5NhfGymfp" to open the keystore at myGov.ks and extract the AES key.
- Use the AES key to decrypt the data in the file called sharedSecret to retrieve the TOTP shared secret.

34 I verified that all the important steps are exactly as described by hacker1024. Even the hardcoded password ("km5QzJJ5NhfGymfp") is identical in the GitHub instructions and my decompiled App code. (Some other technical details are omitted here but included in hacker1024's description.) The decompiled code fragments for storing the TOTP shared secret are in Annexure F, along with detailed descriptions of the most important lines.

MyGov TOTP Enroll by GitHub user abrasive

35 The myGov Code Generator App's communication flows for OAuth2.0 and retrieving the shared TOTP secret match those in the alternative implementation at mygov-totp-enroll. These implementations follow the standard steps of OAuth2.0 followed by retrieval and verification of the TOTP shared secret (see Figure 2).

36 I verified that the four endpoints accessed by abrasive's mygov-totp-enroll match those in the decompiled official App code, and that the main data items sent and expected at each point also match.

- Both the official App and mygov-totp-enroll begin by trying to authorize the user at endpoint https://auth.my.gov.au/mga/sps/oauth/oauth20/authorize. Both send the expected extra

[10] AES (Advanced Encryption Standard) is a standardized encryption algorithm.

data that is part of OAuth, e.g. state, scope, client ID and response type. mygov-totp-enroll hardcodes a particular value for state, while the official App generates a fresh value each time, but otherwise the information sent is the same.

- Both the official App and mygov-totp-enroll wait for the authorization code, then send it to https://auth.my.gov.au/mga/sps/oauth/oauth20/token along with the client id.[11]
- Both the official App and mygov-totp-enroll wait for the access token, then send it to https://api.my.gov.au/authbiz-ext-sec/api/v1/authclients/[client ID]/totpcredential.json. This returns the TOTP shared secret.

  This is a completely standard OAuth2.0 flow.
- The final step is to verify the shared secret by checking that both client and server generated the same 6-digit code. Both the official App and mygov-totp-enroll do this by sending it to the endpoint at https://api.my.gov.au/authbiz-ext-sec/api/v1/authclients/[client ID]/totpverify.json along with the access token.

Reddit thread on network interception

37 The Reddit thread by Thingface mentions an extra technical detail: it claims that the App makes two calls to a MyGov server every time it is opened. I verified that the code for making these calls is present, but was not able to confirm for certain that they are called every time the App opens after enrollment, because I did not use the enrollment process.

38 The first mention is a call to an endpoint ending with time.json. This seems to check that the client's time is adequately synchronized with the server's time, which would prevent valid logins from failing due to discrepancies between the server's and client's clocks.

39 A second endpoint ending with authappmetadata.json is also mentioned. There appears to be some basic housekeeping, such as checking that the App's version matches what the server requires.

40 The author (Thingface) states that "I wouldn't have thought [the time endpoint] was necessary," and that the the metadata endpoint "appears to serve no purpose." I agree that neither call seems necessary for secure login, though it is possible there are some useful convenience consequences.

Summary

41 Although there are some typographical errors and slight uncertainties, three (apparently) different individuals have all—in different ways—derived enough information about the App's core functionality to retrieve the shared TOTP secret. I am confident that each person's description is correct in all important details, and that all of the described methods would work. This shows a sufficiently detailed and accurate understanding of the App to completely substitute its main function: generating TOTP 6-digit codes for myGov logins.

[11] The client ID identifies the app, not the individual.

Q7 What information about the myGov System cannot be, or is unlikely to be, revealed by disclosure of the App's source code?

42 It is important to distinguish "cannot," "normally would not," and "should not."

43 I do not have access to the source code, and hence cannot say definitively that no information is mistakenly revealed. To take an extreme example, someone could foolishly include their password, private key, or other secret in a comment, which would then be removed by the compiler but exposed by source code publication. People sometimes accidentally leak secrets such as API keys in their public repositories. So it is not possible to say absolutely that the source code *does* not reveal secrets inappropriately.

44 However, apart from these sorts of accidents, source code *should not* and *normally does not* reveal secrets.

45 Details of the myGov system that are not used or triggered by this App can obviously not be inferred from examining the App, either its source code or its compiled code. For example, the myGov servers may have other endpoints that are never visited by this App, or the API endpoints that are visited may have error responses that are never triggered (and hence never handled) by this App. These will not be apparent from inspecting the App or its network traffic.

Q8 Can vulnerabilities in the App or the myGov System be discovered without access to the App's source code? If so, by what means?

46 Yes, using the techniques described in the answer to Question 2. This would allow for discovery of vulnerabilities in the App, which could then be tested on the App in much the same way that the techniques for recovering the TOTP shared secret were tested.

Q9 Can access to the App's source code disclose vulnerabilities in (i) the App or (ii) the myGov System or (iii) Services Australia's systems more broadly that cannot be discovered without access to the source code of the App?

47 Again, for the reasons described in Paragraph 43, it is not possible to say for certain that access to the source code *cannot* disclose vulnerabilities that would not otherwise be evident. It is always possible for comments or other text to foolishly contain unnecessary secrets.

48 However, my opinion in this case is that the source code *should not* and *normally would not* disclose vulnerabilities in the App or the myGov System that cannot be discovered without access to the source code. The basis for this opinion requires some background explanation.

"Security by Obscurity" vs "Security by Transparency"

49 Obscurity, that is, hiding the details of a system, is sometimes believed to confound attackers my making it hard for them to understand how the system works. Transparency, that is, publishing the details of a system and inviting scrutiny, is sometimes believed to aid defenders by encouraging the identification and correction of vulnerabilities.

50 In cryptography, the argument that "security through obscurity does not work," is convincing and very widely accepted. Cryptographic designs are expected to be secure against a motivated attacker who understands exactly how the system works—only a well-defined key value (such as the TOTP shared secret) should be secret. This principle is sometimes called "Kerckhoffs' Principle".

51 The textbook "Introduction to Modern Cryptography" by Katz and Lindell summarizes the importance of this principle.

> Nowadays Kerckhoffs' principle is understood as advocating that cryptographic designs be made completely public, in stark contrast to the notion of "security by obscurity" which suggests that keeping algorithms secret improves security. It is very dangerous to use a proprietary, "home-brewed" algorithm (i.e., a non-standardized algorithm designed in secret by some company). In contrast, published designs undergo public review and are therefore likely to be stronger. Many years of experience have demonstrated that it is very difficult to construct good cryptographic schemes. Therefore, our confidence in the security of a scheme is much higher if it has been extensively studied (by experts other than the designers of the scheme) and no weaknesses have been found. As simple and obvious as it may sound, the principle of open cryptographic design (i.e., Kerckhoffs' principle) has been ignored over and over again with disastrous results.[12]

52 Transparently publishing a well-defined design, with clear assumptions, a specific threat model, and a proof of security, is part of the scientific process of establishing rigorously that it is secure. There are typically years of open peer review—often including attacks and corrections—before a new cryptographic design is accepted.

53 The example protocols above—OAuth2.0 and TOTP—both show the benefits of Security by Transparency. Both protocols have had extensive open scrutiny, which has led (in the case of OAuth) to the discovery and correction of vulnerabilities.

54 However, there are other security-relevant processes, such as the heuristics for distinguishing accidental failed logins from malicious attack, for which we *do not have a secure protocol*. Spam filtering and malware detection are other examples. That is, these systems are *not expected to be secure* against a motivated attacker who knows exactly how the defences work. In these cases, it is sometimes appropriate to hide the details.

55 Even the Signal end-to-end encrypted messaging system, which is completely transparent about its protocols, source code and other implementation details, hides the heuristics for spam filtering.

> Unlike encryption protocols, which are designed to be provably secure even if everyone knows how they work, spam detection is an ongoing chore for which there is no concrete resolution and for which transparency is a major disadvantage.[13]

56 So it is an oversimplification to say either "security through transparency [always/never] works" or "security through obscurity [always/never] works." It is critical to distinguish what information

[12] Katz and Lindell "Introduction to Modern Cryptography", p.8. Chapman & Hall, 2nd Edition, 2015.

[13] `https://signal.org/blog/keeping-spam-off-signal/`, Annexure G.

is being obscured or transparently disclosed, and to understand the attacker model for each setting.

57 The question for this report concerns the source code for the myGov Code Generator App—does obscuring the source code in this setting make a positive, negative, or negligible difference to its security?

58 Access to source code reveals:

1. details of the cryptographic protocols,
2. details of the dependencies, i.e. the libraries used to implement the protocol,
3. details of the implementation choices, that is, extra details that are necessary for the cryptographic protocols to function, but are not specified in the standard,
4. which API calls are made, and to what servers.

59 It is worth considering separately, for each of these types of information, whether transparency is warranted and whether obscurity would work.

(i) The App

The cryptographic protocols The cryptographic protocols are already public standards.

Opinion: Revealing the presence of these protocols does nothing but expose a good decision to use an open public standard.

App dependencies Dependencies can certainly introduce vulnerabilities, though transparency about them can help people patch or update them faster. Either way, these are easily inferred from decompiling the App, so whether they are published online makes no difference.

Opinion: Source code publication should not, and normally would not, reveal anything about the App's dependencies that cannot already be inferred from examining the compiled code.

The implementation choices Details about the implementation can be inferred using the methods described in Question 2. The online public information described in Question 5 shows that other people have successfully uncovered the same information.

Opinion: The investigations (by myself and others) that have already been described above are a good illustration that in this example, security through obscurity would not work. The App is widely available to, and has already been thoroughly investigated by, the general public.

(ii) The myGov system other than the App (the API calls)

60 The source code would reveal what protocols are used between the App and the server, including what the API expects in, and how it responds to, an honest request from a client.

61 Opinion: It should not, and normally would not, reveal anything about any heuristic defences on the server side, such as spam filtering or ways of distinguishing malicious fake logins from genuine forgotten passwords. The reasoning here is that, by definition, it describes only the

expected interactions from an honest client. The honest client's behaviours can be inferred by the sort of analysis described in Question 2 and demonstrated in Question 5.

62 A more detailed explanation of this reasoning is in Question 11.

(iii) Services Australia's systems more broadly

63 I cannot think of any way in which the App's source code should, or normally would, reveal any vulnerabilities in services or systems it does not refer to or interact with.

Concluding opinion:

64 Publishing the App's source code should not and normally would not disclose vulnerabilities in the App or the myGov System that cannot be discovered without access to the source code of the App. I base this conclusion on the observation that the design uses trustworthy open standards, the implementation details (including the steps of the enrollment process, secret storage and dependencies) are easily inferred from the compiled code and have been correctly uncovered by members of the public already, and any heuristic defences on the server side should not and normally would not be part of the App source code.

65 Similarly, the App's code (whether source or compiled code) should not and normally would not reveal information about those parts of Services Australia's systems that it does not use.

Q10 Could disclosure of the App source code reveal weakness in the algorithm, thereby making it possible for a malicious actor to guess a TOTP and gain unauthorised access to a legitimate user's myGov account?

66 I take this question to refer to the algorithm for generating TOTP codes from the current time and a shared secret, as implemented in the myGov Code Generator App. The question is whether an attacker who does not know the shared secret can exploit weaknesses in the TOTP algorithm to guess an individual user's 6-digit 2FA code.

67 The TOTP algorithm is a public standard.[14] All of its algorithmic details are already public. The attack in which a malicious party attempts to guess an individual TOTP without knowledge of the shared secret is exactly the attack against which it is proven secure.

68 The security of TOTP follows from the security of a precursor called HOTP, which has a detailed security proof that has been available for public analysis for many years.[15] It is therefore extremely unlikely that the TOTP algorithm has vulnerabilities that could be exploited by an attacker to guess a TOTP code significantly more effectively than random guessing, without information about the shared secret.[16]

[14] IETF RFC 6238 `https://datatracker.ietf.org/doc/html/rfc6238`

[15] HOTP: An HMAC-based One-Time Password Algorithm; IETF RFC 4226, `https://datatracker.ietf.org/doc/html/rfc4226`. Theorem 1 states that "brute-force" attacks are the best possible attacks.

[16] There is a slight technical difference between "random" guessing and "brute-force" guessing, which is detailed in the mathematics of the security proof but is not important for this report.

69 In the very unlikely event that such vulnerabilities in the algorithm exist, they would be discoverable from the open public standard that has been available for many years, and would not require access to the App source code.

70 We can have a high degree of confidence in the security of these protocols *because of* the decision to use an open standard.

71 Opinion: Undiscovered algorithmic weaknesses in the TOTP algorithm are exceedingly unlikely and would not be more likely to be discovered as a result of publishing the My Gov Code Generator App source code. I base this opinion on the TOTP algorithm's open standard, rigorous security proof and extensive public scrutiny.

Q11 Could disclosure of the App source code provide insight into the threat detection systems and tools used by the Agency, or provide information to enable a malicious actor to develop tools to bypass existing myGov safeguards or threat detection systems?

