



Reserve Bank
of New Zealand
Te Pūtea Matua

Designing a digital cash ecosystem

Digital Cash Consultation Note, #1

17 April 2024



Disclaimer

We produce a variety of publications and research about monetary policy, financial stability and related economic and financial issues. Most are available without charge as part of our public information service.

We have made every effort to ensure that information published in this paper is accurate and up to date. However, we take no responsibility and accept no liability arising from:

- errors or omissions
- the way in which any information is interpreted
- reliance upon any material.

We are not responsible for the contents or reliability of any linked websites and do not necessarily endorse the views expressed within them.

[Privacy Policy - Reserve Bank of New Zealand - Te Pūtea Matua \(rbnz.govt.nz\)](#)

Contents

1	Introduction	3
2	A digital cash ecosystem	3
3	The building blocks that make a digital cash ecosystem	7
4	Aligning design to our objectives	7
4.1	Digital cash principles	8
4.2	Our key design judgements	10
5	Developing and mapping representative models	11
6	Digital cash use cases	15
7	Technology approach guidelines	17
7.1	Non-functional requirements	18
8	Conclusion	20
	References	21
Annex A:	Building Block Anatomy	22
Annex B:	Preferred digital cash models	26
	Support the Market	26
	Digital Economy	28

1 Introduction

Digital cash would be a new digital representation of the New Zealand dollar in circulation and use throughout the New Zealand economy. Digital cash is the name we are using to describe a Central Bank Digital Currency (CBDC). Issuing and distributing digital cash will require the design and establishment of a new enabling ecosystem in which New Zealanders will be able to benefit from a range of compelling uses and services. The development and delivery of this ecosystem requires a wide range of policy and design choices. The Reserve Bank of New Zealand (Reserve Bank) is at the beginning of this design process, and detailed design choices are yet to be made.

This Consultation Note expands on our digital cash design approach. It supports the [Digital cash in New Zealand Consultation Paper](#) released 17 April 2024.

We are taking a top-down design approach. We have not conducted any hands-on technical development or experimentation. At this stage, we have completed preparatory work to lay the foundation for how we can progress the design of digital cash that best fits and delivers against our objectives, outcomes and policy principles. Our approach has been to identify all parts of a digital cash ecosystem, and to understand how they relate to each other and the design choices and trade-off decisions that would need to be made to establish the best fit digital cash ecosystem model.

There is a significant amount of research, piloting, testing and development work being undertaken around the world on the design of CBDCs generally. We have drawn extensively from this international body of work.

2 A digital cash ecosystem

The Reserve Bank's design considerations encompass the whole 'ecosystem' that would need to be in place to successfully support New Zealanders having digital cash as an option they could use day to day. Digital cash will require the establishment of a new ecosystem, supported by six interrelated main components.

Digital cash asset

This is the underlying representation of value. It is set in New Zealand dollars and has a 1:1 exchange rate with cash, and NZD. It represents a direct legal claim on the Reserve Bank.

Digital cash platform

The Reserve Bank would develop and operate the core technology platform that securely issues digital cash, manages intermediary access, processing payments, and ensures overall financial stability and management.

Digital cash service providers

Private sector service providers would connect to the platform to distribute digital cash, through their digital cash products and services, to their customers. They will also manage the customer relationship.

Funding institutions

Users will fund their digital cash to/from their transaction accounts or via cash at ATMs. Payment system interoperability and Exchange Settlement Account System (ESAS) settlements will enable digital cash distribution.

Digital cash users

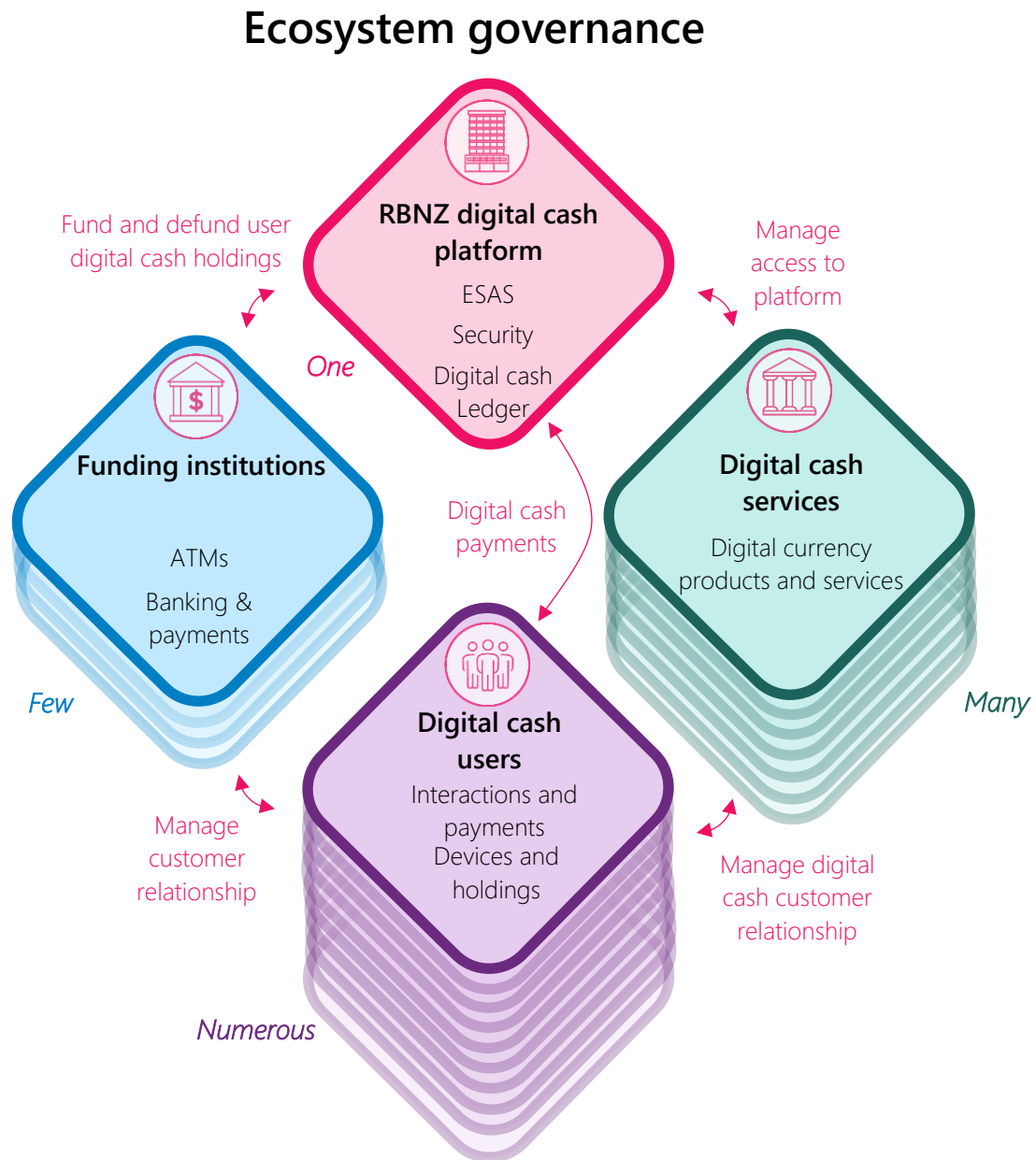
Users are at the heart of the ecosystem. They will expect easy and inclusive ways to store and spend their digital cash anywhere, anytime, and have control over their money, privacy and information.

Ecosystem governance

The entire ecosystem will need to be well governed, managed and regulated. A mix of legislation, regulation, policies, rules, technical standards, user safeguards, monitoring and reporting will all need to be in place. Relevant laws such as the Anti-Money Laundering and Countering Financing of Terrorism Act 2009 and the Privacy Act 2020 will need to be clearly applied. Engagement and governance structures will need to support the digital cash evolution over time.

Figure 1 illustrates these key parts of a New Zealand digital cash ecosystem.

Figure 1: A possible New Zealand digital cash ecosystem



Source: Adapted from Bank for International Settlements Innovation Hub et. al. (2023).

Box A: A future view of New Zealand's digital economy

Digital cash is a long-term proposition to help New Zealand and New Zealanders thrive in a digital world. As there would be a multi-year lead-time to decide, build and launch digital cash, we need to anticipate what kind of a digital world it would be launched into. While foreseeing the future is challenging and heavily caveated, we can make assumptions about what New Zealand's money, payments and digital economy could look like particularly if competition and innovation flourish.

Aotearoa New Zealand's digital economy:

- Economic activity is increasingly digital.
- There is an increased impact on those who are digitally and financially excluded.
- As a small trading nation, digital competitiveness is vital to our economic growth.

