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Why the World Needs an Open Source Digital Wallet Right Now

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With a foreword by Daniel Goldscheider, Founder, OpenWallet Foundation



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WHAT ARE DIGITAL WALLETS?

Digital wallets store **digital assets, credentials, and useful items, such as tickets and keys.**



DIGITAL WALLET ACCESS

Nearly all digital wallets are restricted **by vendor lock-in from the banks, merchants, companies, or nations that issue them.**



SECURITY AND DIGITAL WALLETS

Security is a constant concern since **hackers are constantly trying new ways to hack into digital wallets.**



CODE SECURITY



The design, development, and updates for most wallets are all done **in a black box controlled by a single organization so that no one else can see their code.**

WALLET FLEXIBILITY

Most digital wallets can only do a few things, **so consumers must juggle multiple wallets.**



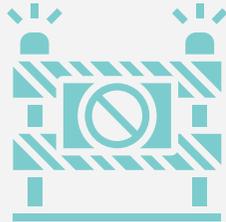
THE WORLD OF WALLETS



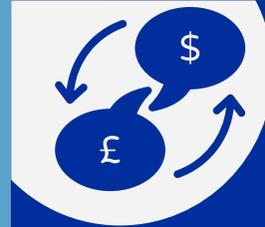
Around the world, countries are **rapidly implementing wallets to manage their digital identity programs.**

WALLET COMPATIBILITY

Current wallets lack any **interoperability across functions, devices, credential issuers, merchants, and nations.**



MARKET ACCEPTANCE



The success of digital wallets depends on **standardizing the engine that runs them so they can all interoperate and share information.**

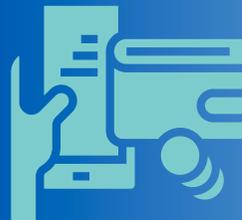
THE WAY FORWARD & THE FUTURE

The mission of the Open Wallet Foundation (OWF) is to **create an open source software stack and best practices that any developer can use to create a wallet.**



THE DIFFERENCE: OWF

OWF wallets will be **portable, highly secure, privacy-preserving, standards-based, interoperable, and multi-functional.**



OWF BENEFITS: CULTURE

On top of these shared standards, **any developer can provide unique functions, interfaces, and customer experiences.**



OWF BENEFITS: DEVELOPMENT

The OWF continues to build out its stack **with feedback from the worldwide community of those interested in the challenges of digital wallets.**



Foreword

As our world becomes increasingly digitized, the same holds true for everyday assets. From money to credentials for identity, academic achievements or your driver's license, information is manifesting itself as digital tokens requiring secure and interoperable infrastructure as never before. Part of that infrastructure is specific to custody; consequently, the development of secure wallet architecture is as vital as the development of the digital assets themselves.

Digital wallets will permeate all facets of society, at the government, enterprise, and peer to peer level. Institutions of all kinds will face the need to issue, secure, trade, and store emerging classes of digital assets, including Central Bank Digital Currency (CBDC), securities, health and academic credentials to other types of cryptoassets, with an aim to creating trusted digital marketplaces and increasingly trusted institutions. The digital wallet could become the most important tool ever for asserting control and engendering trust in our digital lives.

To date, the development of commercial digital wallets has often been centralized, with a handful of technology conglomerates dominating the digital payments landscape. With the rise of open source as a framework for mass collaboration at scale, opportunities abound for collaboration in digital asset infrastructure like never before.

These opportunities were central to the formation of the OpenWallet Foundation, which aims to be the organization of choice for mass collaboration on open source digital wallet technologies and best practices in governance. With the Foundation's launch, enterprises, nonprofits and the public sector the world over can collaborate on the development of new and

innovative foundational digital wallet solutions, and importantly, the decision-making frameworks that solve common challenges and create shared value.

This report delves into the world of digital assets and the opportunities created through digital wallet technologies and best practices, answering the question, "why open source?" The benefits have been leveraged across industries, in terms of faster time to market, lower total cost of ownership, and having access to innovation beyond the boundaries of the firm. They apply equally in the context of digital wallet. We are convinced that open source can also play a vital role to democratize the wallet ecosystem.