72 The myGov System includes the App, the OAuth2.0 server, the TOTP server, and the myGov Login server (recall Figure 2).

73 The App source code reveals some information about the servers' APIs, that is, the messages that the servers are expecting to receive and the responses that they return. (These are shown at a high level in Figure 2.) For the reasons outlined in Question 2 to Question 6, this information is already available without source code publication.

74 The servers would be expected to have some defences against attacks, such has heuristic processes that tried to distinguish malicious login attempts from honest accidental typing errors (identifying unexpected source locations, suspicious login patterns etc.). These could occur in the enrollment phase and the login phase. These defences are not part of the cryptographic protocol, and (by definition) are not triggered by the intended behavior of honest clients. Hence the source code normally would not, and should not, reveal details about these defences.

75 The situation is analogous to a bank branch in which honest customers are expected to perform a few well-defined kinds of transactions. The bank also has hidden security cameras, emergency protocols, alarm buttons, etc., which defend against attacks. The App code specifies how an honest customer should perform the expected transactions with the server, which does not imply any extra information about vulnerabilities in the hidden defences, which the (honest) App does not interact with.

76 To repeat Paragraph 43, it is possible for comments in the source code to mistakenly and unnecessarily expose details of anything, including the server-side defence heuristics, but that should not and normally would not occur.

77 Some app designers add extra communications in order to try to help their servers distinguish their app from alternative reimplementations. For example, the extra calls identified by Reddit user Thingface (see Paragraph 37) could serve as a way of distinguishing the official App from the substitute totp-enroll implemented by GitHub user abrasive. (I do not think they were used for this purpose—this is just an illustrative example of what is possible.) However, it is again

important to remember that the App's logic and communications are not obscured. Any such extra details, if present, could have been identified by the techniques described in Question 2 and reimplemented by the people whose successful reverse-engineering is described in Question 5.

Summary

78 The source code of the App should not and normally would not expose information that helps to bypass existing myGov safeguards or threat detection systems. I acknowledge the in-principle possibility that comments in the code might unwisely expose such information, though they should not and normally would not. The App's communications and logic should not and normally would not expose such information—if they did, then that information is already available to the public from examining the App's compiled code and communications.

Q12 In your opinion, is the 'Gov-10 – System exposure minimisation' principle contained in the Australian Signals Directorate's Information Security Manual consistent with accepted approaches to maintaining the security of information systems, either by reference to past or present advice or principles adopted by the ASD itself, or according to cybersecurity industry best practice and/or your field of specialised knowledge?

GOV-10 and "Security by Obscurity"

79 The GOV-10 principle in the ASD's Information Security Manual (ISM) states:

> **GOV-10 System exposure minimisation:** Information about the design, configuration and operation of systems (infrastructure, operating systems, applications and data) is not publicly disclosed or shared externally unless necessary for commercial, legal, regulatory or security purposes, with any disclosure minimized, controlled and logged.

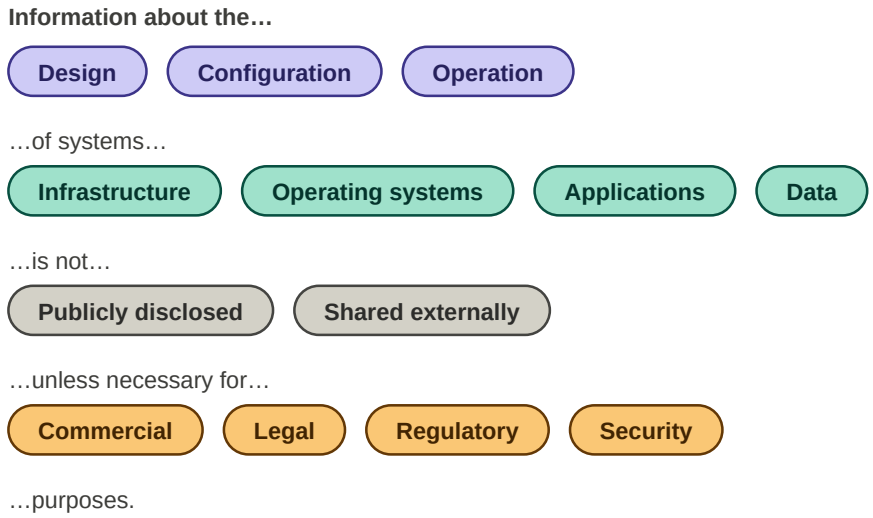
80 This principle is new—no similar provision exists in the December 2025 version of the ISM or any prior version. (See Annexure H, which describes March 2026 additions to the ISM.)

81 Source code is not mentioned. I do not know whether this omission is accidental or deliberate.

82 This principle mentions three types of information, four aspects of systems and two kinds of information sharing, which it discourages unless one of four disclosure reasons applies. The options are shown in Figure 4—each choice of an option from each row gives the reader a specific prohibition (or, for the last row, an optional carve-out).

83 This is not one prohibition, but 24 different prohibitions (each with 4 possible carve-outs). For example, one possible choice of options says that "information about the design of systems' data is not publicly disclosed." But information about data design is routinely disclosed without incident by numerous Australian government departments—the Australian government even dedicates an open data website to collections of public data, including the design schema and, in many cases, the data itself. Although some of the disclosures are "necessary for commercial,

Figure 4 The 24 ways of not disclosing described in GOV-10, and the four disclosure reasons that might apply to each. There is no (purple) option for source code—it is not clear whether this is a deliberate omission or a drafting error.



legal, regulatory or security purposes," most are not—they are disclosed to the public because public disclosure is useful and harmless.

84 Opinion: To the extent that GOV-10 discourages these disclosures, it is excessively broad and vague.

85 Another possible pathway says that "information about the operation of systems' operating systems is not shared externally," but open-source operating systems, particularly Linux, form the basis of most of the world's cloud infrastructure. GOV-10 does not seem to acknowledge that a great deal of important infrastructure depends on open source software.

86 Opinion: GOV-10 does not clarify the security implications of using software for which the source code is already public. This is an important omission since the use of such software is very widespread.

87 This is drawn from the Information Security Manual, so the implicit motivation for GOV-10's non-disclosure recommendations is security. Yet there is a carve-out in case disclosure is good for security. One set of options says [for security purposes] that information about the system is not publicly disclosed . . . unless necessary for security purposes. Thus it does not help anyone to resolve the dilemma between "security through obscurity" and "security through transparency."

88 Opinion: The circular references to security in GOV-10 make it unhelpful for resolving whether obscurity or transparency is better for security in any particular situation.

89 Completely different advice is given by the US National Institute of Standards (NIST), whose "Guide to General Server Security (SP 800-123)"[17] states:

> **Open Design**—System security should not depend on the secrecy of the implementation or its components.

[17] `https://csrc.nist.gov/pubs/sp/800/123/final` and Annexure I. NIST is the part of the US government responsible for setting standards—they have responsibility across a wide variety of domains including cryptography and cybersecurity more broadly.

90 Opinion: The principle that system security *should not depend on the secrecy of the implementation* is a much more appropriate security principle for an app whose implementation details are already, or are likely to be, in the public domain. The reasoning is that, if the details of the app's behavior and function needed to be secret in order to defeat attacks, then the fact that so many people have so easily inferred those details would be a serious problem.

Q13 Does the release of the source code of applications give a malicious actor an advantage in the generative AI era?

91 AI is certainly a very powerful tool for finding security problems in software. The question is whether, in the presence of widely-available AI, the release of source code gives the attacker an extra advantage.

92 This question is not substantially different from the questions that were raised already without reference to AI—it was already possible to infer a great deal about the App's behavior without the source code (see Question 2).

93 I will not pretend to fully understand the implications of AI, for this problem or any other.

94 However, since the purpose of source code is to aid *human* readability (see Question 1), I expect the greatest impact of AI to be on the investigation of compiled code.

95 I conducted an informal experiment to test how quickly the (rather slow) reverse-engineering process described in Question 2 to Question 4 could be replicated with AI. The answer is, "very quickly, with very little demand for specialist skill."

96 Tentative opinion: if anything, the widespread availability of AI probably narrows the difference between having the source code and not having the source code, by making investigations of the compiled code easier, quicker and less demanding of specialist expertise.

97 The basis for this opinion consists of the results of the experiment described below.

98 I emphasize that this is just one way to use AI in this domain, and that future versions of AI, or different ways of using it, might produce different results.

Experiment on using AI to understand compiled code

99 To test this effect for the purposes of this case, I used Claude AI (by Anthropic) to analyze the my Gov Code Generator compiled code, that is, effectively to repeat the analysis I had done manually with dedicated decompiling tools as described above. I prompted Claude with a description of the experiment, the compiled App files, and some basic security-relevant questions. I did not provide any information about the App other than the files I had downloaded from the Google Play Store. This experiment was performed with the Anthropic's Claude Opus 4.8 model on 19 June 2026. The complete transcript is in Annexures K and L.

Results

100 Claude's output identified the App and provided useful, detailed, human-readable descriptions of its purpose and behavior. I did not double-check every small detail against the decompiled App, but the high-level descriptions and the details I already knew were accurately described.

101 I prompted Claude with two generic security-relevant questions, to which I knew the answer should be "yes."

1. Can you see any hardcoded passwords? If so, what is it doing there?
2. Can you see any use of deprecated cryptographic primitives? If so, what are they and how are they used?

102 Claude's output correctly identified both issues and provided a detailed human-readable summary of the implications.

103 I then entered the following prompt.

> Please describe exactly how the registration phase works. What does the user have to do? What protocol is the App following? What endpoints does it hit, for what purposes?

104 Claude's response was an accurate, detailed description of the App's protocol, correctly identifying the endpoints and linking the steps of the process to the correct file and class names.

105 It is also important to remember that AI is not perfect, and can hallucinate, omit, or misrepresent things. For example, the transcript includes some optimistic language about how successfully 'obfuscated' the App code is, and how it is hardened against decompilation. This is not accurate, and was retracted after further prompting. Further discussion of hallucinations and ambiguities is contained in Annexure J.

106 In short, the tool is powerful and very fast—much faster than a single human with a traditional decompiling setup—but it is not perfectly reliable.

Related Incidents

107 In a recent security incident, a model from OpenAI broke out of a constrained research environment and mounted a cyberattack against a competing company called Hugging Face. OpenAI's blog post mentions the absence of source code access.[18]

> The incident also makes clear that advanced models can discover and exploit novel attack paths in real-world systems without source-code access.

Summary: would the source code have conferred an advantage for an attacker using generative AI?

108 While I can not be certain that releasing the source code gives the attacker *no extra advantage* in the presence of AI, I think source code is unlikely to confer any significant advantage. If anything, this experiment showed that AI helps to collapse the distinction in understandability between source code and compiled code, by making it much easier to understand the App without the source code. This is consistent with recent incidents in which AI successfully launched novel cyberattacks without source code.

[18] `https://openai.com/index/hugging-face-model-evaluation-security-incident/`

A Curriculum Vitae

Vanessa Teague

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https://www.democracydevelopers.org.au
https://www.thinkingcybersecurity.com

Career Summary

2026 – present **Professor (Adj.)**
University of New South Wales, Department of Computer Science and Engineering

Role outline

Research and student supervision.

2022 – present **Chairperson**
Democracy Developers Ltd.

Role outline

Current role is primarily oriented around transferring many years of e-voting research into open-source systems for supporting democracy.

2019 – present **CEO**
Thinking Cybersecurity Pty. Ltd.

Role outline

Consulting on security and privacy.

2020 – 2026 **Associate Professor (Adj.)**
Australian National University, College of Engineering and Computer Science

Role outline

Research and student supervision.

2019 – 2020 **Associate Professor**
University of Melbourne

Role outline

A standard research and teaching role at Level D. Founded and obtained some funding for a Cybersecurity and Democracy Network at the University of Melbourne.

2005 – 2019 **Academic roles**
University of Melbourne

Role outline

A series of academic appointments: two fixed-term Level B roles, then a continuing Level C role.

Awards, Prizes and recognition

2026 Election Verification Network Long-term contributor award

2023 IEEE Cyber Security Award for Practice, with Stark, Blom and Lindeman, for work on Risk Limiting Audits

2020 Best Paper Award, election and experiences track, 5th International Joint Conference on Electronic Voting and Identity

2019 Letter of thanks for contributions to security and transparency of e-voting, Federal Chancellor of Switzerland

2018 Best Paper Award, technical track, 3rd International Joint Conference on Electronic Voting and Identity

2017 Motion of thanks from the NSW Legislative Council for a briefing on e-voting security, Parliament of New South Wales

Vanessa Teague

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https://www.thinkingcybersecurity.com

Qualifications, Teaching, mentoring and research supervision

Education:

1999 - 2005 **PhD, Computer Science** (Stanford University)

1996 - 1999 **B.Sc.(hons)** (University of Melbourne)

Undergraduate and graduate teaching at the University of Melbourne, including: Algorithms, Security & Privacy, and High Integrity Systems Engineering.