How global technology trends will influence New Zealand's payments landscape:

- Artificial intelligence becomes embedded in normal digital economic activity, including payments.
- Securities, trade, carbon credits and bank deposits are increasingly represented by digital tokens.
- BigTech platform companies offer payment services to New Zealanders.
- Payments are increasingly real time and seamlessly embedded in digital activities.
- Stablecoins are offered by a range of entities to provide new services to customers.
- Biometric technologies are increasingly used to authenticate payments.
- Crypto assets increasingly available to more people, with limited usage in payments.

Aotearoa New Zealand specific outcomes:

- Cash remains available into the future as long as it is valued by New Zealanders, but cash systems remain under pressure.
- Māori Data Sovereignty principles are increasingly embedded in digital economic activity, elevating New Zealand's best practices.
- Open banking becomes widely used by New Zealanders, supported by the Consumer Data and Products legislative framework and industry standards.
- New Zealand has real-time payments between bank accounts and a modernised payments capability.
- An expanded range of businesses will access and provide money and payment services.
- Regulatory focus on the direction of New Zealand's payments and money systems continues to sharpen.

How New Zealanders' digital and payment expectations will evolve:

- People increasingly use mobile device wallets to manage their money, payments, and digital identity.
- People learn to expect to be able to manage their consents and control their own digital data.
- People have a strong preference for cash to remain a viable payments option but use it less often.
- People safely use their digital identity in a wide range of digital activities.

3 The building blocks that make a digital cash ecosystem

To understand the various component parts of the full ecosystem, we researched and developed a 'building block anatomy'. We defined 57 building blocks that provide the foundation to understand the range of design choices and the breadth of issues that will need consideration when constructing a digital cash ecosystem. We expect these building blocks to evolve and be added to over time as we learn more and adjust based on feedback from stakeholders.

The building blocks provide a mechanism and structure to help develop our preferred options for a digital cash ecosystem and model. It does this by:

- Providing a structure to capture and classify digital cash design subjects and issues.
- Supporting the optioneering process by understanding the design areas and decision options and trade-offs.

The building block anatomy has four main categories:

- **Asset:** a NZ dollar with a 1:1 exchange rate with cash. Has a direct legal claim on the Reserve Bank.
- **Platform:** Core technology layer enabling the issuance and transfer of the asset.
- **Market:** The environment of systems, services, roles, providers and arrangements supporting service providers and third parties.
- **User:** The end person or entity storing, spending or receiving digital cash.

To help organise the building blocks, they have been grouped into 'design areas'. See Annex A to view the Building Block Anatomy.

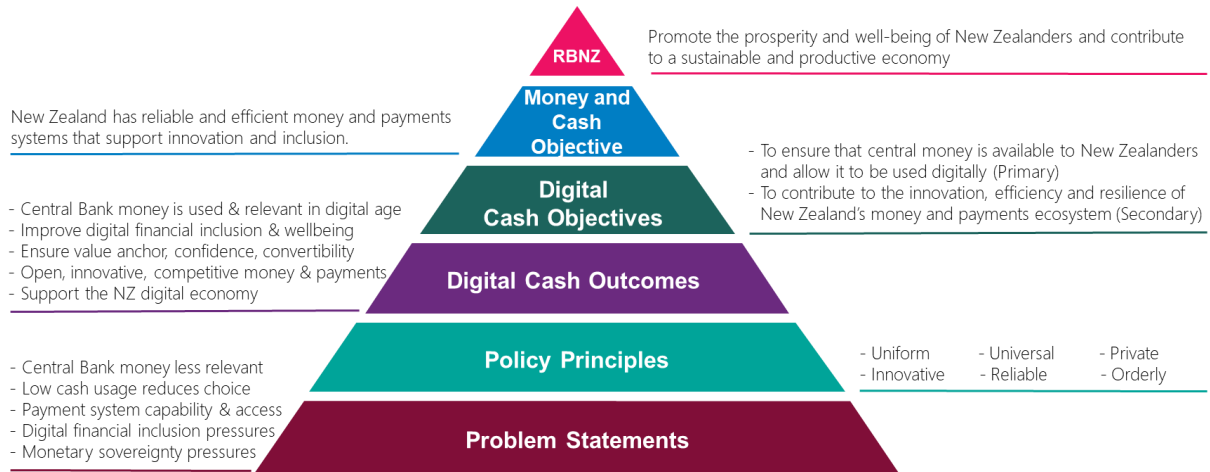
4 Aligning design to our objectives

There are a wide range of potential kinds of digital cash and many different approaches can be taken. We have begun the narrowing process by taking a policy-led approach that ensures our activities align to our purpose and outcomes (Figure 2). This initial narrowing is directional, high level and non-binding. This helps us focus the future work programme and provides a basis to

seek stakeholder feedback on the desirability, feasibility and commercial aspects of potential digital cash. As we learn more through the work programme, we can adjust or change as appropriate.

We also collaborated with Accenture to identify the most important design choices, and work through the trade-off considerations to design digital cash.¹ We workshoped starting positions for each of these design choices, although no design decisions have been made yet. All this work provides input to help early design thinking.

Figure 2: Our top-down policy-led approach to designing digital cash



Source: Reserve Bank.

4.1 Digital cash principles

Table 1 provides the digital cash principles that embody our policy research and guide the design of the digital cash.

Table 1: Digital cash principles

Principle	Supporting criteria
<p>1</p> <p>Uniform</p> <p>Digital cash will have the same dollar value as cash and bank deposits. It supports NZD as unit of account and our monetary sovereignty.</p>	
<p>2</p> <p>Universal</p> <p>Digital cash will be universal. Everyone will be able to use it for everyday payments and savings, just like with cash.</p> <p>To achieve this, digital cash must be inclusive.</p>	<p>Inclusive</p> <p>Everyone can access and use digital cash, in the same way that anyone can use physical cash to make a payment. This requires users to have meaningful choice, and autonomy.</p> <ul style="list-style-type: none"> • Meaningful choice: There is a range of money and payments products and services provided in the digital cash ecosystem. Physical cash is supported.

¹ Accenture et al. (2024).

Principle	Supporting criteria
<p>3</p> <p>Private</p> <p>Your information and lives will be kept private, and not influenced by the Reserve Bank when using digital cash.</p> <p>To achieve this, we must build in information governance and assurance.</p>	<ul style="list-style-type: none"> • Autonomy: Digital cash is trusted and can be used with confidence. Digital cash services are accessible, and information is easy to access and understand. <p>Information governance</p> <p>Your privacy will be protected by the Privacy Act and good data governance principles.</p> <p>The Reserve Bank will collect as little data as possible and won't be able to see your personal information or how you spent your money. You will have a choice on how your information is used, stored, shared, and deleted.</p> <p>Digital cash will uphold Māori data sovereignty.</p> <p>Assurance</p> <p>You can feel confident in your freedom and rights when using digital cash.</p>
<p>4</p> <p>Innovative</p> <p>Digital cash will be innovative and support new and improved ways to make payments.</p> <p>To achieve this, digital cash must be efficient and feasible.</p>	<p>Efficient</p> <p>The digital cash ecosystem uses the least resources possible and makes sure to allocate resources towards user requirements. This requires more competition and high interoperability with the existing payments landscape.</p> <ul style="list-style-type: none"> • Competition: Digital cash enables broad access to, and participation in, New Zealand's money and payments landscape. Businesses compete to win and retain users of digital cash. • Interoperability: Digital cash is compatible with different payment devices and systems in New Zealand. <p>Feasible</p> <p>Digital cash and its ecosystem of services can be delivered in New Zealand. Service providers are incentivised to be involved in the ecosystem. This requires digital cash to be simple and have balanced incentives.</p> <ul style="list-style-type: none"> • Simple: Digital cash should be simple to design, develop and implement. • Balanced incentives: Service providers — banks, payment companies, and new providers — will deliver digital cash services in a sustainable and efficient way.
<p>5</p> <p>Reliable</p> <p>Digital cash will be reliable – so you can trust that your money remains safe</p>	<p>Resilient</p> <p>Digital cash can recover quickly if it's exposed to risks or outages.</p> <p>Safe</p>

	Principle	Supporting criteria
	<p>and payments can be made when you want to.</p> <p>To achieve this, digital cash to be resilient and safe.</p>	<p>Digital cash is protected from things like failures and cyber-attacks, so you feel safe using it. This requires the payment to be final and compliant.</p> <ul style="list-style-type: none"> • Final: Once you make a payment, it can't be reversed or reclaimed. • Compliant: Digital cash will need to comply with all relevant legislation and regulations.
6	<p>Orderly</p> <p>Digital cash will be issued by the Reserve Bank in an orderly way to minimise disruption to the financial system and economy.</p> <p>To achieve this, we must monitor stability and maintain controls.</p>	<p>Stability</p> <p>The Reserve Bank will monitor the impact of issuing digital cash on financial conditions. This includes monitoring whether commercial banks can get enough funding to conduct their businesses.</p> <p>Controls</p> <p>The Reserve Bank can control the timing, speed, and amount of digital cash in the economy and will make sure the financial system remains stable.</p>

4.2 Our key design judgements

The policy principles informed our preliminary design judgements. The following list summarises these judgements as they stand now, based on what we currently know. Over time we expect our understanding to deepen as we learn more, and so these judgements will likely adapt and change, particularly as we work through what digital cash could and should be, how it could be used, and by who.