This report is a must-read for leaders who want to learn more about open source best practices as they pertain to digital wallet architecture, security and interoperability considerations, and the outcomes that can emerge from multi stakeholder collaboration and innovation. Like the OpenWallet Foundation itself, this report is a valuable resource which we hope will inspire new and widespread understanding of the opportunities before us.

Daniel Goldscheider
Founder, OpenWallet Foundation

Overview

Our physical wallets are quickly becoming digitized, especially the three vital functions of making payments, proving our identity, and accessing handy items, such as tickets and keys.

Hundreds of digital wallets already exist. But these are textbook examples of vendor lock-in: when we can't move our data, we can't choose between competing products. Without interoperability, we need a separate wallet for each different function.

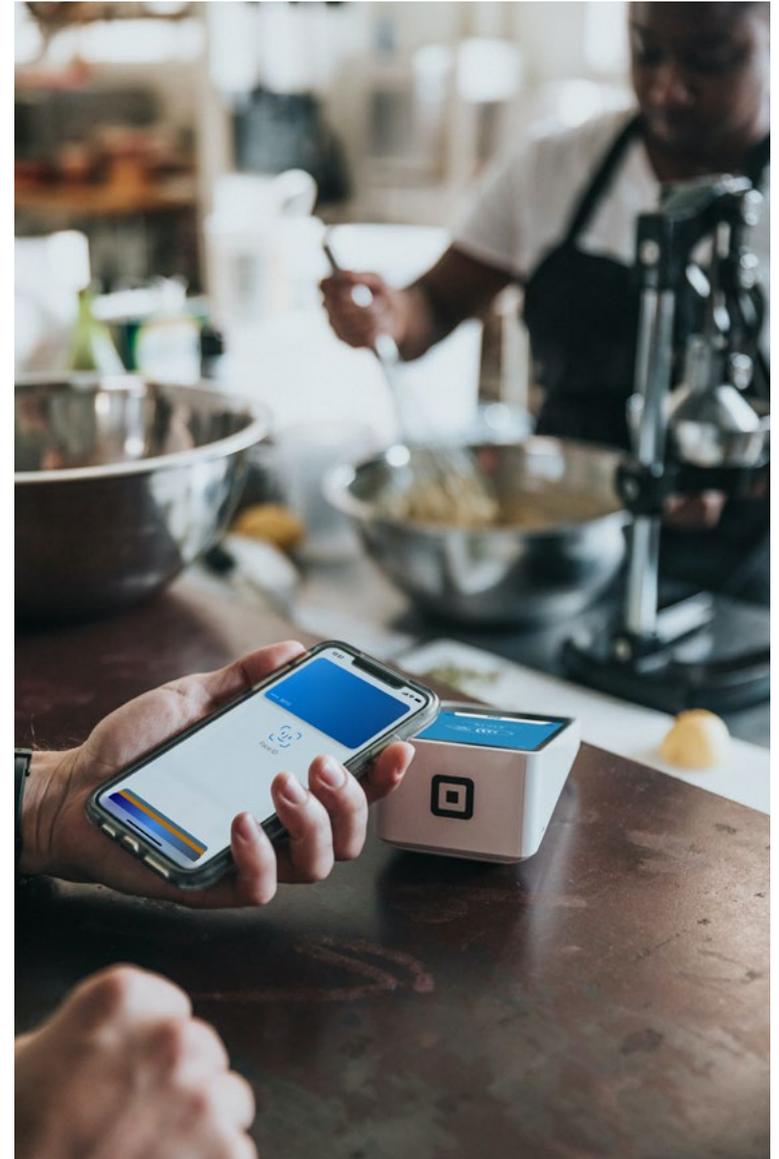
Many of today's digital wallets also suffer from problems such as questionable security, intrusive business models, black-box design, and limited capabilities.

We need a wallet engine to help developers create portable and secure digital wallets that anyone can use on any device, with any operating system, for any app or service, with any currency, in any language, anytime, anywhere.

The Open Wallet Foundation (OWF) was formed to make this dream a reality by creating an open source software engine and best practices to support it. Then, any developer can use that engine to build a digital wallet that will share data and interoperate with every other wallet built around the same codebase.

As a project of the Linux Foundation, the OWF brings together hundreds of people from all over the world: from digital identity activists, standards organizations, and governments to billion-dollar companies in banking, credit cards, and software.