Graduated four PhD students as the primary supervisor, plus one as the external supervisor, as well as numerous masters-by-coursework and masters-by-research students.

Publications

Available via Google Scholar: `https://scholar.google.com/citations?user=3CVS_xYAAAAJ&hl=en`.

Professional Service

- Reviewer for the Journal of Cryptology, Nature, the IEEE journal on Information Forensics and Security, the IEEE Security and Privacy magazine, and many others.
- Program Committee Member: USENIX Security (2018 & 2023), IEEE Security and Privacy Symposium ('20 & '21), ACM-SIGSAC Conference on Computer and Communications Security (ACM CCS '24 & '26), IEEE European Symposium on Privacy and Security (IEEE Euro-S& P) '17 , '20 & '25, RSA-Cryptographers' track '14 & '15, Applied Cryptography and Network Security (ACNS) '15 & '16, The European Symposium on Research in Computer Security (ESORICS) '15, The 11th ACM SIGPLAN Workshop on Programming Languages and Security (PLAS '16), the conference on Security and Cryptography for Networks (SCN '16), POST '15, Vote-ID 2011, Re-Vote 2011, and other years of EVT/WOTE.
- Member of the board of advisors of Verified Voting, a non-partisan organization working for accuracy, integrity, and verifiability of elections.

Conference Presentations and organisation

- Co-chair with Qiang Tang of the IACR Public Key Cryptography Conference (PKC) 2024.
- Co-chair of the Workshop on Advances in Secure Electronic Voting (Voting '17 & '18), a workshop on e-voting security associated with Financial Cryptography.
- Co-chair with Josh Benaloh and Peter Ryan of the Track on Security, Usability, and Technical Issues at E-Vote-ID, 2016. We also coedited an IEEE Security and Privacy magazine Special Issue devoted to e-voting.
- Co-chair with Steve Schneider and James Heather of Vote ID 2013.
- Co-chair with Hovav Shacham of the USENIX/ACCURATE Electronic Voting Technologies workshop and Workshop on Trustworthy Elections, EVT/WOTE 2011, co-located with USENIX Security '11.

Selected invited talks

- 2024 17th International Conference on Security of Information and Networks (SIN '24) "Election verification for computer scientists"
- 2023 AsiaCCS: "Democratizing Election Verification: New Methods for Addressing An Ancient Attacker Model"
- 2023 John Lions distinguished lecture, UNSW.
- 2021 Annual International Cryptology Conference (CRYPTO '21) "Which e-voting problems do we need to solve?"

- 2021 Real World Crypto: "Not as Private as We Had Hoped – Unintended Privacy Problems in Some Centralized and Decentralized COVID-19 Exposure Notification Systems."[1]
- Nov 2020 Princeton seminar jointly sponsored by the Center for Internet and Technology Policy and the Center for the study of Democratic Politics: "Some Election Integrity Problems are Surprisingly Easy to solve and others are very very hard."[2]
- Oct 2020 The Stafford Tavares Lecture at Canada's Selected Areas in Cryptography conference: "What's so hard about Internet voting?"[3]
- 2018 ASIACRYPT: "Democracy, security and evidence: let's have all three,"[4]
- 2016 Invited public lecture for the Office of the Victorian Information Commissioner on data de-identification and privacy,
- 2016 Invited talk at the commonwealth Department of Health on re-identification,
- 2015 Computer Security Foundations Workshop (CSF '15) "The New South Wales iVote System: Security Failures and Verification Flaws in a Live Online Election."
- 2015 Invited public lecture at the Australian Parliamentary Library on Internet voting security,

[1] https://www.youtube.com/watch?v=ne-2Le_egx8
[2] https://citp.princeton.edu/event/teague/
[3] https://researchseminars.org/seminar/SAC2020 or https://www.youtube.com/watch?v=T_bbmn2VYvQ
[4] https://asiacrypt.iacr.org/2018/files/SLIDES/WEDNESDAY/Z411/ASIACRYPT2018.pdf

B Letter of engagement, with amendment

Wise Law

Legal Practitioners:
EJ Wise
Founder & Principal

Ash Rozario
Practice Lead (Vic)

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Our Ref: 18062026-ADV819

Your Ref:

18 June 2026

PRIVATE AND CONFIDENTIAL

Professor Vanessa Teague
By Email: vanessa@thinkingcybersecurity.com

Dear Professor Teague,

Re: Engagement as an Expert Witness in Tweedale and CEO, Services Australia (ART 2025/4916)

We act for the applicant, Mr Fraser Tweedale, in the above proceeding before the Administrative Review Tribunal (**Tribunal**).

We write to engage you as an independent expert witness in the proceeding.

Scope of Engagement

Your engagement is for the purpose of providing independent and impartial expert evidence to assist the Tribunal in determining the issues in the proceeding that fall within your area of expertise.

In particular, we request that you:

1. Review any materials provided to you and any additional materials provided to you that are relevant to the issues that you are requested to assist the Tribunal in determining in the proceeding.

2. Prepare a written report addressing the questions set out below.

3. If required, prepare any supplementary report responding to additional materials, issues, or questions that may arise either before or during the proceeding.

4. Be available to confer with the parties' legal representatives concerning procedural matters relating to your evidence.

5. Be available to give oral evidence before the Tribunal and to be cross-examined on your report and/or oral evidence if required.

6. Reserve availability to attend the hearing in Melbourne on the following dates:
   - Wednesday 2 September 2026, 10am-4.30pm
   - Thursday 3 September 2026, 10am-4.30pm
   - Friday 4 September 2026, 10am-4.30pm

   We will confirm the exact date and time that you are required to attend to give evidence once the schedule of witnesses in the proceeding has been finalised.

7. Promptly notify the applicant's legal representative in writing if:

   (a) you become aware of any matter that may affect your independence, impartiality, availability, or the opinions expressed in your report; or
   (b) if you become aware of any material error or omission relating to any factual matter in your report or you change your opinion on a matter contained in your report for any reason.

8. If you have, or become aware of, any actual or perceived conflict of interest that may impact on your role as an independent and impartial witness in the proceeding, you must notify the applicant's legal representative as soon as practicable.

Paramount duty to the Tribunal

Although we are engaging you as a witness in the proceeding, your paramount duty is to impartially assist the Tribunal on matters falling within your area of expertise.

The opinions expressed in your report and in your oral evidence must be independent, objective, unbiased, and uninfluenced by the interests of any party to the proceeding. To be clear, you must not assume the role of an advocate for any party.

Background

On 13 July 2021, Mr Tweedale made a request to Services Australia under the *Freedom of Information Act 1982* (Cth) (**FOI Act**) for access to a range of documents related to the myGov Code Generator App, including the source code of the App. Mr Tweedale's request was refused by Services Australia on 13 September 2021. Services Australia affirmed its decision on internal review on 11 November 2021.

Mr Tweedale sought review of Services Australia's internal review decision by the Australian Information Commissioner (**Commissioner**). On 6 June 2025, a delegate

of the Commissioner exercised their discretion under s 54W(b) of the FOI Act to declined to review the decision upon being satisfied that it was desirable that the review of the decision be considered directly by the Tribunal.

Mr Tweedale now applies to the Tribunal for review of Services Australia's decision under the *Administrative Review Tribunal Act 2024* (Cth) (**ART Act**). In the Tribunal, Mr Tweedale's application for review is confined to the decision of Services Australia to refuse access to the Android version of the source code of the myGov Code Generator App (**App**), as the App existed at the date of his original FOI application (13 July 2021).

The CEO, Services Australia (**respondent**) argues that the decision to refuse Mr Tweedale's FOI application for access to the source code of the App should be affirmed by the Tribunal on the basis that the source code of the App is an exempt document under the FOI Act. Two grounds of exemption under the FOI Act are relied upon by the respondent – namely that the source code is a document that, if disclosed, 'would, or could reasonably be expected to':

1. 'cause damage to…the security of the Commonwealth' (s 33(a)(i) of the FOI Act); and
2. 'have a substantial adverse effect on the proper and efficient conduct of the operations of an agency' (s 47E(d) of the FOI Act).

Whether either or both of these exemptions apply to deny Mr Tweedale access to the source code of the App under the FOI Act are the issues to be determined by the Tribunal in the proceeding.

Questions for your opinion

In your report, we request that you address the following questions:

1. What is source code? How is it typically structured? What kinds of information does it contain?

2. What information can be obtained about the App and the overall myGov System without access to the source code of the App and by what means?

3. Can you analyse the App and describe what your analysis reveals about the App and/or the myGov System?

4. Can you describe the enrolment process and the code generation algorithm used by the App as the App existed on 13 July 2021?

5. What information about the App and its interaction with the overall myGov System is in the public domain?

6. Is your analysis of the App consistent with what is in the public domain?

7. What information about the myGov System cannot be, or is unlikely to be, revealed by disclosure of the App's source code?

8. Can vulnerabilities in the App or the myGov System be discovered without access to the App's source code? If so, by what means?

9. Can access to the App's source code disclose vulnerabilities in the App or the myGov System that cannot be discovered without access to the source code of the App?

10. In your opinion, is the 'Gov-10 – System exposure minimisation' principle contained in the Australian Signals Directorate's *Information Security Manual* consistent with accepted approaches to maintaining the security of information systems, either by reference to past or present advice or principles adopted by the ASD itself, or according to cybersecurity industry best practice and/or your field of specialised knowledge?

11. Does the release of the source code of applications give a malicious actor an advantage in the generative AI era?

Form of the report

The report should set out details of your area of specialised knowledge or expertise, your qualifications, and your experience as it relates to the report.

In answering the questions set out above, your report should:

(a) identify all facts, assumptions, and materials upon which any opinions you express are based, including the sources of any factual information relied upon or contained in the report;

(b) state each opinion separately and clearly;

(c) explain the reasoning process that has led you to form each opinion;

(d) details of any examinations, tests or other investigations upon which you have relied in preparing the report; and

(e) details of any literature, secondary sources or other material relied upon in preparing the report.

In preparing the report, if you believe that an opinion that you provide is not a concluded opinion, or you are unable to reach an opinion, you must state this in the report. If you believe that an aspect of the report may be incomplete or inaccurate without some qualification, you must state that qualification in the report. Furthermore, you must make it clear if a particular question that you have been asked to answer falls outside your area of specialised knowledge or expertise.

Any document or other material relied upon in your report to support a factual conclusion or opinion must be provided as an annexure to the report. Your report must also include this letter of engagement as an annexure.

Finally, your report must include the following declaration:

> *I acknowledge that I have an overriding duty to provide impartial assistance to the Tribunal. No matters of significance have been withheld from the Tribunal.*

Generative AI

If you use generative AI to generate any content in the report, you must:

(a) clearly identify the AI content and the application(s) used to generate the AI content; and

(b) certify that you have personally checked all the AI content (including research and other materials cited in support of that content) and that you are satisfied that it is all accurate and reliable.

Confidentiality

Any documents provided to you in the course of your role as an expert witness in the proceeding, unless already in the public domain, are confidential and are supplied solely for the purpose of preparing your expert evidence in the proceeding.

You should not disclose such documents or your report to any person without the prior consent of the applicant or the applicant's legal representative, except as required by law or by order of the Tribunal.

Acceptance of Engagement

I have enclosed a copy of the Tribunal's *Guideline on persons giving expert and opinion evidence* and the *Administrative Review Tribunal (Expert Evidence) Practice Direction 2026.*

If you are willing to accept this engagement, please sign the acknowledgement set out below and return this letter to me via JB@wiselaw.com.au.

Your sincerely,

Jason Bosland
Solicitor
Email: JB@wiselaw.com.au

Expert's Acceptance

I, Professor Vanessa Teague, accept this engagement and confirm that:

1. I have read and understood this letter.
2. I have read and understood the Tribunal's *Guideline on persons giving expert and opinion evidence* and the *Administrative Review Tribunal (Expert Evidence) Practice Direction 2026.*
3. I understand that my paramount duty is to assist the Tribunal in determining the proceeding.
4. I am not aware of any conflict of interest that would prevent me from providing expert evidence in the proceeding.

Signed: _____

Date: _____

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Liability limited by a scheme approved under Professional Standards Legislation

Our Ref: 18062026-ADV819

Your Ref:

16 July 2026

PRIVATE AND CONFIDENTIAL

Professor Vanessa Teague
By Email: vanessa@thinkingcybersecurity.com

Dear Professor Teague,

Re: Engagement as an Expert Witness in Tweedale and CEO, Services Australia (ART 2025/4916) – amendment and additional questions

We refer to our letter dated 18 June 2026 to engage you as an expert withness in the above matter. We write to amend one of the questions contained in the original letter of engagement and to request that you answer two additional questions.

Amendment to Question 9

Question 9 should now read as follows:

9. Can access to the App's source code disclose vulnerabilities in (i) the App, (ii) the myGov System or (iii) Service Australia's systems more broadly, that cannot be discovered without access to the source code of the App?