1. **Digital cash would be issued to the public for general use, prioritising retail use cases.** 'Use cases' describe how people might use digital cash, and a focus on retail cases means looking at people earning and spending digital cash as they would cash today. Retail use cases also means a focus on people to business transactions, rather than wholesale use cases which would describe financial institution to financial institution transactions. See section 7 for more information on priority use cases.
2. **The Reserve Bank would issue and govern digital cash,** and this may mean that the Reserve Bank operates the technology platform and networks needed to run and manage digital cash. It is too early to say how this might work, but the Reserve Bank would control digital cash in a similar way to how physical cash (banknotes and coins) is issued and governed today. Who builds the platform, and provides the network is something to be decided in the future. It will need central control and governance if it is to be efficient and to provide new options to all New Zealanders.
3. **Digital cash would be issued in exchange for cash and ESAS reserves.** The Reserve Bank would issue or redeem digital cash on a 1:1 New Zealand dollar basis, settled in ESAS reserves. The Reserve Bank has not yet decided the settlement and access model or inter-relationships with payment clearing systems would work. We would also like to see users be able to exchange their physical cash for digital cash in a wide range of locations across New Zealand.

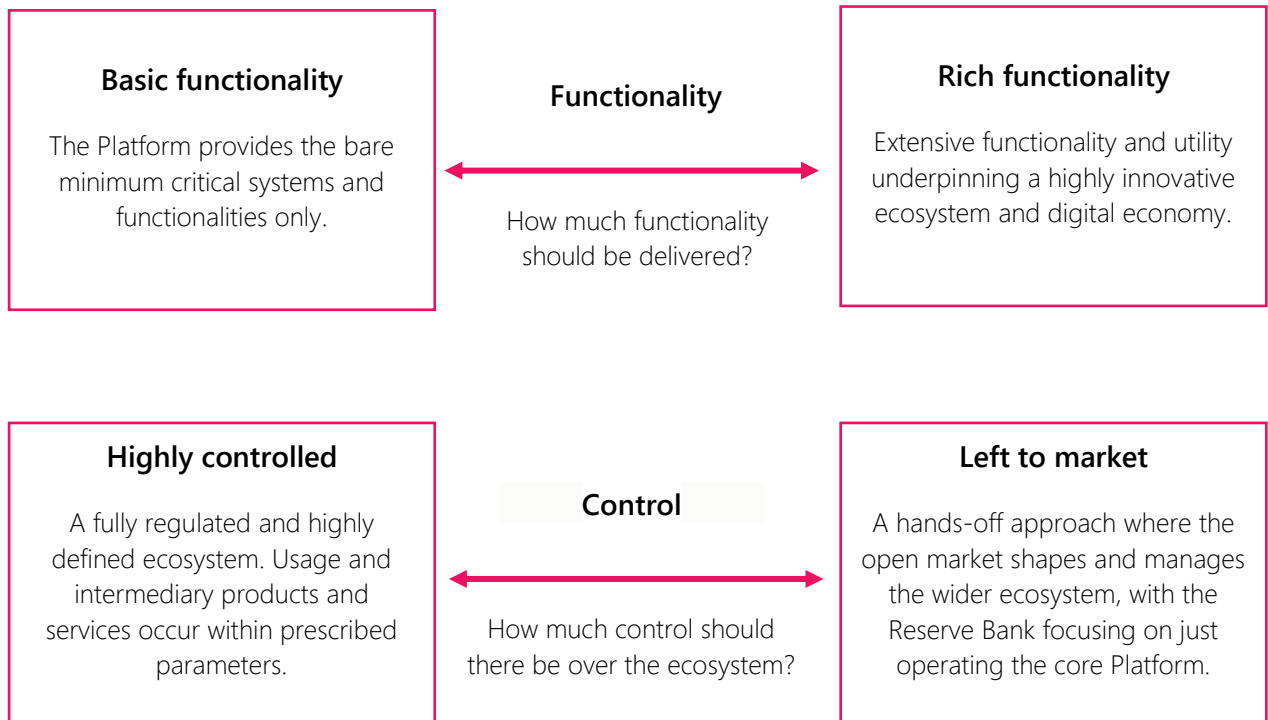
4. **Issued digital cash would be a liability to the Reserve Bank**, meaning that the Reserve Bank would be obliged to redeem any digital cash presented to it in exchange for cash. This makes it a direct claim on the Reserve Bank.
5. **There would be no “programmable money”**. “Programmable money” is where the digital currency itself features limits or constraints as to how it can be used, for example by including expiry dates, or constraints on where or what it can be spent on. Our preliminary judgement is to align with most countries and rule this out, as it could undermine the uniformity of money by making digital cash akin to a voucher. It is important to note that this is a separate design consideration to ‘programmable payments’, where smart contracts and other programmable features are applied by users and service providers that provide for the automation of activities and processes should certain pre-agreed conditions be met – we think this will be an important digital cash capability.
6. **The digital cash platform should operate with very high operational reliability and resilience**. What this means in practice will be determined through future work, but we need the platform to be highly available so people can spend their digital cash at any time, even potentially during or very quickly after disaster scenarios. Refer to section 8 below for more information on non-functional requirements.
7. **The Reserve Bank would collect, store, and retain only minimal user data – if any**. Some data may need to be collected to meet legislative and regulatory obligations, but this will be minimised. Exactly what data would be collected and whether this will need to be held by the digital cash platform or held only by the intermediary will need to be determined. The Reserve Bank would prefer not to hold any user data and would not hold any data that identifies individuals and specific transactions. We will be transparent about what data will be collected, how it will be processed and handled, for what purpose, and by who.

We expect digital cash to be managed through an ‘intermediated’ model. This means the Reserve Bank won’t do everything itself and will use other companies and organisations (‘service providers’) to deliver and run the system end to end. Our preference is to design a model that has low or acceptable levels of dependency on incumbent market actors, and that new opportunities are presented to encourage new businesses and innovations in this area. As well as the private sector, potential service providers could also include public sector agencies and purpose-driven entities such as iwi or charities. Third parties will develop products and services that use digital cash, and these may be integrated into their other product offerings as part of managing their overall customer relationships.

5 Developing and mapping representative models

In the initial narrowing of design choices, we considered what key dimensions might help shape our initial design preferences. Based on our work to date, the work with Accenture, and our ongoing research on international developments we then focused on the dimensions of functionality and control, as shown in the diagram below. These dimensions reflect the stance that Reserve Bank will take when considering the key design decisions that will need to be made – particularly around the extent of the role Reserve Bank should play in the wider ecosystem, and how much functionality should be provided by the digital cash platform. The dimensions of control and functionality are illustrated below:

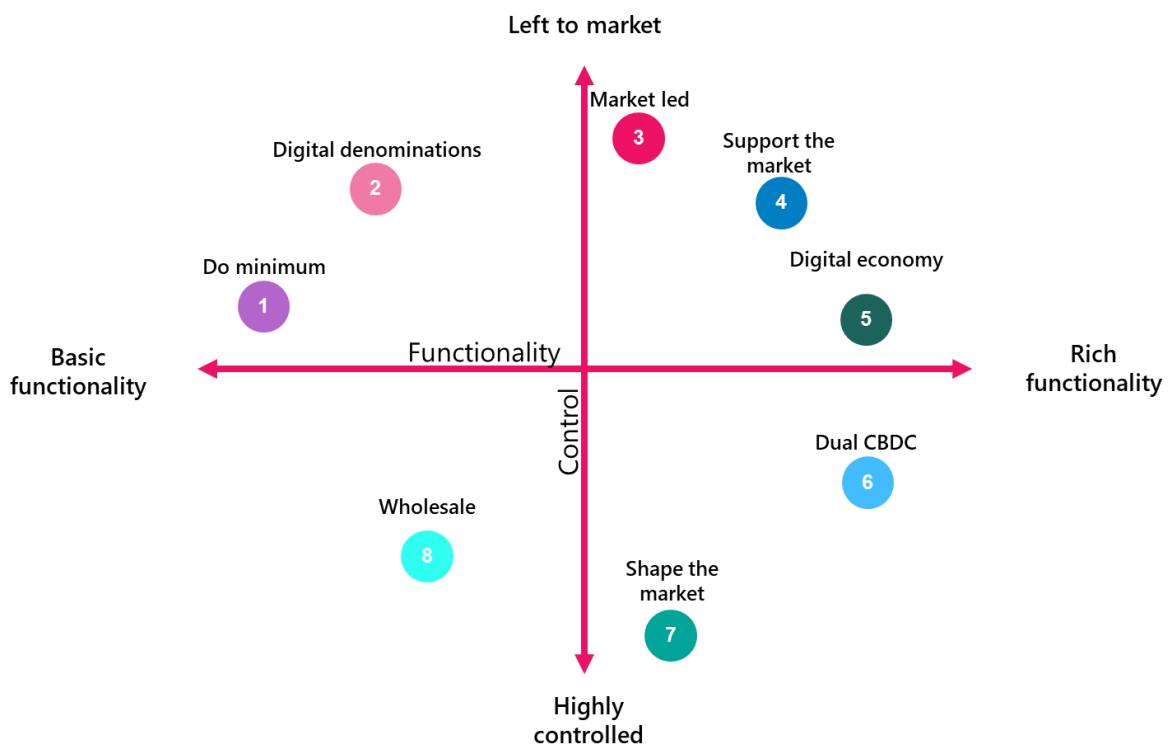
Figure 3: Digital cash model dimensions of control and functionality



Source: Reserve Bank.

These two dimensions helped provide a structure to start defining some representative model options. Setting these dimensions up in the form of a two-by-two quadrant helped us develop, organise and assess some potential representative models.

Figure 4: Mapping of representative models



Source: Reserve Bank.

Models can exist anywhere in these four quadrants, so we chose to narrow to eight representative models which we then named and described further (Figure 4). Each is a stylised representative model of a certain approach. They are intentionally developed and positioned on the outer areas of the quadrant. Any model could be 'dialled up or down' to move it away or towards the centre point. One model - the Reserve Bank 'direct to user' model - has not been included on the basis of previous considerations that digital cash should be intermediated to enable innovation benefits. There is also no separate 'public sector to user' model - a publicly provided basic service, as this could occur in any model if a public sector agency acted as an intermediary. The eight representative models are summarised below:

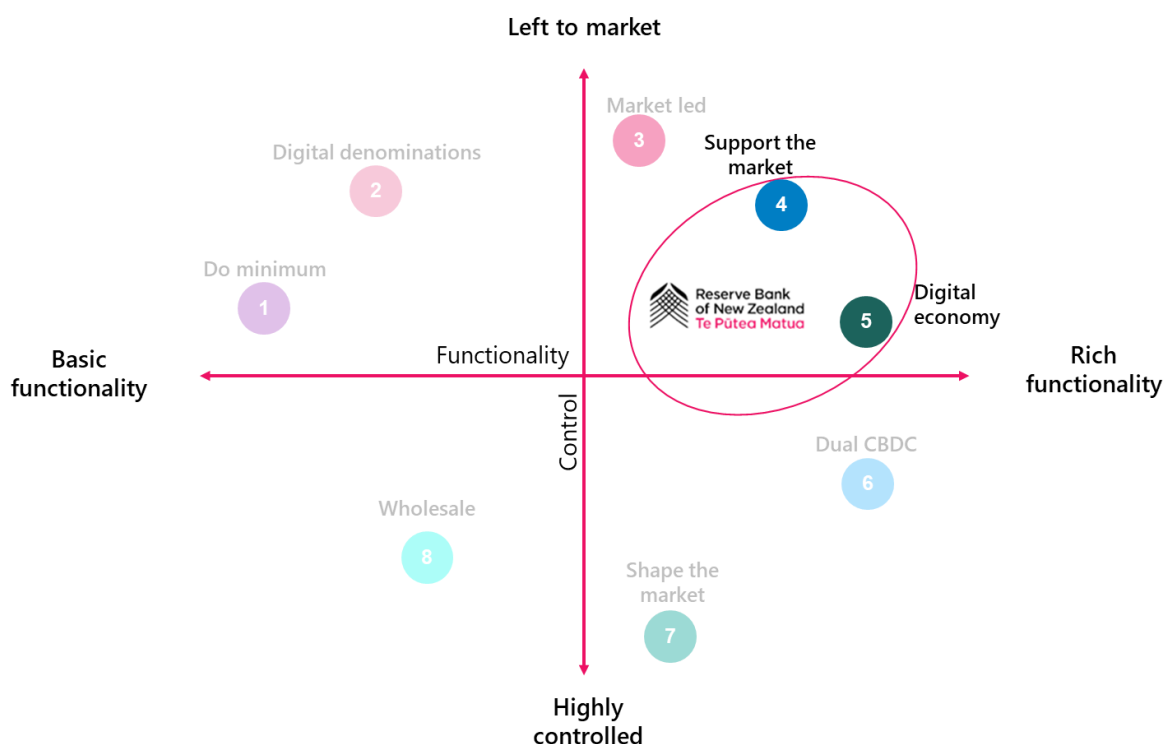
Table 2: Representative models

#	Model Name	Key features	Potential motivations
1	Do Minimum Simplest possible controlled launch with a roadmap.	Only core systems and functions initially with flexibility to expand. Focused on retail use cases. Less defined ecosystem.	Motivated by wanting a simple start to provide early momentum while keeping options open. Could be transitory to other models.
2	Digital Denominations Digitally mimics the attributes of physical cash.	Openly available with cash-like autonomy and privacy in a fixed denomination (e.g. \$10, \$20, etc) digital token form. Offline capable. Lower innovation. Existing cash AML/CFT applies.	Motivated by wanting to just replicate physical cash attributes and denominations in a digital world, drawing on user familiarity and existing practices.
3	Market Led An open lightly regulated market driven ecosystem.	Wide access to basic Platform. Intermediaries (not Platform) hold user information and transactional activity. Many roles left to market.	Motivated by the clarity of a narrow Reserve Bank role and prioritising innovation and competition.
4	Support the Market Collaborate to provide enabling tools and functions.	Wide access to a feature-rich enabling Platform that provides functions designed to support and accelerate innovative products and services.	Motivated by wanting to incentivise market innovation and encourage competition and wanting faster uptake and seeing network effects quickly.
5	Digital Economy Proactively integrated with the wider digital economy.	Open architecture, feature-rich platform that supports a wide selection of use cases. Highly integrated with other digital economy systems and stakeholders.	Motivated by ambitions to deliver a highly connected digital dollar aiming to underpin NZ's future digital economy.
6	Dual CBDC Connected retail and wholesale digital currencies.	An innovative digital currency stablecoin. Highly intermediated. Retail digital currency claim on intermediary backed 1:1 by wholesale holdings.	Motivated by a view that safe and assured public-issued stablecoins will be vital for innovation and stability, along with future proofing wholesale.

#	Model Name	Key features	Potential motivations
7	Shape the Market Regulated usage and a controlled economic model	Platform plus a 'scheme' and rules setting economic/price arrangements, product, and user safeguards. Highly controlled and managed.	Motivated by wanting to ensure high levels of control over public-policy social, economic outcomes and risks.
8	Wholesale Innovation layer for wholesale central bank money.	Innovation layer on top of ESAS to provide enhanced innovative services to existing ESAS users. Includes cross-border bridge.	Motivated by future proofing and adding innovation to existing wholesale central bank money and ESAS services.

Of these eight models, our current preferred positioning is the area around two models: Support the market and Digital economy as shown in Figure 5. See Annex B for further details of these two models.

Figure 5: Reserve Bank's preferred design positioning



Source: Reserve Bank.

We've narrowed our current focus to the area in the pink circle because:

- We think this area will help support widespread adoption and use across the digital economy and will be faster to scale up if supported by the market.
- We think this area prioritises innovation, open competition and a dynamic market.

- This area broadly aligns with some other central banks, most notably the Bank of England and Sweden's Sveriges Riksbank, which may help as other countries progress down a similar path.

We are comfortable that this area will likely bring a higher dependency on a range of market actors and give less direct control over outcomes, but that this can be managed.

This initial positioning is directional at this stage and will be subject to further work. The positioning does not preclude wider public sector direct involvement with users, although the Reserve Bank itself would not have direct involvement or interaction with users.

6 Digital cash use cases

Use cases describe how people might use digital cash, and a focus on retail cases means looking at people earning and spending digital cash as they would cash today.

Digital cash could be widely used in many use cases. Our prioritised use cases categories aim to achieve scaled adoption and widespread usage, and best alignment to our policy goals.