To be part of this historic movement, go to <https://openwallet.foundation> and sign up.



In essence, a *digital wallet* is “a thing where we put our stuff.”¹

Beyond that, definitions branch off in all directions.

Digital wallets can offer three vital functions. As shown in **FIGURE 1**, these are making payments, proving your identity, and accessing items such as tickets, keys, or documents.²

FIGURE 1: THE THREE FUNCTIONS OF DIGITAL WALLETS

PAYMENTS

- Debit card
- Credit card
- Gift card
- Alipay, Apple Pay, Google Pay, etc.
- Cryptocurrencies
- NFTs
- Other

IDENTITY

- Loyalty card
- Work badge
- Birth certificate
- Driver's license
- Health card
- Passport
- Self-sovereign ID
- Other

ACCESS

- Tickets
- Receipts
- Keys
- Passwords
- Warranties
- Health records
- Documents
- Other



A digital wallet is a container where you can store and access digital assets, credentials, and other useful items, such as tickets and keys. Another software component, most often called an *agent*, can put items into a wallet, take items out of a wallet, or process items in a wallet. While the wallet is the container, the agent is the mover and shaker.

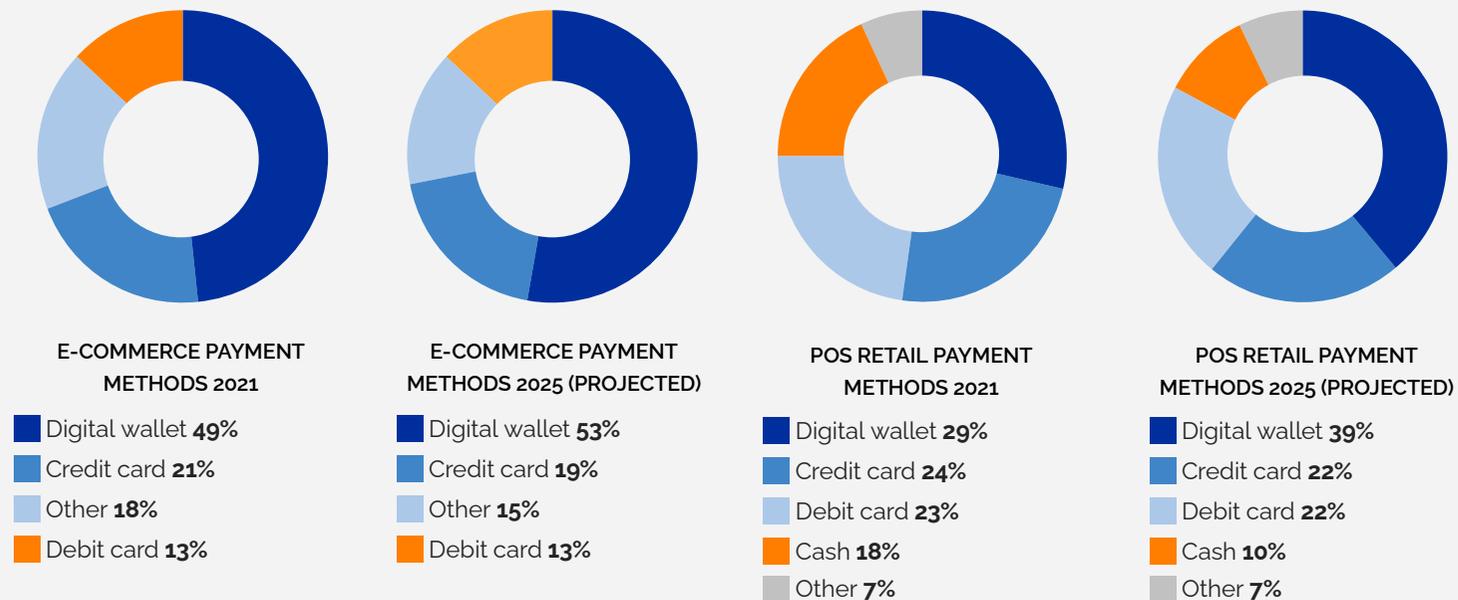
How popular are digital wallets?