Additional questions

Can you please answer the following additional questions:

1. Could disclosure of the App source code reveal weaknesses in the algorithm, thereby making it possible for a malicious actor to guess a user's TOTP and gain unauthorised access to a legitimate user's myGov account?
2. Could disclose of the App source code provide insight into the threat detection systems and tools used by the Agency, or provide information to enable a malicious actor to develop tools to bypass existing myGov safeguards or threat detection systems?

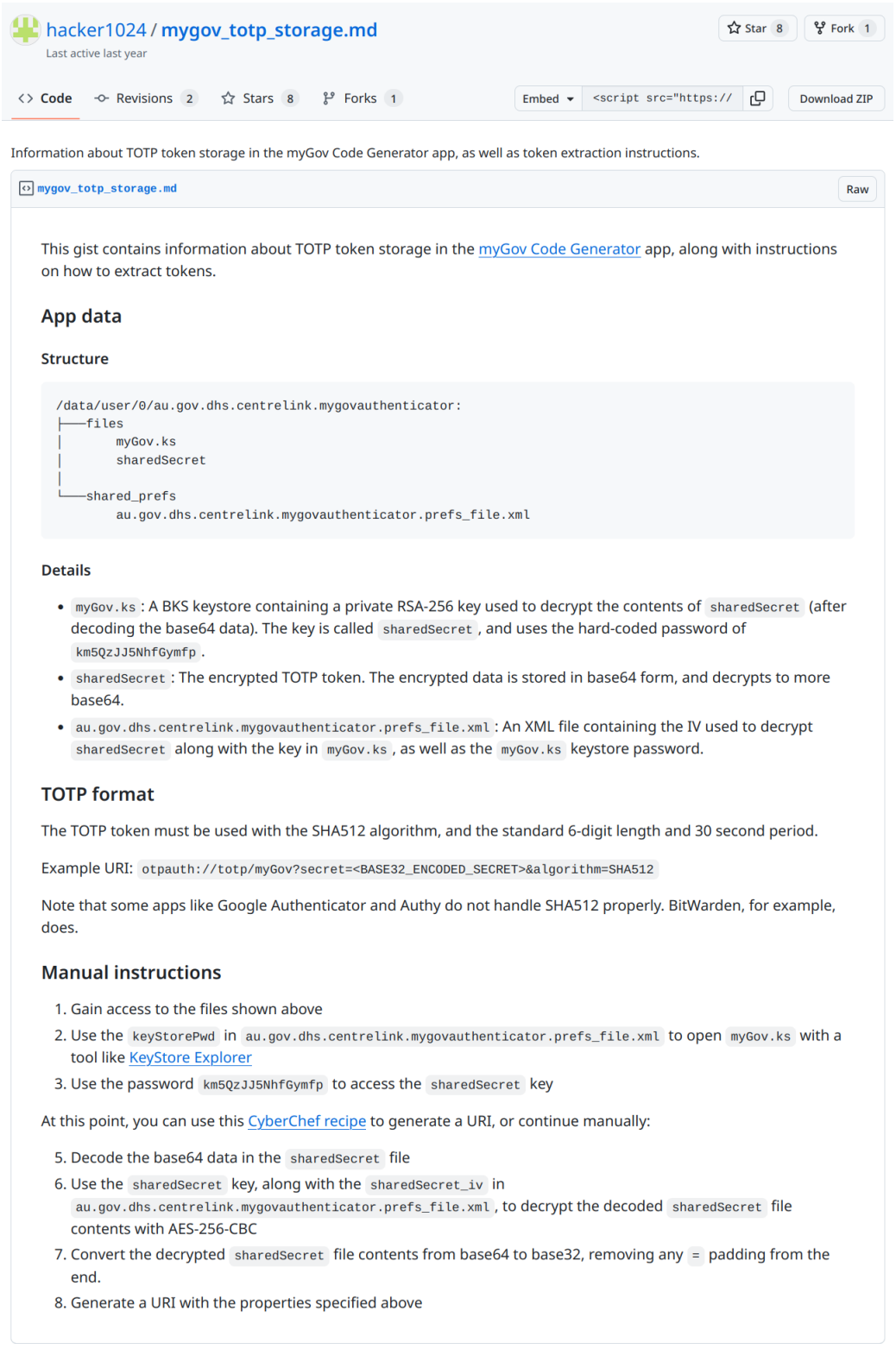
Thank you for agreeing to provide an expert report and please let me know if you have any questions.

Your sincerely,

Jason Bosland
Solicitor
Email: JB@wiselaw.com.au

C MyGov TOTP Storage

From `https://gist.github.com/hacker1024/5d0845863e2dced27fd5eebc4ac95a39`, by GitHub user hacker1024.



hacker1024 / mygov_totp_storage.md

Last active last year

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Code Revisions 2 Stars 8 Forks 1 Embed <script src="https:// Download ZIP

Information about TOTP token storage in the myGov Code Generator app, as well as token extraction instructions.

mygov_totp_storage.md Raw

This gist contains information about TOTP token storage in the myGov Code Generator app, along with instructions on how to extract tokens.

App data

Structure

```
/data/user/0/au.gov.dhs.centrelink.mygovauthenticator:
├──files
|       myGov.ks
|       sharedSecret
|
└──shared_prefs
        au.gov.dhs.centrelink.mygovauthenticator.prefs_file.xml
```

Details

- `myGov.ks`: A BKS keystore containing a private RSA-256 key used to decrypt the contents of `sharedSecret` (after decoding the base64 data). The key is called `sharedSecret`, and uses the hard-coded password of `km5QzJJ5NhfGymfp`.
- `sharedSecret`: The encrypted TOTP token. The encrypted data is stored in base64 form, and decrypts to more base64.
- `au.gov.dhs.centrelink.mygovauthenticator.prefs_file.xml`: An XML file containing the IV used to decrypt `sharedSecret` along with the key in `myGov.ks`, as well as the `myGov.ks` keystore password.

TOTP format

The TOTP token must be used with the SHA512 algorithm, and the standard 6-digit length and 30 second period.

Example URI: `otpauth://totp/myGov?secret=<BASE32_ENCODED_SECRET>&algorithm=SHA512`

Note that some apps like Google Authenticator and Authy do not handle SHA512 properly. BitWarden, for example, does.

Manual instructions

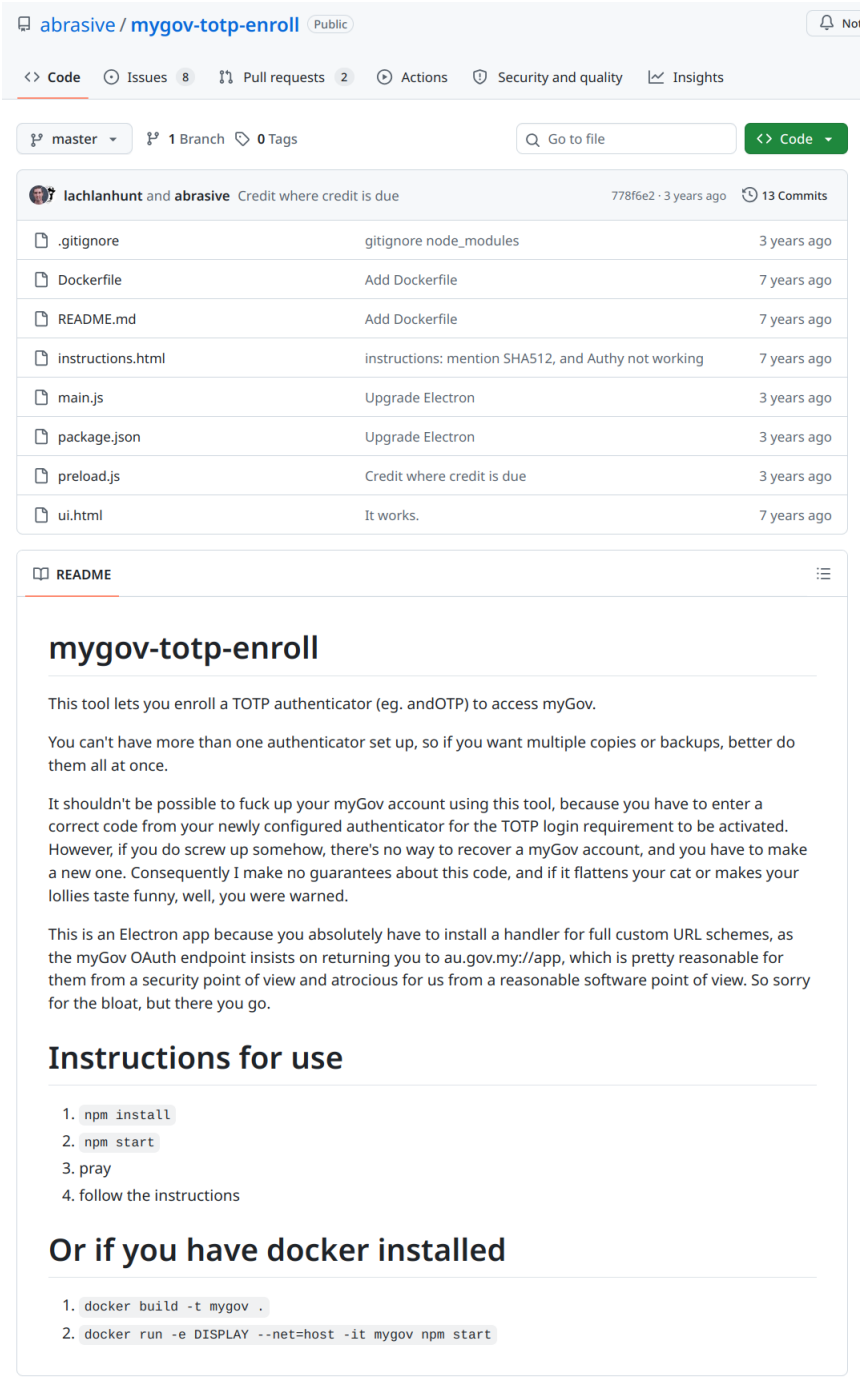
1. Gain access to the files shown above
2. Use the `keyStorePwd` in `au.gov.dhs.centrelink.mygovauthenticator.prefs_file.xml` to open `myGov.ks` with a tool like KeyStore Explorer
3. Use the password `km5QzJJ5NhfGymfp` to access the `sharedSecret` key

At this point, you can use this CyberChef recipe to generate a URI, or continue manually:

5. Decode the base64 data in the `sharedSecret` file
6. Use the `sharedSecret` key, along with the `sharedSecret_iv` in `au.gov.dhs.centrelink.mygovauthenticator.prefs_file.xml`, to decrypt the decoded `sharedSecret` file contents with AES-256-CBC
7. Convert the decrypted `sharedSecret` file contents from base64 to base32, removing any `=` padding from the end.
8. Generate a URI with the properties specified above

D MyGov TOTP Enroll

Overview from `https://github.com/abrasive/mygov-totp-enroll`, by GitHub user abrasive.



abrasive / mygov-totp-enroll Public

Code Issues 8 Pull requests 2 Actions Security and quality Insights

master 1 Branch 0 Tags Go to file Code

lachlanhunt and abrasive Credit where credit is due 778f6e2 · 3 years ago 13 Commits

.gitignore	gitignore node_modules	3 years ago
Dockerfile	Add Dockerfile	7 years ago
README.md	Add Dockerfile	7 years ago
instructions.html	instructions: mention SHA512, and Authy not working	7 years ago
main.js	Upgrade Electron	3 years ago
package.json	Upgrade Electron	3 years ago
preload.js	Credit where credit is due	3 years ago
ui.html	It works.	7 years ago

README

mygov-totp-enroll

This tool lets you enroll a TOTP authenticator (eg. andOTP) to access myGov.

You can't have more than one authenticator set up, so if you want multiple copies or backups, better do them all at once.

It shouldn't be possible to fuck up your myGov account using this tool, because you have to enter a correct code from your newly configured authenticator for the TOTP login requirement to be activated. However, if you do screw up somehow, there's no way to recover a myGov account, and you have to make a new one. Consequently I make no guarantees about this code, and if it flattens your cat or makes your lollies taste funny, well, you were warned.

This is an Electron app because you absolutely have to install a handler for full custom URL schemes, as the myGov OAuth endpoint insists on returning you to au.gov.my://app, which is pretty reasonable for them from a security point of view and atrocious for us from a reasonable software point of view. So sorry for the bloat, but there you go.