Third party service providers, from both the public and private sectors, will be able to develop and offer innovative products and services to New Zealanders that address use cases. The role of the Reserve Bank will be to ensure its technical platform and governance settings provide the base functionalities and enabling environment so that the private sector can develop innovative services to provide to end users. Accordingly, the Reserve Bank needs to consider what functionality meets both intermediary demand and end user needs, and what could enable a wide range of innovative use cases.

The Reserve Bank's focus is on general purpose digital cash, which is designed for New Zealanders and New Zealand businesses to store, use and spend digital New Zealand dollars. General purpose digital cash will not be specifically designed for 'wholesale' use cases (financial institution to financial institution scenarios), although wholesale usage may not be precluded.

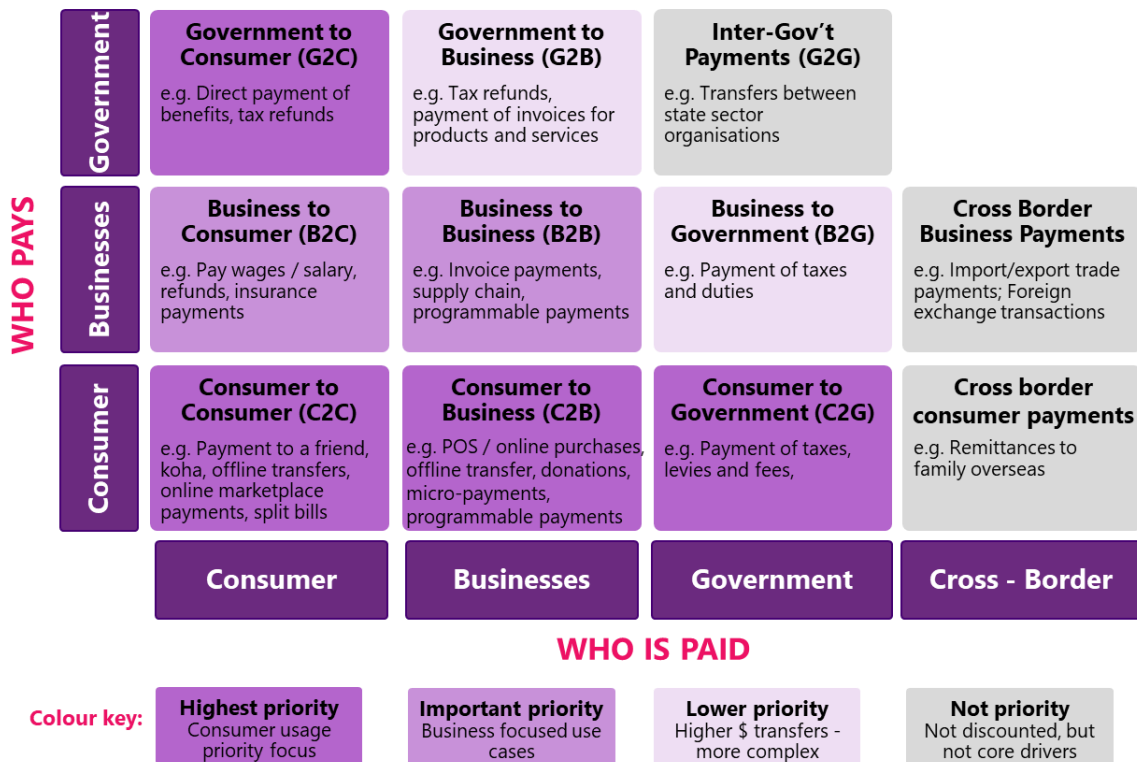
There are many payments between New Zealanders and public sector agencies. Ensuring key public sector agencies can at least accept digital cash payments, and potentially make digital cash payments, will be an important use case area. We hope to identify use cases that allow public sector agencies to generate operational efficiencies through use of digital cash.

Given the importance of small businesses to the New Zealand economy, a priority area for use cases will include businesses, including to or from other businesses or individuals.

Using digital cash to facilitate cross border payments has significant potential and is the focus of significant research and development in other jurisdictions. New Zealand could benefit from cross border digital cash in the long term, given our small and open trading economy, and comparatively high cost of remittances – particularly to our South Pacific neighbours. Using digital cash for cross border payments requires both the issuance of digital cash into our domestic economy and have multi-jurisdictional CBDC cross-border systems and arrangements to be in place. From a pragmatic perspective, we are first focusing on the exploring what the case is for digital cash within our domestic economy. CBDCs being used as cross border payments is not yet a priority focus of our work programme. Should there be a decision to issue digital cash, in time it could be expected to it 'plug in' to cross-border CBDC standards or systems once they have been established globally.

Figure 6 below summarises our relative use case category priorities that are described above. Note this diagram does not include wholesale use cases, which as mentioned above, is not a priority focus.

Figure 6: Initial use-case priorities



Source: Accenture and the Reserve Bank of New Zealand (2024).

Looking beyond broad categories, it is difficult to predict over the longer term what use cases will be successful and resonate with end users. Four sampler uses cases and user journeys were developed, with support from Accenture. These were developed to: demonstrate versatility; better understand how digital cash might deliver a range of policy outcomes; and understand what enabling functionality would be required to support the use cases.² The four use cases are summarised as follows:

Resilience through offline payments

- Use case scenarios: Person to person (P2P), and person to business (P2B).
- Description: Payment option when other online types of payment are not available.
- Outcome: Improved resilience.
- Supporting functionality: Offline payments.
- Persona: Digitally savvy. Digital payments when outage or there is no internet access. Low value payments in certain social settings.

² See Accenture et. al. (2024).

New payment options for small and medium enterprises (SMEs) and small organisations

- Use case scenarios: P2B and Business to Business (B2B)
- Description: New payment options to small organisations that support their unique needs.
- Outcomes: Efficiency. Competition. Te Ao Māori sovereignty.
- Supporting functionality: Real time payments. Proxy/Alias functions. Point of Sale (PoS) acceptance.
- Persona: Māori SME. Remote area. Challenges accessing payment and banking services.

Making digital payments more accessible

- Use case scenarios: P2P
- Description: New digital payment support options from friends, family or services.
- Outcomes: Financial inclusion. Meaningful choice. Enhanced autonomy.
- Supporting functionality: Consent/permissions. Joint control options. Cash/Digital cash interaction.
- Persona: Banked but less confident or not confident making digital payments.

Improved cashflow from supply chain

- Use case scenarios: B2B
- Description: Conditional payment linked to delivery and inspection of sold goods.
- Outcome: Supporting innovation. Efficiency and productivity gains. Cashflow benefits.
- Supporting functionality: Conditional (programmable) payments. Smart contracts.
- Persona: Small agricultural manufacturer. Cashflow constraints/risks from payment timeliness.

7 Technology approach guidelines

The Reserve Bank has not yet developed or experimented with any digital cash technology, and it has not yet made any technology-based design decisions. Our approach is to first develop our preferred ecosystem design models, and then undertake a high-level technology assessment to better understand the scale, costs, benefits, resourcing and development approach required to support that model. At this initial stage, we have developed a set of eight technology approach guidelines to inform our future technology assessment:

1. Vendor independence

The digital cash system architecture should avoid vendor lock-in and proprietary systems. Maintaining independence and control of the digital cash solution is imperative to achieve wider outcomes and objectives. Use of non-proprietary solutions or components reduces or eliminates vendor dependence and roadmap lock-in.

2. Modular solutions

The digital cash system architecture is modular and layered to enable both resilience and innovation. The separation of a digital cash system into well-defined modules, layers and other encapsulations can facilitate the resolution of competing needs. For example, stability, scalability and resilience can be adversely affected by change if not correctly encapsulated and separated.

3. Design for interoperability

Digital cash features are accessed through well-defined and well-designed Application Programming Interfaces (APIs). APIs are likely to be the primary digital cash interface used by the actors in the ecosystem and will require robust analysis and design practices to ensure quality outputs.

4. Just in time technical decisions

Technical component selections are made just-in-time, to avoid unduly influencing strategic business decisions. Selecting technical options early can lead to undesirable restrictions or unintended consequences.

5. Design for test, run and change

Design for long-term operational considerations to achieve quality, resilience and innovation goals. As a digital cash system would be a long-lived asset, it is necessary to ensure technical quality assurance, operations and change management are considered and appropriate design features included.

6. Secure and private by design

Consider security and user privacy throughout the solution development and operational lifecycle. Safety, user privacy and security are key to ensuring the policy objectives are achieved over the long term. They should be considered early and incorporated as key requirements with appropriate solution design features.