Well, for one of the big three functions—payments—digital wallets rule. As shown in **FIGURE 2**, digital wallets are now the world's leading payment method for both e-commerce and point-of-sale retail.

In 2021, the value of all digital wallet transactions came to an astounding U.S. \$15.9 trillion.³ By 2025, digital wallets will likely be even more popular.⁴

The fact is that digital wallets are not coming some day in the future. They're here now, used by billions of people.

FIGURE 2: GLOBAL TRANSACTIONS MADE WITH DIGITAL WALLETS



Source: The Global Payments Report 2022, Worldpay from FIS

Drawbacks of today's digital wallets

Hundreds of digital wallets already exist, from Accelitec WalletBuilder to Zomato.⁵ A recent report by Darrell O'Donnell analyzed 250 digital wallets.⁶ Each one of those wallets took thought and effort to create.

But today's digital wallets suffer from a host of problems:

- Vendor lock-in with no interoperability
- Questionable security
- Intrusive business models
- Black-box design
- Limited capabilities

Let's consider each drawback in brief.

Vendor lock-in with no interoperability

Nearly all digital wallets are tethered to a single bank, payment system, merchant, company, region, nation, or cryptocurrency exchange, and it's exceedingly difficult or impossible to move our assets, credentials, or data to a different wallet.

This is a textbook example of vendor lock-in. When we can't move our data, we can't choose between competing products. And without any interoperability, we need a separate wallet for every function.

Questionable security

Wallet developers work hard to keep ahead of cybercriminals, but they sometimes lose the race. Here are two sobering statistics:

- Cryptocurrency crime was U.S. \$14 billion in 2021,⁷ with all these crimes involving digital wallets
- E-commerce fraud will likely total U.S. \$41 billion in 2022 and rise to U.S. \$48 billion in 2023,⁸ with much of this committed via digital wallets⁹

Hackers use a vast arsenal to attack digital wallets, including code exploits, flash loans, keyloggers, pagejacking, phishing, ransomware, rug pulls, and even the venerable Ponzi scheme. When they win, everyone else loses—wallet holders, merchants, banks, and insurers.

Intrusive business models

A wallet can easily collect a stream of valuable data on our consumer behavior. That data can then be sold and re-sold to third parties, such as ad agencies, health insurers, even the dark web. So much for our privacy.

On the back end, wallets can extract fees from transactions, even if those fees are hidden. In the end, consumers cover those fees by paying higher prices for everything we buy. So, as it turns out, we could be paying extra to have our personal information pilfered. How many consumers would knowingly agree to that?

Black-box design

Hundreds of wallets have been coded by someone, somewhere, but we don't know exactly who or where. A black box is not at all transparent. But if you can't see how a product works, you can't tell how good it is or whether you can trust it.

The only people who can fix bugs or add features work for that one organization. Sounds a little lonely, doesn't it?

Limited capabilities

The final drawback: You really can't do much with most digital wallets.

Remember the three functions of payments, identity, and access? Nearly all digital wallets perform just one function. So, you need this wallet to pay with fiat, but that wallet to pay with bitcoin. You need this wallet for your identity, and that wallet—or app, really—to access your keys.

No one wants to juggle 15 or 20 digital wallets that can't talk to one another. But that's where we're headed.

Not ready for prime time

With vendor lock-in, no interoperability, questionable security, intrusive business models, black-box design, and few capabilities, today's digital wallets just aren't ready for prime time.

Yet the world is plowing ahead. More wallets are constantly appearing, but none are designed to overcome these drawbacks.

Wallet projects around the world

Many intriguing wallet projects are underway. The potential time and money savings that digital IDs can offer are what drive most national projects. Plus, the fact that digital IDs are cryptographically generated makes them harder to counterfeit.

Here's a quick rundown on what some countries are doing.

The European Digital Identity Wallet expects to pilot a prototype in 2023. Initially designed for digital ID, this wallet will be available to 450 million citizens across all 27 E.U. member countries.¹⁰ More features, such as payments, are currently in development.¹¹

Canada¹² and the U.K.¹³ are developing national trust frameworks that spell out standards, rules, and best practices for a digital infrastructure in their jurisdictions. This is a necessary first step before creating a national digital wallet.