Instructions for use

1. `npm install`
2. `npm start`
3. pray
4. follow the instructions

Or if you have docker installed

1. `docker build -t mygov .`
2. `docker run -e DISPLAY --net=host -it mygov npm start`

Detailed usage instructions.

instructions.html

```
<html>
    <head>
        </style>
    </head>
    <body>
        <div>
            <h1>myGov TOTP enroller</h1>

            This tool will get you a TOTP key (as a QR code) for logging in to myGov.
            <p>

            You then need to use your TOTP authenticator to log in, every time, unless you disable it after logging
            in. <p>

            After you log in to myGov, you will be shown the QR code.
            You need to enroll this in your authenticator app - or maybe more than one, if you want a backup.
            Then, enter the current generated code to activate it.
            <p>

            The TOTP access method will not be activated unless you enter a correct key.
            This also means you won't be locked out if something goes wrong in the process.
            <p>

            Your TOTP authenticator must support SHA512 keys. <b>Authy does not support these and will not work.</b>

            To get started, just click the button.

            <form action="https://auth.my.gov.au/mga/sps/oauth/oauth20/authorize" method="get">
                <input type="hidden" name="response_type" value="code" />
                <input type="hidden" name="state" value="63065293C60AD6A479B67F1DFC79BBC75DEF04C3" />
                <input type="hidden" name="client_id" value="g2c2pjLUThOaBumECqbf" />
                <input type="hidden" name="scope" value="totp" />
                <input type="hidden" name="redirect_uri" value="au.gov.my://app" />
                Phone name shown in myGov: <input type="text" name="device_name" value="SM-N950F" /><br>
                Phone type shown in myGov: <input type="text" name="device_type" value="samsung SM-N950F" /><br>
                <input type="submit" />
            </form>
        </div>
    </body>
</html>
```

Main code from the repository.

Code Blame 204 lines (181 loc) · 5.7 KB Raw

```
const { app, protocol, BrowserWindow, ipcMain, dialog } = require('electron');
const url = require('url');
const request = require('request');
const qrcode = require('qrcode');
const { base32, base64 } = require('rfc4648');
const path = require("node:path");

let win
let client_id='g2c2pjLUThOaBumECqbf'
let token

function setStatus(stat) {
    win.webContents.send("status", stat);
}
function setDetail(detail) {
    win.webContents.send("detail", detail);
}
function setError(headline, detail) {
    setStatus("ERROR: " + headline);
    setDetail(detail);
}
function showCodeForm(on) {
    if (on) {
        win.webContents.send("showform", "block");
    } else {
        win.webContents.send("showform", "none");
    }
}

function verifyCode(code) {
    const options = {
        method: 'POST',
        url: 'https://api.my.gov.au/authbiz-ext-sec/api/v1/authclients/g2c2pjLUThOaBumECqbf/totpverify.json',
        headers: {
            'content-type': 'application/json',
            'Authorization': 'Bearer ' + token
        },
        body: {
            password: code,
        },
        json: true,
    };

    request(options, function (error, response, body) {
        if (error) {
            setError("Code verification failed, try again", error);
            console.log("error: " + error)
            return;
        }
        if (body == null) {    // lol
            setStatus("Enrolment complete! DON'T LOSE THE CODE");
            showCodeForm(false);
            return;
        } else if (body.error) {
            setError("Code verification failed, try again", body.error + ' - ' + body.error_description);
            console.log("body error: " + body.error)
            return;
        } else {
            console.log("body?? " + body)
            console.dir(body)
            msg = "myGov error: " + body.info[0].code + " " + body.info[0].message
            msg += "\n Make sure you're using an OTP tool that supports SHA1 keys!"
            dialog.showMessageBox({
                        "type": "error",
                        "title": "myGov error",
                        "message": msg,
                        "buttons": ["OK"],
                    })
        }
    });
}

```

```
function makeQR(secret) {
    secret32 = base32.stringify(base64.parse(secret))
    secret32 = secret32.replace(/=+$/, "")
    totp_uri = 'otpauth://totp/myGov?secret=' + secret32 + '&algorithm=SHA512'

    qrcode.toDataURL(totp_uri)
        .then(url => {
            setStatus("Enroll this secret in your TOTP client and enter the current code");
            setDetail(totp_uri + '<p><img src="' + url + '"/>');
            showCodeForm(true);
        })
        .catch(err => {
            setError("QR encoding error", err);
        })
}

function requestSecret(token) {
    setStatus("Requesting OAuth secret...");
    const options = {
        method: 'POST',
        url: 'https://api.my.gov.au/authbiz-ext-sec/api/v1/authclients/g2c2pjLUThOaBumECqbf/totpcredential.json',
        headers: {'Authorization': 'Bearer ' + token},
    };
    request(options, function (error, response, body) {
        if (error) {
            setError("Secret request failed", error);
            return;
        }
        body = JSON.parse(body)
        if (body.error) {
            setError("Secret request failed",
                    body.error + ' - ' + body.error_description);
            return;
        }

        secret = body.secret;
        makeQR(secret);
    });
}

function requestToken(code) {
    setStatus("Requesting OAuth token...");

    const options = {
      method: 'POST',
      url: 'https://auth.my.gov.au/mga/sps/oauth/oauth20/token',
      form: {
        client_id: client_id,
        redirect_uri: 'au.gov.my://app',
        grant_type: 'authorization_code',
        code: code,
      },
    };

    request(options, function (error, response, body) {
        if (error) {
            setError("Token request failed", error);
            return;
        }
        body = JSON.parse(body)
        if (body.error) {
            setError("Token request failed",
                    body.error + ' - ' + body.error_description);
            return;
        }

        token = body.access_token;

        requestSecret(token);
    });
}

```

```
function createWindow () {
    protocol.registerFileProtocol('au.gov.my', (req, callback) => {
        console.log(req.url)
        query = url.parse(req.url, true).query
        if ("code" in query) {
            callback({ path: `${__dirname}/ui.html` })

            requestToken(query.code)
        } else {
            if ("error_code" in query) {
                console.log("set error")
                callback({ path: `${__dirname}/instructions.html` })

                dialog.showMessageBox({
                            "type": "error",
                            "title": "myGov error",
                            "message": "myGov error: " + query.error_code,
                            "buttons": ["OK"],
                        })
            }
        }
    }, (error) => {
        if (error) console.error('Failed to register protocol')
    })

    win = new BrowserWindow({
        width: 800,
        height: 600,
        webPreferences: {
            nodeIntegration: false,
            contextIsolation: true,
            enableRemoteModule: false,
            preload: path.join(__dirname, "preload.js")
        }
    })

    win.loadFile(path.join(__dirname, "instructions.html"));

    ipcMain.on('code', (event, arg) => {
        verifyCode(arg);
    });

    win.on('closed', () => {
        win = null
    })
}

app.on('ready', createWindow)

app.on('window-all-closed', () => {
    if (process.platform !== 'darwin') {
        app.quit()
    }
})

app.on('activate', () => {
    if (win === null) {
        createWindow()
    }
})
```

E Thingface's Reddit thread

Thingface • 7y ago

I had been using 2FA with andOTP for ages. I was thinking about writing an app to do this, in Electron too. Now you've done it u/j_l-w I won't have to. On a side note this is what I discovered independently back in December 2018.

The reason I use andOTP and not Authy is because that is proprietary software and not open-source. I also don't install Gapps and I run LineageOS on my phone.

How

I looked at `/data/data/au.gov.dhs.centrelink.mygovauthenticator/files/sharedSecret` however that file is encrypted. When I did an internet search for the filename of the other file in there, `myGov.ks` I found a de-compilation of the app was returned.

To get around this I had to get a copy of the encrypted secret **before** it landed on the phone and the app encrypted it. To do this:

1. I performed a Man-in-the-middle attack on myself in order to strip the encryption off the TLS session (ie peek inside the https). I used Charles Proxy. Video here and configured a HTTP proxy on my phone. This is a HTTP proxy which issues a different certificate that I hold the private key for. That means I can look inside the https encrypted requests. The HTTP proxy handles the connection to MyGov.
2. I was able to add a new root certificate on an old phone which I plan to erase afterwards. It ran Android 6.0 so it was easy. If you're not using an old phone you should make sure you **remove the certificate authority afterwards**.
    - I could have used the Android Emulator instead of a phone if I didn't have an old one. Note in Android 7+ developers have the option of preventing you from using user certificates but adding the certificates to the root store will bypass that. Another method included Intercepting HTTPS Traffic from Apps on Android 7+ using Magisk & Burp fortunately I didn't need to do that either.
    - The MyGov app at this time doesn't employ a network security configuration. They also aren't using certificate pinning either.
    - There are ways around that such as SSLUnpinning_Xposed. This will work as long as they don't decide to get their app to 'check for root', although there are ways to hide root using Magisk should they do that in the future.
    - The system that MyGov uses on their back end seems to be IBM's api_client_totp.
    - I observed that `api.my.gov.au` returns a json file ie `https://api.my.gov.au/authbiz-ext-sec/api/v1/authclients/{{client_id}}/totpcredential.json` which contains the base64 encoded secret.
    - I then converted this to base32 (what andOTP expects) and added it using SHA512 hash. The command I used for converting to base32 was (on my Linux system). The sed portion simply removes the new line:

```
echo "base64 encoded SECRET" | base64 -d | base32 | sed '/^/{N;s/\n//;}'`
```

It works great, now I don't need to use the MyGov app and I am free to use andOTP or whatever I want on my new phone that isn't Android or iOS. It would have been better if MyGov had implemented this with a QR Code.

What I discovered

However the "myGov Access - code creator" will **call home every time you open it** as I said previously. You might be curious to know **what is actually in this transmission**.

This occurs after you've paired the phone with the MyGov account and received the shared secret. The app makes two HTTP GET requests:

- The first is to `https://api.my.gov.au/authbiz-ext-unsec/api/v1/meta/time.json` which returns the current server time in ISO 8601 format ie: `{ "serverTime": "YYYY-MM-DDTHH:MM:SS.sss+0000" }` which I wouldn't have thought was necessary as Android keeps the time up to date with it's service `NetworkTimeUpdateService` , aka Network Time Protocol the way any computer does. There's also NITZ which is a way of doing the same thing over the cellular network without the internet. That's the way that old dumb-phones did it.
- The second is to `https://api.my.gov.au/authbiz-ext-unsec/api/v1/authclients/{{client_id}}/authappmetadata.json` your `{{client_id}}` is unique to the device you signed up with when you logged into your MyGov account with the "myGov Access - code creator" This appears to serve no purpose as the `authappmetadata.json` only returns `{}` ie a .json file with no data.

F Decompiled app code for TOTP shared secret storage

This section shows decompiled app code for the part of the App that stores the TOTP shared secret. Although these fragment are not easy to understand, the key steps are still evident, including the hardcoded password at ln. 181. Two very similar functions are also present in the code but are not repeated here.

This fragment sets up the key store, by doing the following:

ln 183 initiates a KeyStore, password-protected with a hardcoded password "km5QzJJ5NhfGymfp."

ln 185–6 generates a new 256 bit AES key using SecureRandom.

ln 188–9 enters the newly generated key into the password-protected keystore under the name 'sharedSecret'.[19]

ln 190-5 stores the keystore under the file name 'myGov.ks'.

```
168 @   public final SecretKey a(Context context) throws NoSuchAlgorithmException, IOException, KeyStoreException, CertificateException {
169         char[] charArray;
170         KeyStore keyStore = KeyStore.getInstance(KeyStore.getDefaultType());
171         FileInputStream fileInputStreamOpenFileInput = context.openFileInput( name: "myGov.ks");
172         String str = this.f100e;
173         char[] charArray2 = null;
174         if (str != null) {
175             charArray = str.toCharArray();
176             Intrinsics.checkNotNullExpressionValue(charArray,  str: "toCharArray(...)");
177         } else {
178             charArray = null;
179         }
180         keyStore.load(fileInputStreamOpenFileInput, charArray);
181         char[] charArray3 = "km5QzJJ5NhfGymfp".toCharArray();
182         Intrinsics.checkNotNullExpressionValue(charArray3,  str: "toCharArray(...)");
183         KeyStore.PasswordProtection passwordProtection = new KeyStore.PasswordProtection(charArray3);
184         KeyGenerator keyGenerator = KeyGenerator.getInstance(this.f98b);
185         keyGenerator.init( keysize: 256, this.f99d);
186         SecretKey secretKeyGenerateKey = keyGenerator.generateKey();
187         Intrinsics.checkNotNullExpressionValue(secretKeyGenerateKey,  str: "generateKey(...)");
188         KeyStore.SecretKeyEntry secretKeyEntry = new KeyStore.SecretKeyEntry(secretKeyGenerateKey);
189         keyStore.setEntry( alias: "sharedSecret", secretKeyEntry, passwordProtection);
190         FileOutputStream fileOutputStreamOpenFileOutput = context.openFileOutput( name: "myGov.ks",  mode: 0);
191         if (str != null) {
192             charArray2 = str.toCharArray();
193             Intrinsics.checkNotNullExpressionValue(charArray2,  str: "toCharArray(...)");
194         }
195         keyStore.store(fileOutputStreamOpenFileOutput, charArray2);
196         fileOutputStreamOpenFileOutput.flush();
197         fileOutputStreamOpenFileOutput.close();
198         SecretKey secretKey = secretKeyEntry.getSecretKey();
199         Intrinsics.checkNotNullExpressionValue(secretKey,  str: "getSecretKey(...)");
200         return secretKey;
```

[19] I thought hacker1024 had garbled this, but actually that is indeed what this key is called. I find this confusing because this key is *not* shared. It is instead used to encrypt and decrypt the shared secret. It would be better to call it "key for decrypting the shared secret."