7. Platform approach

The ability to adapt and evolve over time is critical to ensure digital cash maintains relevance. Components can be developed, deployed and operated independently, but leverage common standards, rules and resources.

8. Sustainable energy use

Design the digital cash ecosystem to be energy efficient and minimise the impact on the environment.

7.1 Non-functional requirements

Non-functional requirements describe a system's operational capabilities and constraints, outlining how a system will operate, and often defining the quality attributes of a system. Identifying broad types of non-functional requirements will help us narrow down choices when we make them in the future and help us identify what we think will be important to a new system of this type in the future.

We think some of the following types of non-functional requirements will be important. This is not an exhaustive list, and these are presented without any form of prioritisation. We think they will provide helpful input into future stages of work as we develop more what a platform an ecosystem for digital cash could be like.

Table 1: Types of non-functional requirements

Ref	Requirement classification	Description	Type of non-functional requirements to be considered
NF1	Availability	Requirements for a system or service to be operational and accessible when needed, without interruption.	Whether the system will be available for use 24 hours a day, 7 days a week. What provision there may be for maintenance or downtime.
NF2	Extensibility	Capability of a system to easily integrate additional features, functionalities, or new extensions with requiring significant modifications to the core structure.	Whether innovative new services can be easily added by the private sector. How well the new system will be able to adapt to evolving features and trends.
NF3	Interoperability	Requirements to ensure different software, hardware or systems exchange and use information seamlessly and effectively.	How compatible the new system will be with existing banking and financial systems so people can earn and spend digital cash quickly and easily.
NF4	IT service management	How the system can be incorporated into a service management regime.	Whether monitoring and reporting tools are available to ensure efficient operations. How system components are supported for responding quickly to issues.
NF5	Maintainability	The ease with which a system, software, or product can be maintained, updated or repaired over time.	How easily system components can be fixed or replaced. Whether software is open source. Whether physical components are specialised and proprietary or off-the-shelf and easily replaced. How widely the technology and infrastructure are used in the market.
NF6	Portability	Whether a system feature or function can operate in different environments or on different system versions.	Whether users can quickly and easily move their digital cash holdings between service providers.
NF7	Privacy	How the system protects the privacy of data and users.	How well the system protects user privacy per the policy principles.

Ref	Requirement classification	Description	Type of non-functional requirements to be considered
			How the system meets any privacy reporting obligations.
NF8	Reliability	Measures of how a system will perform without failing for a specified period of time or usage.	How long the system and its components are up and running. How components tolerate failure over time. How the system may be distributed physically to be available during and after a disaster. How the system ensures transactions are complete, accurate, valid and timely and that settlement is final.
NF9	Scalability and performance	How fast the system responds under different usage conditions, and how will this performance change with increasing workloads.	The system is suitably fast to respond when needed, and that this is maintained as the system workload increases.
NF10	Security	How the system is protected against unauthorised access or malicious attacks.	Whether data and transactions are suitably encrypted. How system access is managed and maintained. How cyber-attacks or threats are identified and prevented.
NF11	Service level requirements	How the system can comply with any agreed service levels.	What targets the system should meet when operating. How quickly service can resume after failure.
NF12	Usability	How easily and effectively users can learn and use a system.	How the system will be made easy to use and accessible for everyone. How the system will prevent double spending of any digital cash.

8 Conclusion

Designing a digital cash ecosystem will require a wide range of interconnected design decisions. This note provides the initial framework for how these design decisions will be considered at this early stage. It reflects that the Reserve Bank's work is at a preparatory stage and detailed design choices are yet to be made.

References

Digital cash consultation publications

To support the Digital Cash consultation the following notes and reports are available [here](#).

- Reserve Bank (2024a) 'Digital cash in New Zealand' Consultation Paper.
- Reserve Bank (2024b) 'Innovation and reliability opportunities for digital cash', *Digital Cash Consultation Note*, No 2.
- Reserve Bank (2024c) 'Inclusion opportunities for digital cash', *Digital Cash Consultation Note*, No 3.
- Reserve Bank (2024d) 'Designing privacy into digital cash', *Digital Cash Consultation Note*, No 4.
- Accenture and the Reserve Bank of New Zealand (2024) 'Central Bank Digital Currency', Strategic Insights Dossier, April.
- GravitassOPG and One Picture (2023) 'User needs for money management and payments', Qualitative research report, April.
- The digital cash storyboard presented to the Reserve Bank of New Zealand Board, February 2024.

References

Accenture and the Reserve Bank of New Zealand (2024) 'Central Bank Digital Currency', Strategic Insights Dossier, April.

Bank for International Settlements Innovation Hub, Bank of Israel and Hong Kong Monetary Authority (2023) 'Project Sela: an accessible and secure retail CBDC ecosystem', September.

Annex A: Building Block Anatomy


The digital cash Building Block Anatomy describes a four-tier framework: asset, platform, market, and user. The table below describes the anatomy of all building blocks that fit within the four-tier framework. The building blocks are organised into groupings of related 'design areas'. Collectively, all the building blocks make up a digital cash ecosystem.

Table A1: Building block anatomy

Framework	Design Area	BB Ref	Building block	Description
Asset 	Asset design	BA10	Currency representation	How digital cash is technically represented, and how its state is managed.
		BA15	Programmable money	Whether the digital cash asset has the capability to build in rules and conditions that constrain its usage or expiry.
		BA20	Currency integrity	How the design of digital cash retains its integrity and prevents risks such as counterfeiting and double spend.
	Legal authority	BA25	Legal basis	Ensuring RBNZ has the unconstrained legal entitlement to issue digital cash in New Zealand.
Platform 	Core functionality	BP10	Ledger	The technical infrastructure that safely and securely records the balances of digital cash holdings, and updates those balances after transfers have been made.
		BP15	Minting and destruction	How digital cash stock is securely created and stored until it is issued as legal tender, and how it is securely destroyed.
		BP20	Issuance and redemption	The issuing and redemption of digital cash as a legal tender in circulation (being a liability of the RBNZ).
		BP25	Funding and defunding	The systems, transport layers and validation processes for a user to fund and defund their digital cash holdings to/from private money in bank accounts or cash.
		BP30	Transfers	The systems, transport layers, validation processes, record keeping and privacy-enhancing processes for transferring digital cash between users in real time, resulting in final and irrevocable settlement.
		BP35	User and data management	The policies, technologies and data management model for recording user and account information on the platform while appropriately protecting user privacy.
	Financial instrument design	BP40	Interest bearing	Whether the platform's functionality enables users to earn interest returns on some or all of their digital cash holdings.
		BP45	Balance fee adjustments	Whether the platform directly supports the potential for adjustments to be made to a user's digital cash holdings, to support fee-based or cost-recovery business models.
		BP50	Transfer fee adjustments	Whether the platform directly supports the potential for user fees to be charged on transfers.
		BP55	User holding, transfer limits, and tiering	Whether the platform supports limits, or tiers of limits, on the amount of digital cash that a user can hold and/or transfer.
		BP60	User accounts or wallet limits	Whether the platform supports limits on the number of digital cash accounts or wallets that a user can have at any time.
		BP65	Settlement for issued and redeemed digital currency	The settlement processes that facilitate the exchange of New Zealand dollars held in ESAS for the equivalent value of digital cash issued by the Reserve Bank of New Zealand (and in reverse for redemptions).
		BP70	Programmable payments	Whether the platform provides functionality that supports the digital programming of a transfer between users that is executed when pre-determined conditions are met.

Framework	Design Area	BB Ref	Building block	Description
		BP75	Offline transfers	Whether platform functionality supports offline digital payments that verify the user's availability of funds and validate an instant transfer, without requiring validation by the platform.
		BP80	Cross border connectivity and exchange	Whether the platform connects and interoperates with other country's digital currencies, either directly or indirectly, to complete cross border digital currency-to-digital currency payments.
	Intermediary management	BP85	Intermediary access	The requirements and processes for intermediaries such as: A financial institution; electronic money institution; payment service providers; government agencies; or other entities, to gain and maintain access to the platform to provide digital cash products and services.
		BP90	Intermediary transit accounts	Whether intermediaries can hold their own digital cash holding accounts to facilitate the distribution of digital cash from the platform to the users.
		BP95	Access gateway	The technical interface used by authorised intermediaries to securely connect to and interact with platform's functions.
		BP100	Custodial management policy	The model and arrangements for the safe custody of the user's private keys (if any) of their digital cash holdings, including the role of the platform and intermediaries in this.
		BP105	User liability claim management	Whether platform's functionality supports users proving their access to their digital cash holdings, to make a direct claim on the RBNZ independently from their intermediary.
		BP110	User switching intermediaries	How the platform's functionality support users changing the intermediary that connects them to their digital cash holdings.
		BP115	Market support tools	Whether the platform provides services that support current and potential intermediary's development of digital cash products and services (e.g. development sandboxes, platform integration support, or other product development tools).
		BP120	Intermediary failure management	The model and arrangements for ensuring the user's liability claim on the RBNZ remains operationally viable in the event of the user's intermediary failing in any way.
	Non-core capabilities	BP115	Data analytics	The data and information that is collated and reported by the platform to support its reliable and efficient operations, and economic modelling.
		BP120	Fraud detection and risk management	Whether the platform monitors users and usage to detect, report and prevent fraudulent activity.
		BP125	External system integration	Whether the platform technically connects with external systems such as ESAS, payment clearing systems, digital identity systems, or other services.
		BP130	Activity queries	The ability of authorised intermediaries to make real time status, activity, and balance queries of the platform on behalf of their users.
		BP135	Platform maintenance	The processes, technical architectures and development environments required to support the efficient management of the platform, including maintenance, upgrades, fixes and enhancements.
	Non-functional requirements	BP145	Performance and scalability	Ensuring the platform can easily meet the current peak and forecast future growth in issuance, transfer, and user volumes.
		BP150	Maintenance and change management	Ensuring the platform is efficiently supported, maintained and easily extensible to new services or functions.