Denmark, Finland, Iceland, Norway, and Sweden have studied electronic ID and e-signature interoperability across their borders.¹⁴

While some projects do not involve a digital wallet from the outset, they could well adopt a wallet that was designed for their needs.

India's Aadhaar digital ID covers 1.34 billion people, making it the world's largest biometric ID system.^{15,16} So far, the program uses a plastic card with security features.¹⁷ The ID number enables many transactions, and a digital wallet could implement this feature.

The Philippines and Morocco have rolled out digital ID on the modular open source identity platform. Nine more countries are in the pipeline, with a goal to issue 500 million digital IDs by the end of 2023. Some of those millions of people would likely appreciate a digital wallet to hold their credentials.¹⁸

The World Bank is making an effort to reach out to the world's 1.1 billion people who have no ID at all.¹⁹ A properly designed digital wallet, perhaps based simply on QR codes, could help with that effort.

But who's coordinating all these projects?

Somehow, all these projects must stay in sync. Otherwise, every country or organization that issues credentials could become a walled garden where IDs and wallets from elsewhere don't work. Imagine how that would disrupt travel and tourism, international students, and mobile workforces.

Coordinating all these projects is a huge challenge that no one is doing. But it points to a likely solution: an open source wallet engine that promotes interoperability around the world.

"Right now, we all have a common problem: consistent, compliant, and secure access to products and services," says Juliana Cafik, a principal standards architect with the identity standards team at Microsoft.

"An open wallet can provide a common core that enables interoperable, compliant, and secure exchanges that align with trust frameworks for policy and governance. This is a practical opportunity to come together in an open source community to create the foundational components for wallets."²⁰

No one expects a future where one digital wallet reigns supreme as a "super app" that does all things for all people. Instead, we will likely have several wallets, each doing a few things better or faster or cheaper, or simply in a way that appeals to us.

"We see a future where we'll still have multiple wallets," says Drummond Reed, director of trust services at Gen Digital and a digital ID pioneer and author. "That's why we need a world-class wallet engine to ensure that interoperability is built in."²¹

We've been here before

Twenty-five years ago, early-stage web browsers were incompatible and non-standardized. This threatened to derail the web. That threat brought everyone to the table to adopt a core set of standards that ensured interoperability and helped the web to flourish.

Today, everyone routinely uses a browser to access the web—but we're free to switch between browsers anytime we like. Open source browser engines, such as Blink, Gecko, and WebKit, give developers a quick start on their own projects.

The parallel is striking.

Digital wallets are becoming the interface to our entire digital lives. But today's early-stage wallets are incompatible and non-standardized. It's time for everyone to come to the table to create a core engine that adopts a set of standards with built-in interoperability to help our digital world flourish.

Yesterday, we made the right choice. Many organizations worked together to unleash a monumental wave of innovation on the web.

Today, we must do that again. Many organizations must work together to unleash a new wave of innovation in digital wallets.

Tomorrow, we can look back in pride at what we achieved, knowing that the creation of open wallets was a major milestone in the history of technology that benefited everyone.

What the world needs now

Our economic and social progress is being held back by the limitations of today's digital wallets, especially the lack of interoperability. Meanwhile, many countries and groups are rushing ahead to create their own bespoke digital wallets.

That's why we need an open, secure digital wallet engine that anyone can use on any device, with any operating system, for any app or service, with any currency, in any language, anytime, anywhere. And we need it now.

People from all over the world who share the same vision of a truly portable, secure, privacy-preserving, standards-based, multi-function digital wallet must design this wallet engine.

Hundreds of people who share this vision have come together to start the OWF, a project of the Linux Foundation. The OWF's mission is to create an open source wallet engine—a set of foundational software components that any developer can use to create a wallet without the cost and risk of reinventing the wheel.

The OWF will also research, develop, and promote best practices for building digital wallets. There's a precedent in the standards developed by the W3C that helped the web to grow and flourish.

But we need your help to turn this dream into reality.

"If you're interested in payments, in digital ID, and you hope for a future where a lot of wallets blossom, we want to hear from you," says Daniel Goldscheider, convenor of the OWF Roundtable in Dublin that attracted interest from more than 350 entities.²²

You can be part of this historic movement: go to <https://openwallet.foundation/> and sign up.