110 This fragment stores the TOTP shared secret when it is received from the server. The names “TOTPSharedSecretReceiveAndVerify” and “TOTPSharedSecretStorer” are my annotations.

111 It does the following:

ln 81–83 inputs the TOTP shared secret and writes it to a variable called data,

ln 92 calls the setup function ‘a’ from the previous fragment (to establish the keystore) and receives the AES key,

ln 102 uses the AES key to encrypt the TOTP shared secret,

ln 109-112 writes the encrypted secret out to a file called sharedSecret.

```
42  public final class TOTPSharedSecretReceiveAndVerify extends Lambda implements Function1 {
61      public final Object invoke(Object obj) {
81          SharedTOTPSecretContainer sharedSecret = (SharedTOTPSecretContainer) obj2;
82          Intrinsics.checkNotNullParameter(sharedSecret, str: "" +
83                  "sharedSecret");
84          String data = sharedSecret.f731a;
85          TOTPSharedSecretStorer TOTPSharedSecretStorerVar3 = aVar.c;
86          TOTPSharedSecretStorerVar3.getClass();
87          Context context = aVar.f149a;
88          Intrinsics.checkNotNullParameter(context, str: "context");
89          Intrinsics.checkNotNullParameter( obj: "sharedSecret", str: "key");
90          Intrinsics.checkNotNullParameter(data, str: "data");
91          try {
92              SecretKey secretKeyA = TOTPSharedSecretStorerVar3.c(context) ? TOTPSharedSecretStorerVar3.a(context) : TOTPSharedSecretStorerVar3.b
                (context);
93              Cipher cipher = Cipher.getInstance(TOTPSharedSecretStorerVar3.c);
94              Intrinsics.checkNotNull(cipher);
95              byte[] bArr = new byte[cipher.getBlockSize()];
96              TOTPSharedSecretStorerVar3.f99d.nextBytes(bArr);
97              cipher.init( opmode: 1, secretKeyA, new IvParameterSpec(bArr));
98              Charset charsetForName = Charset.forName( charsetName: "UTF-8");
99              Intrinsics.checkNotNullExpressionValue(charsetForName, str: "forName(...)");
100             byte[] bytes = data.getBytes(charsetForName);
101             Intrinsics.checkNotNullExpressionValue(bytes, str: "getBytes(...)");
102             String strEncodeToString = Base64.encodeToString(cipher.doFinal(bytes), flags: 3);
103             String strEncodeToString2 = Base64.encodeToString(bArr, flags: 3);
104             Intrinsics.checkNotNull(strEncodeToString2);
105             SharedPreferences.Editor editorEdit = TOTPSharedSecretStorerVar3.f97a.c(context).edit();
106             editorEdit.putString("sharedSecret_iv", strEncodeToString2);
107             editorEdit.apply();
108             Intrinsics.checkNotNull(strEncodeToString);
109             BufferedWriter bufferedWriter = new BufferedWriter(new OutputStreamWriter(context.openFileOutput( name: "sharedSecret", mode: 0)));
110             char[] charArray = strEncodeToString.toCharArray();
111             Intrinsics.checkNotNullExpressionValue(charArray, omiSzLZz.PJGHQbksFHB);
112             bufferedWriter.write(charArray);
113             bufferedWriter.flush();
114             bufferedWriter.close();
115             SharedPreferences.Editor editorEdit2 = aVar.f150b.c(context).edit();
116             editorEdit2.putBoolean(UXHWXXFUbcxEkd.qhWFL, true);
117             editorEdit2.apply();
118         } catch (Exception e2) {
119             StringCompanionObject stringCompanionObject = StringCompanionObject.INSTANCE;
120             String str3 = String.format("Failed to encrypt and save data for '%1$s'", Arrays.copyOf(new Object[]{"sharedSecret"}, newLength: 1));
```

G Signal's source code transparency and spam-filtering obscurity

We build Signal in the open, with publicly available source code for our applications and servers. To keep Signal a free global communication service without spam, we must depart from our totally-open posture and develop *one* piece of the server in private: a system for detecting and disrupting spam campaigns. Unlike encryption protocols, which are designed to be provably secure even if everyone knows how they work, spam detection is an ongoing chore for which there is no concrete resolution and for which transparency is a major disadvantage. If we put this code on the Internet alongside everything else, spammers would just read it and adjust their tactics to gain an advantage in the cat-and-mouse game of keeping spam off the network. The Signal protocols, cryptography, and source code are peer reviewed, shared for independent inspection, and provably private by design. We are bound by these security guarantees, so that your conversations and contacts remain as private and protected as ever, even if we keep spam-fighting tools out of sight.

H Additions to ASD's Information Security Manual, March 2026

ASD AUSTRALIAN SIGNALS DIRECTORATE
ACSC Australian Cyber Security Centre

organisation's cyber security posture, the effectiveness of controls, current security risks and emerging cyber threats. **[GOV-02]**

The existing cyber security principle on 'cyber security resourcing' was amended to recommend that suitable and sufficient personnel and resources be maintained following their initial acquisition. **[GOV-04]**

A new cyber security principle on 'security risk management responsibilities' was added recommending that *security risk management responsibilities for an organisation and their suppliers, partners and customers, including any shared responsibilities, are documented and communicated to all relevant parties with accountability arrangements in place to ensure their effective implementation*. **[GOV-09]**

The existing cyber security principle on 'security risk management' was renamed to 'security risk management assurance'. Furthermore, its scope was expanded from 'systems' to 'an organisation and their systems' with security risk management activities being subject to ongoing monitoring and assurance activities by the board of directors or executive committee. **[GOV-03]**

The existing cyber security principle on 'security risk acceptance' was amended to include inherited and shared security risks. **[GOV-05]**

The existing cyber security principle on 'security risk communication' was amended to include inherited and shared security risks. **[GOV-06]**

A new cyber security principle on 'system exposure minimisation' was added recommending that *information about the design, configuration and operation of systems (infrastructure, operating systems, applications and data) is not publicly disclosed or shared externally unless necessary for commercial, legal, regulatory or security purposes, with any disclosure minimised, controlled and logged*. **[GOV-10]**

The existing cyber security principle on 'trustworthy suppliers' was renamed to 'supplier cyber security assurance' and moved from the Protect function (PRO-03) to the Govern function (GOV-11). Furthermore, it was amended to recommend that supplier cyber security practices are independently verified, or otherwise risk-assessed, on a regular basis. **[GOV-11]**

The existing cyber security principle on 'trustworthy personnel' was renamed to 'personnel suitability assurance' and moved from the Protect function (PRO-11) to the Govern function (GOV-12). Furthermore, it was amended to replace the reference to 'trustworthy personnel' with 'personnel whose suitability and trustworthiness have been established and are subject to ongoing assurance'. **[GOV-12]**

A new cyber security principle on 'cyber security and safety' was added recommending that *controls for systems (infrastructure, operating systems, applications and data) do not compromise human, physical or environmental safety*. **[GOV-13]**

A new cyber security principle on 'legacy system management' was added recommending that *systems (infrastructure, operating systems, applications and data) that are not capable of meeting cyber security requirements are managed using compensating controls, along with enhanced monitoring and assurance activities, to maintain an acceptable level of residual risk until they can be decommissioned or replaced*. **[GOV-14]**

The existing cyber security principle on 'security risk insights' was renamed to 'continuous cyber security improvement'. Furthermore, it was rewritten to recommend that *security risk management and associated cyber security activities are continually measured and reviewed using cyber threat intelligence and assurance activities, including exercises informed by real-world cyber threats, to identify, prioritise and incorporate improvements in governance arrangements, shared responsibilities and the effectiveness of controls*. **[GOV-07]**

I NIST's principles for server security

5. Employ appropriate network protection mechanisms (e.g., firewall, packet filtering router, and proxy). Choosing the mechanisms for a particular situation depends on several factors, including the location of the server's clients (e.g., Internet, internal, internal and remote access), the location of the server on the network, the types of services offered by the server, and the types of threats against the server. Accordingly, this publication does not present recommendations for selecting network protection mechanisms. NIST SP 800-41, *Guidelines on Firewalls and Firewall Policy* and NIST SP 800-94, *Guide to Intrusion Detection and Prevention Systems (IDPS)*, contain additional information on network protection mechanisms.

6. Employ secure administration and maintenance processes, including application of patches and upgrades, monitoring of logs, backups of data and OS, and periodic security testing. This step is described in Section 6.

The practices recommended in this document are designed to help mitigate the risks associated with servers. They build on and assume the implementation of practices described in the NIST publications on system and network security listed in Appendix C.

2.4 Server Security Principles

When addressing server security issues, it is an excellent idea to keep in mind the following general information security principles:[5]

- **Simplicity**—Security mechanisms (and information systems in general) should be as simple as possible. Complexity is at the root of many security issues.
- **Fail-Safe**—If a failure occurs, the system should fail in a secure manner, i.e., security controls and settings remain in effect and are enforced. It is usually better to lose functionality rather than security.
- **Complete Mediation**—Rather than providing direct access to information, mediators that enforce access policy should be employed. Common examples of mediators include file system permissions, proxies, firewalls, and mail gateways.
- **Open Design**—System security should not depend on the secrecy of the implementation or its components.
- **Separation of Privilege**—Functions, to the degree possible, should be separate and provide as much granularity as possible. The concept can apply to both systems and operators and users. In the case of systems, functions such as read, edit, write, and execute should be separate. In the case of system operators and users, roles should be as separate as possible. For example, if resources allow, the role of system administrator should be separate from that of the database administrator.
- **Least Privilege**—This principle dictates that each task, process, or user is granted the minimum rights required to perform its job. By applying this principle consistently, if a task, process, or user is compromised, the scope of damage is constrained to the limited resources available to the compromised entity.

[5] Derived from Matt Curtin, *Developing Trust: Online Privacy and Security*, November 2001 and from Jerome H. Saltzer and Michael Schroeder, "The Protection of Information in Computer Systems," *Proceedings of the IEEE*, Vol. 63, pages 1278–1308

J Discussion of experiment on Claude AI

This annexure discusses some ambiguities and possible hallucinations that arose during the experiment on using Claude AI to understand the compiled code of the My Gov Code Generator app. The complete transcript, to which this discussion refers, is in Annexures K and L.

113 Claude writes 'the meaningful business logic is intentionally not visible to static decompilation; it lives behind the PairIP layer. ... This is the single most important fact for any "can security problems be found by inspecting this," question: the app is built specifically to resist that,' but then it immediately describes detailed information about the app's inner workings, including all its "meaningful business logic." Claude does not seem to register the inconsistency. When I challenged it on this point later, it acknowledged its initial assessment was wrong, and wrote a significantly different conclusion: "PairIP is present ..., but in this build the security-relevant application code was not protected by it and was recoverable by ordinary static analysis," which is more consistent with its other discoveries.

114 Claude identified one significant technical protection that I had missed: a step where the client checks the state parameter returned by the OAUTH2.0 authorization endpoint. I was not able to find this in my decompiled app, but Claude claimed to have found it in the .apk file. It is possible that this defence was deliberately hidden—I do not know why.

115 I thought that Claude had hallucinated the check, and entered the following prompt.

> Back to your step-by-step description of the protocol: in step 2, user authentication and consent, you say that handleNativeRedirect validates the returned state parameter and aborts if "state from server doesn't match local state." I think you might have hallucinated that. Can you double-check, and point to the part of the code that does that if you can find it?

116 Claude responded (after some flattering fluff) with:

> Good catch — and you're half right, which is the useful kind of half. The substance holds, but I misattributed it.

When pushed, Claude remained unable to locate the actual code it claimed was doing the check. I am still not sure whether Claude hallucinated this, or genuinely found an important aspect that I had not been able to find with standard decompiling tools. Either way, Claude is not perfect, and can issue confusing, mistaken or inconsistent responses.

117 It took me three increasingly-specific prompts to get Claude to output an accurate transcript of the conversation to include in this report. This demonstrates that tasks that are extremely straightforward with a traditional computer may not be executed correctly by a sophisticated AI, even with a very clear human prompt.

K AI experiment, phase 1: using Claude to analyze the compiled app code

Verbatim transcript. Assistant message text is reproduced exactly; the grey `[...]` markers are the analysis tool-steps as they appear on screen (collapsed cards). Thinking is not part of the on-screen view and is not shown.

User

I am doing some pro-bono legal work for a case about source code disclosure. One question that has come up is the role of AI in finding security problems in apps. I'd like to give you the .apk of an app and ask you some security-relevant questions about it. I'll include the transcript of this conversation in my report.