Framework	Design Area	BB Ref	Building block	Description	
Market 	Distribution	BP155	Reliability	Ensuring the platform consistently meets service level speed and availability targets, while keeping service disruptions within acceptable limits.	
		BP160	Resilience and security	Ensuring the platform is resilient to cyber security attacks, data breaches, theft, natural disasters, and other risks.	
		BP165	Sustainable energy usage	Ensuring the platform is energy efficient and designed in a way which minimises the impact on the environment.	
	Services: payment initiation and processing	Distribution	BM10	Connectivity to platform	The intermediary's internal technological, operational, and business practices required to connect to the access gateway and interact with the platform.
			BM15	Distribution model	The model and arrangements for intermediary performing functions to distribute digital cash to users.
			BM20	Supervision and compliance	The supervisory framework that ensures an intermediary complies with any obligations in relation to providing digital cash products and services to users.
		Services: payment initiation and processing	BM25	Point of interaction acceptance	Any hardware, software and arrangements for payees, including merchants, to efficiently interact with users to initiate and accept digital cash transfers as a means of paying for goods and services. This includes merchant point of sale.
			BM30	Payee identification and addressing	Any technical protocols, systems and arrangements for payers and payees to share identifying information that supports the safe and efficient routing of transfers to the correct digital cash account or wallet (e.g. QR codes, Near Field Communication, alias/proxy identifier look up services, or unique identifiers).
			BM35	Payments overlay services	Payment services operated by a third party that are deployed on top of the platform, that deliver value-add services to a set of users or intermediaries.
			BM40	Payment instruments	A personalised device or set of procedures between the user and the payment service provider used to initiate a payment order (e.g. card, app, rules, or smart contract).
Services: account management	Services: payment initiation and processing	BM45	Clearing system interoperability	The platform's technical, semantic, and business attributes that make it compatible with other payment clearing systems and forms of money.	
		BM50	User liquidity management	Payments and digital cash transfer services that support users manage the amount of digital cash they hold, including sweeping services between digital cash holdings and private money in bank accounts.	
		BM55	Custodial management	A potential intermediary custodial service that securely stores the user's private keys (if any) for their digital cash holdings.	
Services: account management	Services: account management	BM60	Consented data sharing services	Whether an open finance model is supported where the user consents to third parties accessing information about their digital cash holding balance, transfer history or other information held by their intermediary or the platform.	
		BM65	Digital identity overlay services	Whether digital identity trust frameworks and other identity management services are utilised by intermediaries to support customer due diligence, privacy, user safety, user authentication and innovation.	
		BM70	Account overlay services	Information management services operated by a third party that are deployed on top of the platform, that deliver value-add services to a set of users or intermediaries.	
Customer relationship	Customer relationship	BM75	User relationship management	The intermediary's customer relationship management and support services, in relation to customers' use of their digital cash products and services. This includes on-boarding and off-boarding the customer.	
		BM80	Compliance obligations	The minimum compliance obligations on the intermediary providing digital cash products and services to the user, including compliance with existing laws such as AML/CFT legislation.	

Framework	Design Area	BB Ref	Building block	Description
		BM85	Dispute management obligations	Any requirements of intermediaries that ensure their customers have access to appropriate dispute resolution services.
User 	Uptake and usage	BU10	User needs	The design features that support and promote the widespread uptake and regular use of digital cash by users.
		BU15	User experience	Ensuring users have an accessible and efficient hands-on experience when holding, using, and transferring digital cash.
		BU20	Uptake and adoption	Strategies and activities that support the uptake and adoption of digital cash by users.
		BU25	User protections	Any digital cash safeguards, protections, and remediation available to users in the case of fraud or loss.
		BU30	Communications	Coordinated communication activities designed to help inform users and nurture trust in digital cash, including supporting New Zealander's financial and digital inclusion.

Annex B: Preferred digital cash models

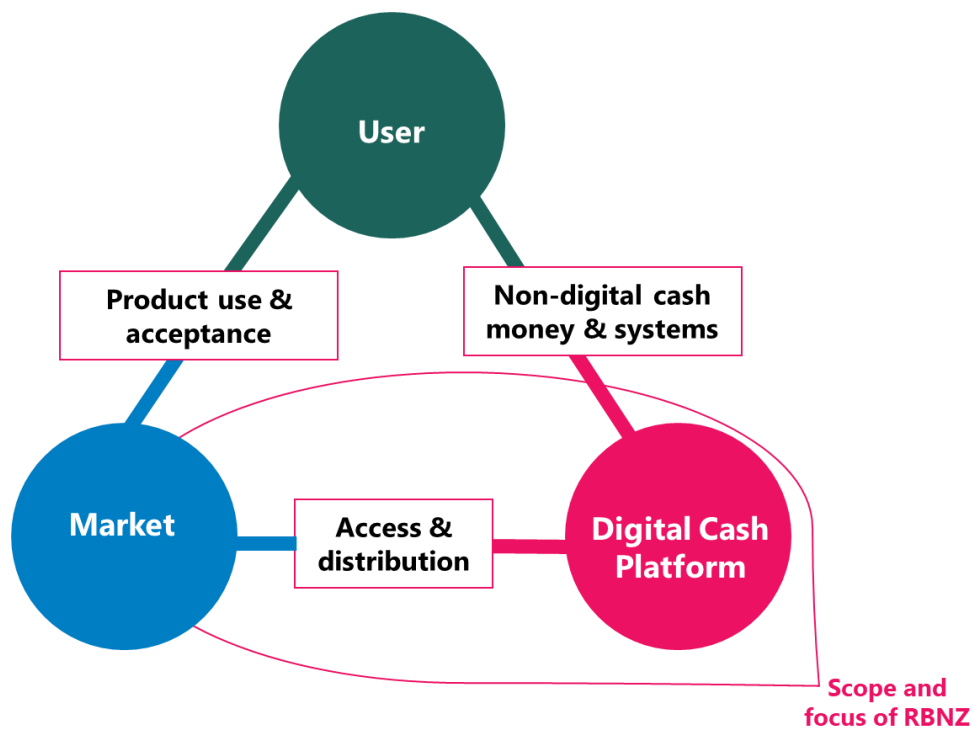
Our current preferred positioning is the area around two models – ‘Support the market’ and ‘Digital economy’. These models are described further below.

Support the Market

The ‘Support the Market’ model relies on the Reserve Bank and the market to collaborate to provide digital cash tools and functions. In ‘Support the Market’, the Reserve Bank would focus on establishing a digital cash platform with high levels of functionality that are aligned with market needs. Specially, the Reserve Bank would enable wide access to a feature-rich enabling platform that provides functions designed to support and accelerate innovative products and services.

This is depicted in Figure B1 where the Reserve Bank’s scope and focus would be on the platform and partially on the market as shown by the area in the pink circle. The end user products and services would not be in focus for the Reserve Bank. The digital cash issuance and redemption function is not depicted in this diagram as the Reserve Bank would own and control that aspect of the digital cash ecosystem in every model.

Figure B1: Reserve Bank’s scope and focus areas for the Support the Market model.



This model is broadly characterised as follows:

- Digital cash collaboratively designed by both the public and private sector for use in a digital age.
- Beyond the platforms base functions, the Reserve Bank would provide innovation-enabling tools and functionality needed by intermediaries to develop innovative products and services to offer to users.

- The digital cash ecosystem would be open, flexible and as hands off as possible, with the Reserve Bank taking a collaborative supportive stance that is responsive to market demand and user needs.
- Digital cash usage would not be limited to retail usage. Supports business usage, and potentially wholesale.

Key features of ‘Support the Market’

- Beyond base functionality, the digital cash platform would provide a range of enabling ingredients, functions and optional modules that are aligned with market needs. Examples of enabling ingredients might include:
 - base functions for programmable payments
 - fraud detection tools
 - an alias identifier module
 - intermittent offline payments (extended offline in due course); and
 - user switching tools.
- It would aim to be supported by an open access regime, with access criteria set to make the platform widely accessible.
- It would adopt a collaborative approach adding and adjusting functionalities over time in response to market and user needs.
- It would aim for as few restrictions on market activities and digital dollar usage as possible, with few limits.
- It could provide market accelerator tools, such as product testing sandboxes or white labelling services.
- Digital cash could be represented by Unspent Transaction Output tokens (UTXO) to help support market innovation. Think of UTXOs as individual physical bills in your wallet, each with a different value, much like using various bills to make a cash payment.
- Industry and intermediaries would manage and develop their own payment instruments and any overlay services that sat on top of the base digital cash platform.

Potential motivations for ‘Support the Market’

This model is motivated by wanting to support market innovation and develop a competitive money and payments landscape in New Zealand’s digital economy. It prioritises providing innovation-enabling base functionality that the market then uses to develop innovative products and services. While motivated by supporting market innovation, the Reserve Bank has a clear demarcation line that it would not develop any market-facing innovations itself. It is also motivated by wanting to quickly create network effects and a dynamic market. While innovation is a priority, it would not be to the substantive detriment of the remaining digital cash principles and leaves open the option to set guardrail rules if needed. This model is consistent with fewer constraints and limits on how digital cash is used in the market.

Table B1: Our initial assessment of 'Support the Market'

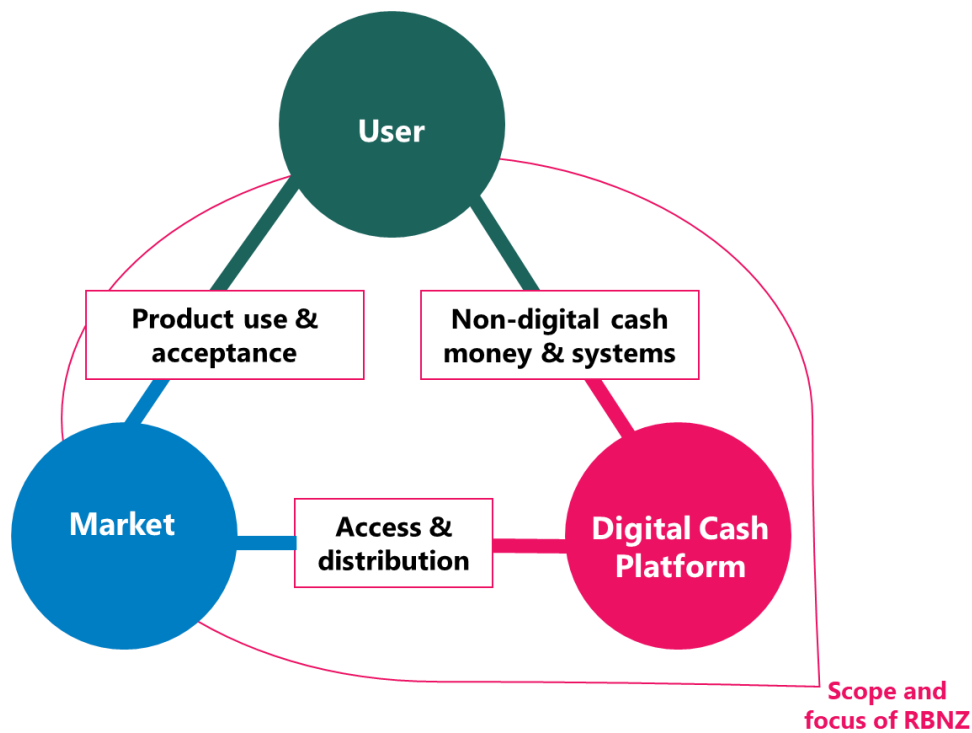
Assessment against digital cash principles	Strategic and policy implications
<ul style="list-style-type: none"> • A good all-round model that scores well against the digital cash principles. • Adds a layer of support and control compared to the 'Market-Led' model, so has potential to deliver better outcomes where the market may not. • Could deliver more user privacy than market alternatives and a more reliable service through improved support for compliance. • Would likely improve orderliness of the overall system by balancing out any market extremes with Reserve Bank requirements. 	<ul style="list-style-type: none"> • This would be a more controlled option than a 'Market Led' model and has a greater chance of delivering the Reserve Bank's intended digital cash outcomes. • The most likely model to create network effects and have a faster uptake and usage adoption curve. • Would require a collaborative public-private mindset and supporting structures and capabilities on both sides. This has the risk of slowing development and initial launch, particularly if either side was slow to make decisions or execute. • Supplier capability to deliver is likely to be high, as this is a very flexible model, and could attract many new suppliers if CBDC was widely adopted.

Digital Economy

The 'Digital Economy' model relies on the digital cash ecosystem to be proactively integrated in the wider digital economy. In the 'Digital Economy' model the Reserve Bank would focus on establishing a highly functioning and inter-connected digital cash platform, with elements covering the market and products and services delivered to end users. Specifically, the Reserve Bank would provide an open architecture feature rich platform that supports all use categories. This would be highly integrated with other digital economy systems and stakeholders.

The model is depicted in Figure B2 where the pink circle depicts that the Reserve Bank's design scope and focus would be on the platform and partially on the market and end user experience. The digital cash issuance and redemption function is not depicted in this diagram as the Reserve Bank would own and control that aspect of the digital cash ecosystem in every model.

Figure B2: Reserve Bank's scope and focus areas for the Digital Economy model



This model is broadly characterised as follows:

- Digital cash supported by a visionary and ambitious platform that is highly interconnected with other cornerstones of NZ's digital economy.
- Consciously designed to maximise synergies with other existing and emerging digital systems.
- Highly interconnected, integrated, and interoperable.
- Tending towards a market led model with some controls over usage and inter-system relationships.

Key features of 'Digital Economy'

- Supports most use case categories such as person, business, government, cross border, maybe wholesale.
- Has a more open architecture and access options supporting a range of 'plug and play' options.
- Likely to provide enabling ingredients, functions and optional modules that build relationships with other systems and align with market needs similar to the 'supporting the market' model.
- Develops and recognises interoperability standards to underpin linkages between different digital systems and payment systems.
- Deep consideration of overlay services built on top of the platform and how overlay services might span multiple systems (e.g. sharing fraud detection and/or alias services with real time payments).

- More likely to prefer broad digital cash use across the whole economy.
- Requires a proactive and open co-design and collaborative approach.
- Highly integrated interactions between a user's money in bank accounts and their digital cash.
- More likely to be feature rich, with full offline payments, programmable payments and so on.

Potential motivations for 'Digital Economy'

Motivated by a developing an expansive and visionary digital cash that plays a vital role supporting New Zealand's long-term digital economy. This model takes an ambitious stance, positioning digital cash as a key pillar of New Zealand's future digital and economic strategy. It supports digital cash being very widely used in the long term and puts a high value on ensuring sovereign control over New Zealand's digital economy. The model also prioritises supporting innovative and competitive outcomes where market actors can easily weave digital cash into their broader digital products and services. It may require some comfort with a higher level of complexity and accepts a degree of dependency on other systems and actors, as well as a larger scope and investment profile. It would take continuous effort, commitment, and adaption to achieve the model.

Table B2: Our initial assessment of 'Digital Economy'

Assessment against digital cash principles	Strategic and policy implications
<ul style="list-style-type: none"> • A good, more controlled model that scores well against the digital cash principles. • Could improve privacy and orderly outcomes compared to other models. • Features a high innovation rating, but also has some innovation constraint risk due to the complexity and constraints because of integration with other systems. • Reliability could be lower as this is likely one of the most complex models to deliver and operate, with more dependencies. • Rated as a highly orderly model, one that could minimise disruption the most compared to the other retail models. 	<ul style="list-style-type: none"> • Would require Reserve Bank to be active in the digital economy policy and strategy area. • Features high levels of dependency on external systems and market actors. • Should be underpinned by a commitment to develop a target state with existing market actors for the New Zealand digital economy and would require new capabilities and funding to deliver that. • Digital cash aspects should be closely integrated to current industry plans to develop payments systems and other public sector digital economy activities. • Complexity of this model would likely make it slower than others to deliver, and likely more costly. • Who bears integration costs, and the associated ongoing operating costs would be a likely source of contention for the market.