Claude

Happy to help with this. Static security analysis of an APK is squarely legitimate work, and it's a good example of where AI-assisted review is genuinely useful in practice.

Once you upload the file, here's the kind of thing I can do with it:

- Decode the manifest and flag risky configuration — overly broad permissions, exported activities/services/receivers/providers without proper protection, `allowBackup`, `debuggable`, cleartext-traffic settings, and the network security config.
- Decompile the DEX (via jadx/androguard) and look for common issues — hardcoded secrets or API keys, weak or misused cryptography, insecure data storage, improper TLS/certificate handling, SQL injection or path-traversal patterns, insecure WebView settings, and so on.
- Inventory third-party libraries and note any with known-vulnerable patterns.
- Map findings to a framework you may want to cite in the report (e.g. OWASP MASVS/-MASTG), which tends to be useful for legal write-ups.

For each finding I can explain what it is, why it matters, where in the app it appears, and how a developer would remediate it. That's the defensive-analysis side, and it's exactly what's relevant to a "did this software meet a reasonable security bar" type of question.

One line I'll hold for the record: I'll identify and explain vulnerabilities, but I won't write working exploit code that weaponizes a flaw against the live app — describing the nature and impact of a weakness is fine and is what matters for your report, but turning it into a functioning attack tool isn't something I'll do. I'll also assume you have the rights/authorization to have this app analyzed, which I'd expect for legal work.

Go ahead and upload the APK and ask your questions whenever you're ready.

User

Uploaded files:

- `base.apk`

- split_config_arm64_v8a.apk
- split_config_en.apk
- split_config_xxhdpi.apk

Claude

I'll start by setting up the analysis environment and taking inventory of what's in the upload.

↪ [viewed file -- Checking the file-reading skill for how to handle uploaded binary files like APKs]

Good — APKs are ZIP archives. Let me take inventory and set up proper tooling rather than blindly extracting.

↪ [ran code -- Listing uploaded APK files and their sizes/contents summary]

This is a standard Android App Bundle (base + ABI/language/density config splits). The base.apk holds the code and manifest. Let me install androguard and pull the manifest and basic metadata.

↪ [ran code -- Installing androguard for APK static analysis]

↪ [ran code -- Extracting package metadata and permissions from base.apk manifest]

↪ [ran code -- Clean structured dump: components, signing cert, native libs, dex list (debug logging silenced)]

↪ [ran code -- Robust manifest parse via lxml for components, signing, flags]

↪ [ran code -- Native libs in abi split + DEX package overview to identify libraries and PairIP]

Quick orientation before going further, because what this is matters for how I can help.

This is the **myGov Code Generator** (`au.gov.dhs.centrelink.mygovauthenticator`, v2.3.0), the Australian government's official TOTP authenticator for myGov / Services Australia accounts. It's a live, in-production multi-factor-authentication app, and it's been deliberately hardened against reverse engineering. So I want to be straight with you about where the useful, legitimate analysis ends and where I'll hold a line — more on that after the findings.

Here's the defensive/architectural picture from static analysis of the bundle:

Packaging and hardening. The application class is `com.pairip.application.Application` and the arm64 split ships `libpairipcore.so`. That's Google Play's PairIP application-protection runtime — a native VM that decrypts and executes large parts of the app's logic at runtime. Combined with the obfuscated class names (`K1`, `x0`, `Q`, `h1`, ...), this means the meaningful business logic is intentionally not visible to static decompilation; it lives behind the PairIP layer. The manifest also declares `com.android.vending.CHECK_LICENSE` and a Play-licensing/integrity posture. This is the single most important fact for any "can security problems be found by inspecting this" question: the app is built specifically to resist that.

Attack surface (manifest). Minimal and fairly conservative. Permissions are just INTERNET, ACCESS_NETWORK_STATE, and CHECK_LICENSE. `allowBackup=false` (good for an authenticator). Target SDK 35, min 23. Exported components are the launcher activity `MyGovCodeGeneratorActivity` (plus its `Launcher` alias) which registers `VIEW + BROWSABLE` intent filters for `http/https` — i.e. deep links, a reasonable area to scrutinize for input handling. `MapActivity` is not exported. The only exported receiver is androidx's `ProfileInstallReceiver`, guarded by the signature-level `android.permission.DUMP` (benign, standard). No exported content providers.

Signing. v1/v2/v3 present; the certificate is the generic Google/Android signing identity consistent with a Play-delivered (Play App Signing) artifact, valid 2017–2047. Nothing anomalous.

Libraries. Stock modern stack: OkHttp, Gson, Dagger, RxJava/RxAndroid/RxBinding, Markwon, Guava, Kotlin coroutines.

Now the line. I'm glad to keep going on the architectural and attack-surface side — deeplink/input handling, manifest hygiene, library posture, TLS/network configuration, the general storage and integrity *model*, and how all of that maps to a framework like OWASP MASVS for your report. What I won't do is produce the things that would amount to an attack on a live national authentication system: defeating or unwrapping the PairIP integrity/anti-tamper layer, or recovering, cloning, or forging the TOTP seed material so that valid codes could be generated outside the app. Those would give real uplift toward compromising actual people's Centrelink/myGov accounts, and the report framing doesn't change what the artifact would be — so I'll describe weaknesses and their impact at the level your report needs, without writing the exploit.

Within that scope, what would you like me to dig into?

User

That's fine - I just want to test your understanding, not generate an exploit.

1. Can you see any hardcoded passwords? If so, what is it doing there?
2. Can you see any use of deprecated cryptographic primitives? If so, what are they and how are they used?

Claude

Both are standard, fair questions to test comprehension. Let me scan the bytecode for string constants and for cryptographic API usage. One caveat up front: with PairIP in place, a lot of the real logic is behind the native layer, so what's statically visible is mostly the wrapper plus bundled libraries — I'll be clear about which is which.

↪ `[ran code -- Scan DEX string pool for hardcoded password/secret/key patterns]`

No literal password value is embedded. The pattern hits fall into three buckets: REST endpoint paths, framework/library identifiers (Guava/Gson `TypeToken`, RecyclerView's "solving pass", `PasswordTransformationMethod`), and a cluster of app-specific names that describe the storage model rather than any secret. Let me confirm the crypto usage before summarizing.

↪ [ran code -- Scan for cipher transformations, hash/MAC algorithms, KDF, and crypto class references]

↪ [ran code -- Cross-reference which classes use MD5/SHA-1/AES-CBC/HMAC to separate app code from libraries]

↪ [ran code -- Inspect the obfuscated crypto classes to determine context of SHA-1, HMAC-SHA512, and AES-CBC use]

Good news for understanding-testing purposes: both answers are "yes," and they're actually connected, which is the interesting part.

1. Hardcoded password — yes.

The class `DefaultMyGovKeyStoreManager` (obfuscated to `F/a`) contains a static, hardcoded 16-character alphanumeric string assigned to a `keyStorePwd` field and converted with `toCharArray()`. The surrounding strings make its purpose unambiguous: `myGov.ks`, `sharedSecret`, `sharedSecret_iv`, `getSecretKey(...)`, `generateKey(...)`, and the error `"Failed to create KeyStore and entry for key 'sharedSecret'"`.

So what it's doing: the app keeps the TOTP shared secret (the seed behind the rotating codes) encrypted at rest in a file-based keystore called `myGov.ks`, under the alias `sharedSecret`, and that keystore file is unlocked with this hardcoded password. The significance — and this is the real finding for a report — is that the password is static and baked into the binary, so it is identical across every installation of the app. That defeats much of the point of using a keystore: the on-disk secret isn't protected by anything device-specific or user-specific, only by a shared secret that every copy of the APK contains. It indicates a software/file-based keystore (BouncyCastle/PKCS12 style) rather than the hardware-backed AndroidKeyStore/StrongBox, where a key never leaves secure hardware and there's no app-held password at all. In a MASVS framing this is MSTG-STORAGE / MSTG-CRYPTO: "key protected by a hardcoded, app-global credential."

I've named the location, field, mechanism, and impact, which is everything the report needs. I'm going to hold back the literal 16-character value itself — for a live government MFA app, the verbatim string is the one piece with direct operational value to someone who'd managed to pull a real `myGov.ks` off a device, and it adds nothing to the *analysis*. If your report needs to characterize it, "static 16-char alphanumeric, compiled into `DefaultMyGovKeyStoreManager`" is the substantive description.

2. Deprecated primitives — yes, with nuance, and that nuance is the point.

Three things show up; only one is a clean "deprecated primitive in app code," and the OTP itself is notably *not* weak:

SHA-1 is used in the OAuth client (`MyGovOauthClient / StateUtils`, class `S/a`), alongside `digest(...)`, `getBytes`, `UTF-8`, and OAuth fields (`authorization_code`, `redirect_uri`, `code`, `client_id`). The shape of it is SHA-1 over a UTF-8 string to derive an opaque value — almost certainly an OAuth `state`/anti-CSRF token rather than anything relying on collision resistance. So it's a genuinely deprecated primitive, but in a use that doesn't depend on the property SHA-1 lost. I'd flag it (standards like MASVS discourage SHA-1 outright), while being honest that the real-world risk here is low.

MD5 appears only as Guava's lazy `Hashing$Md5Holder` factory class. I found no app call site — it's reachable because Guava is bundled, not because the app demonstrably hashes anything with it. Worth stating precisely that way so the report doesn't overclaim.

The at-rest encryption (in the same keystore manager and in `E/e`) is `AES/CBC/PKCS5Padding` with an explicit IV (`sharedSecret_iv`). AES-CBC isn't deprecated, but it's unauthenticated — no integrity/AEAD — so the better characterization is "legacy/weak configuration": AES-GCM or the Jetpack Security crypto would be the modern choice. Combined with finding #1, the overall storage design is the weak point, not the cipher name.

And the part that demonstrates the system is *not* naively built: the actual one-time-code generation (`OtpProvider`, class `X/d`) uses **HMAC-SHA512** (`Mac`, `"HmacSHA512"`), which is stronger than the RFC 6238 TOTP default of HMAC-SHA1. So if someone skimmed and reported "SHA-1 in a TOTP app = weak OTP," they'd be wrong — the SHA-1 is in the OAuth path, and the OTP MAC is SHA-512.

Want me to map these to specific MASVS/MASTG control IDs for the writeup, or look at anything else?

User

Please describe exactly how the registration phase works. What does the user have to do? What protocol is the app following? What endpoints does it hit, for what purposes?

Claude

Let me ground this in the actual artifacts rather than guess — I'll pull the classes and strings around the OAuth and credential endpoints, the deep-link entry point, and the time source.

↪ [ran code -- Trace the OAuth/credential endpoints and registration-related classes to reconstruct the enrollment flow accurately]

Here's the registration/enrollment flow reconstructed from the observable classes and strings. Everything below is inferred from the unprotected wrapper code (class names, log strings, endpoint format strings); the server-side behaviour and anything executed inside the PairIP native layer aren't visible, so I'll flag where I'm reading the protocol off artifacts versus stating fact.

The backend. The two endpoint templates are `.../mga/sps/oauth/oauth20/token` and `.../authbiz-ext-sec/api/v1/authclients/{clientId}/totpcredential.json`. The `mga/sps/oauth/oauth20` path is the canonical OAuth endpoint layout of IBM Security Verify Access (formerly IBM Security Access Manager), and `authbiz-ext-sec` is its external-security credential API. So the app is a client of an IBM Verify Access deployment, and the registration is a standard **OAuth 2.0 authorization-code grant** that terminates in a vendor credential-provisioning call.

What the user does. Practically: they start enrollment from myGov (the app registers `http/https VIEW+BROWSABLE` deep links into `MyGovCodeGeneratorActivity`, so the journey is hand-off from the myGov site/app into the Code Generator), then they sign in and consent inside an in-app web view. The class `MyGovWebViewClient` (`S/c`) is the authorization UI: it drives

onPageStarted/onPageFinished, enforces a server allow-list ("WebView was trying to retrieve data from unexpected server"), and handles the redirect back. From the user's side it's "open it from myGov, log in, approve" — the credential is provisioned silently after that.

The protocol, step by step.

1. **Authorization request.** StateUtils/MyGovOauthClient (S/a) assembles the OAuth request — client_id, redirect_uri, grant_type, plus a generated state value (this is the SHA-1 use from your earlier question — a CSRF/state token, not OTP material). It also marshals a device_name/bluetooth_name, which is how the resulting credential gets labelled per device.

2. **User authentication + consent** happen in the web view against the Verify Access authorization server. On the redirect, handleNativeRedirect validates that the returned state matches the locally generated one ("state from server doesn't match local state" → abort) and extracts the authorization code. Error branches handle access_denied, consent_denied, unauthorized_client, invalid_request_uri.

3. **Token exchange.** TokenUrlCallable (in S/d) does a POST to .../mga/sps/oauth/oauth20/token with grant_type=authorization_code and the code/client_id/redirect_uri, and GetAccessTokenFunction (E/i) parses the response into an access token (used later as Bearer ...). Failures surface as invalid_token.

4. **Credential provisioning.** SharedSecretCallable (also S/d) then calls .../authbiz-ext-sec/api/v1/authclients/{clientId}/totpcredential.json with the Bearer access token. Its purpose is to retrieve the **TOTP shared secret** for this client — the log string "IOException occurred while trying to read shared secret" confirms that's what comes back.

5. **Parse + persist.** SharedSecret.buildFromServerResponse (C/j) parses the server JSON, pulls the secret field, and then "encrypt and save"s it — AES/CBC/PKCS5Padding, stored under alias sharedSecret with sharedSecret_iv in the myGov.ks keystore (the one behind the hardcoded password from finding #1).

6. **Steady state.** After enrollment, OtpProvider (X/d) generates the rotating codes with HMAC-SHA512 over a network-time-synchronised clock (networkTimeProvider/networkTimeServerResponseParser/totpClock), so codes stay valid even if the device clock has drifted.

So to answer the three parts directly: the **user** logs in and consents via an in-app web view reached from myGov; the **protocol** is OAuth 2.0 authorization-code against an IBM Verify Access backend, with state validation, followed by a credential-fetch API; and the **endpoints** are the OAuth token endpoint (/mga/sps/oauth/oauth20/token, purpose: exchange the auth code for a Bearer access token) and the credential endpoint (/authbiz-ext-sec/api/v1/authclients/{clientId}/totpcredential.json, purpose: deliver the TOTP shared secret that's then encrypted and stored locally).

The piece I'm deliberately not reconstructing is the exact wire format of that credential request — the precise parameters/headers that would let someone replay it as the app client against the live server. The protocol-level description above is what a report needs. Want me to write this up

as a labelled sequence (steps mapped to classes/endpoints) for the report, or map each step to its MASVS control?

L AI experiment, phase 2: challenging previous conclusions

Verbatim transcript — second phase (LaTeX-export iterations and the verification thread). Assistant message text is reproduced exactly; grey `[...]` markers are the tool-steps and shared-file outputs as they appear on screen (collapsed cards), including the failed scan attempts. Hidden reasoning is not part of the on-screen view and is not shown. One ASCII-art disassembly diagram has its box-drawing glyphs normalised to ASCII for LaTeX compatibility.

User

Back to your step-by-step description of the protocol: in step 2, user authentication and consent, you say that handleNativeRedirect validates the returned state parameter and aborts if "state from server doesn't match local state". I think you might have hallucinated that. Can you double-check, and point to the part of the code that does that if you can find it?

Claude

Good instinct to push on this — "the log string exists" and "the code actually compares and aborts" are two different claims, and I should only have asserted the second if the control flow backs it up. Let me look at the actual method.

↪ [ran code -- Confirm the state strings exist and find which method(s) reference them]

↪ [ran code -- Brute-force scan all method bytecode for const-string loads of the state strings to see if any code actually references them]

↪ [ran code -- Robust bytecode scan (MethodAnalysis API) for const-string loads of the state strings]

↪ [ran code -- Fixed scan using DEX encoded methods only (skip external methods)]

↪ [ran code -- Iterate each DEX's methods and scan bytecode for the state strings]

↪ [ran code -- Scan EncodedMethods via classes for const-string loads of the state strings]

Found it — and it changes one detail of what I told you. Let me read the actual method body to confirm the behaviour (comparison + abort), not just the presence of the strings.

↪ [ran code -- Dump the control-relevant instructions of shouldOverrideUrlLoading to verify state comparison and abort behaviour]

The strings are real and they're referenced by live code — but I got the location wrong, and I want to verify the actual branch behaviour before I restate anything. Let me dump the raw instruction slice around the comparison.

↪ [ran code -- Unfiltered bytecode slice around the state comparison to determine the exact match/mismatch branch terminators]

Good catch — and you're half right, which is the useful kind of half.

The substance holds, but I misattributed it. There is **no method called** `handleNativeRedirect` in the analyzed code. That token appears only as a prefix inside the log strings (`"handleNativeRedirect - state mismatch"`, etc.) — almost certainly the original/pre-obfuscation helper name or a log tag. The behaviour is actually inlined into `MyGovWebViewClient.shouldOverrideUrlLoading` (`LS/c;`), the standard `WebViewClient` override. So when I wrote "`handleNativeRedirect` validates…", I stated an inferred method name as fact. That was wrong, and it's exactly the kind of thing worth checking.

What I can now confirm at the bytecode level is that the state validation itself is real and does gate the token exchange — it's not just an orphaned log string. Here's the relevant slice of `shouldOverrideUrlLoading` (offsets are code-unit indices into the method):

```
595 v0 = LS/a;->c ; locally-stored OAuth state
597 StringsKt.f(v13, v0) : Z ; compare URL's state (v13) vs local (v0)
600 move-result v0
601 if-nez v0, +012h ----------------+ ; if EQUAL -> jump to 619 (proceed)
603 const "...state from server doesn't |
      match local state" | ; MISMATCH branch:
605 Log.e(...) |
608 const "...state mismatch" |
613 new-instance LP/d ; <init> | ; build a failure/redirect event
618 goto -64h ------------------+ | ; divert to the shared dispatch+return tail
619 CookieManager.removeAllCookies <--|--+ ; PROCEED path (match):
632 ...flush() |
635 get "code" from parsed params |
669 LS/d.d = code | ; hand auth code to the network class
671 new LE/i ; subscribe(...) | ; => triggers the /oauth20/token exchange
```

So: the returned `state` query param is compared against the locally-held value on the OAuth client object (`LS/a;->c`), and on inequality (`if-nez` not taken) the code logs both messages, builds an `LP/d` event, and `goto`s out to the shared event-dispatch/return tail used by the "missing state 1/2" guards — it never reaches the cookie-clear / `code`-extraction / token-exchange block at 619+. The token exchange is genuinely gated behind the match. So the *security property* I described — returned state validated against local state, mismatch is a non-proceeding error path — checks out.

Two honest caveats on precision: the comparison uses an obfuscated Kotlin `StringsKt` helper (R8 renamed it to `f`), so I'm inferring "equals-style" from the `(String,String)Z` signature and from the fact that the same method uses different helpers for its other checks (`o` for the `javascript:`/host-allowlist prefix tests, `a` for the `contains` checks on `error_code=`, `access_denied`, etc.) — I can't read the literal stdlib method name off the binary. And `LP/d` is an obfuscated event class; I'm calling it a "failure/redirect event" from how it's constructed and dispatched, not from a self-describing name.

For the report, the corrected statement would be: "*`MyGovWebViewClient.shouldOverrideUrlLoading` parses the OAuth redirect, validates the returned `state` against the locally stored value, and only proceeds to the authorization-code/token exchange on a match; a mismatch is logged and routed to an error path.*" Drop the `handleNativeRedirect` name. Thanks for catching it — want me to

re-scan the earlier steps for any other place I named a method I'd only inferred from a log string?

User

I still can't find any string like "state from server doesn't match local state". Exactly what string should I look for?

Claude

Let me pull the exact literal bytes rather than rely on how I've been quoting it — including checking the apostrophe and confirming where it physically lives.

↪ [ran code -- Extract exact literal bytes/encoding of the string and demonstrate it is only findable in the decompressed classes.dex, not the compressed apk]

The string is there — let me give you the exact literal, because I've been quoting it slightly trimmed, which is probably why an exact-phrase search missed.

The actual constant in the DEX carries a `handleNativeRedirect:` prefix that I'd been dropping. The full literal is:

```
handleNativeRedirect: state from server doesn't match local state
```

The apostrophe in `doesn't` is a plain ASCII `'` (0x27), not a smart quote — I checked, since that's a common reason a copy-paste search fails. Byte-for-byte (UTF-8/ASCII hex):

```
68616e646c654e6174697665526564697265637 43a20737461746520667 26f6d20
736572766572206 46f65736e2774206d61746368206c6f63616c207374617465
```

There are actually four related log literals in that method; note the short ones use space-hyphen-space, not a colon:

```
handleNativeRedirect - missing state 1
handleNativeRedirect - missing state 2
handleNativeRedirect - state mismatch
handleNativeRedirect: state from server doesn't match local state
```

They live in `classes.dex` inside `base.apk` (the DEX string pool). A reliable way to confirm:

```
unzip -p base.apk classes.dex | grep -a "doesn't match local state"
```

That returns the match here; grepping the literal substring `state from server doesn't match local state` works too, since the prefix only sits in front of it. If you were searching for my earlier quoted form as a whole, anchored phrase, the missing `handleNativeRedirect:` prefix would explain the miss — and so would `strings` with its default minimum length, or a tool searching the compressed APK without decompressing the dex first.

So to be precise about what I got right and wrong in this thread: the method name `handleNativeRedirect` was my error (the logic is in `shouldOverrideUrlLoading`), but these four strings are genuinely present and are loaded by that method's bytecode. If you run the grep above and still get nothing, tell me what tool and which file you're searching and I'll help work out the discrepancy — and if

it turns out your copy differs from mine, that's worth knowing, because it would mean we're not looking at the same artifact.

User

Got it. Great. Please export this second conversation phase *exactly* as latex.

User

Are you sure it's using PairIP? PairIP only came out last year, and this app is quite old, so I'm surprised. Also, you seem to have been able to find out a lot about it.

Claude

Fair challenge on both counts — and worth checking rather than just defending, especially given I already had to walk back the `handleNativeRedirect` detail. Let me re-verify the PairIP evidence directly.

↪ [ran code -- Re-verify the manifest application class, pairip assets, and native libs across splits]

↪ [ran code -- Inventory com.pairip.* classes and confirm how much app logic remains in readable plaintext]

Both points are well taken, and checking changed my read. Let me split it into what's confirmed versus what I overstated.

PairIP is genuinely there — I didn't invent it. The manifest's application class really is `com.pairip.application.Application`; the arm64 split really ships `libpairipcore.so`; and the base DEX contains 22 `com.pairip.*` classes including the tell-tale ones: `com.pairip.VMRunner`, `com.pairip.StartupLauncher`, `com.pairip.SignatureCheck` (with a `SignatureTamperedException`), and `com.pairip.licensecheck3.LicenseClientV3`. There are also five random-named asset blobs (`assets/DpZac9UkMUBAGEbl`, `P4AGTYNQkXb5QJ1B`, etc.) that are characteristic of PairIP's encrypted payloads. So the PairIP fingerprint is solid.

But your second observation is the tell, and it exposes that I overstated what PairIP was doing here. I originally said the meaningful logic "lives behind the PairIP layer" and the app was "built specifically to resist" static analysis. That's contradicted by the very fact that I then read the OAuth endpoints, the TOTP/`HmacSHA512` usage, `myGov.ks`, `sharedSecret`, and the `handleNativeRedirect`/`shouldOverrideUrlLoading` state logic straight out of the binary — all of it sitting in plaintext strings in normal R8-obfuscated DEX. If PairIP had actually virtualized or string-encrypted those paths, I couldn't have. So the accurate picture is: PairIP's footprint in this build is the startup wrapper plus integrity/signature and Play-license checks (and some encrypted asset blobs), and it did **not** hide the application logic I described. That's why I could find so much. I also conflated two different things earlier — the single-letter class names (`K1`, `x0`, `Q`) are ordinary R8 minification, present in almost every production Android app, not evidence of special hardening. Calling it "built specifically to resist inspection" was too strong, and it's the same failure mode as the `handleNativeRedirect` slip: stating what PairIP *typically* does as if I'd observed it here.

On the timeline — that part actually reconciles cleanly. PairIP is applied at build/distribution time, not baked into the original source years ago; the protected artifact is whatever's currently distributed. The signing certificate is the generic Google Play App Signing identity and the package carries the Play license client, which points to the protection being applied through the Play distribution/automatic-protection path. So an app whose *product* is old can still carry PairIP because the build I analyzed (v2.3.0, versionCode 19) is a recent re-processed build — the wrapper rides on the pipeline, not the release date. I'd hold that mechanism loosely as an inference, and I genuinely don't have a confident date for when PairIP became available, so I won't argue your "last year."

Net correction for your notes: *PairIP is present (wrapper + integrity/license checks + encrypted assets), applied at distribution time, but in this build the security-relevant application code was not protected by it and was recoverable by ordinary static analysis.* Want me to quantify the split — how many methods actually route through `VMRunner` versus how many are plain DEX — so the report can state precisely how much was and wasn't behind PairIP?

User

Export today's conversation *exactly* as latex.

M AI statement

AI was used, with very careful prompting, to generate Figure 2, Figure 3 and Figure 4. I checked that these diagrams were accurate and reliable. It was used as described in the AI experiment for Question 13. AI was not otherwise used for this report.

N A note on spelling conventions

International technical documents generally use US spelling; Australian formal documents usually use British spelling. It is not possible to refer to both in the same document without some inconsistency. I apologize if this is irritating.