Appendix A: Design principles of the OWF software engine

It's too early to define any specifics about the OWF wallet stack. For example, the OWF software engine likely won't include any branding, interfaces, or smart contracts. Those will remain up to each developer to create.

But what about agents? Functional modules? Plug-ins?

Over time, the OWF will wrestle with these issues and clearly define what the foundation provides and what wallet developers must build.

The OWF founders do agree on something important: the design philosophy that will guide all our discussions. This table shows the key design principles the project will follow, along with the benefits of each one.

PRINCIPLE	DESCRIPTION	BENEFIT
Portable	Users can freely move assets, credentials, documents, and any other data between any wallets based on the OWF engine	No user assets or identities are controlled or locked in by any vendor
Highly secure	User assets, credentials, and all other data are protected against malware and hackers, and updated quickly as criminals come up with new tactics	Users trust the OWF engine
Privacy-preserving	User's digital identities are only selectively disclosed as needed	Users remain in control of their personal data and digital identities
Standards-based	OWF supports all relevant standards for all layers of the wallet stack	Wallet developers do not need to rewrite software over and over as standards evolve
Interoperable	Any wallets based on the OWF engine can quickly and securely exchange data	Users don't need a different wallet for each credential, function, or merchant
Multi-function	Developers create proprietary plug-ins and interfaces on top of the OWF engine	Developers add unique branding, functions, and interfaces to differentiate their wallets

About the author

Gordon Graham—also known as That White Paper Guy—is an award-winning writer who has worked on 300+ white papers for clients from Switzerland to Silicon Valley. Gordon has written on everything from choosing enterprise software to designing virtual worlds for kids, for everyone from tiny startups to major enterprises like 3M, Google, and Verizon. Since 2018, he has helped produce more than 15 white papers and case studies for the Hyperledger Foundation. And he worked with the Blockchain Research Institute on numerous research projects, including a special report on the future of digital wallets.

Sources

1. Definition attributed to John Jordan, Executive Director, BC Digital Trust Service, Province of British Columbia and Executive Director, Trust Over IP Foundation.
2. Don Tapscott, "Toward a Universal Digital Wallet," Blockchain Research Institute, November 2020, pp 5-13. <https://blockchainresearchinstitute.org/project/toward-a-universal-digital-wallet/>
3. "The Global Payments Report 2022," Worldpay from FIS, 2022, p 154. <https://worldpay.globalpaymentsreport.com/en>
4. "The Global Payments Report 2022," Worldpay from FIS, 2022, pp 7, 11. <https://worldpay.globalpaymentsreport.com/en>
5. John Rampton, "Top 101 Digital Wallet Companies," Due.com blog, updated 17 January 2022. <https://due.com/blog/top-101-digital-wallet-companies>
6. Darrell O'Donnell, "The Current and Future State of Digital Wallets," Continuum Loop, 28 April 2019. www.continuumloop.com/wp-content/uploads/2022/02/The-Current-and-Future-State-of-Digital-Wallets-v1.0-FINAL.pdf
7. "The Chainalysis 2022 Crypto Crime Report," Chainalysis, February 2022, p 3. <https://go.chainalysis.com/2022-crypto-crime-report.html>
8. "E-commerce Losses to Online Payment Fraud to Exceed \$48 Billion Globally in 2023, as Fraud Incursions Evolve." Juniper Research, press release, 12 October 2022.
9. "E-commerce Losses Owing to Digital Fraud Set to Exceed \$489 BN World Wide," News 24 Broadcast India, 12 October 2022. <https://news24online.com/business/e-commerce-losses-owning-to-digital-fraud-set-to-exceed-48-bn-world-wide/44413/>
10. "European Digital Identity Wallet Call for Tenders," European Commission, 12 June 2022. <https://digital-strategy.ec.europa.eu/en/funding/european-digital-identity-wallet>
11. "Multi-country Consortium Comes Together to Launch Pan-European Payments Pilot for EU Digital ID Wallet." Fintech Finance News, 14 September 2022. <https://ffnews.com/newsarticle/multi-country-consortium-comes-together-to-launch-pan-european-payments-pilot-for-eu-digital-id-wallet/>
12. <https://diacc.ca/pctf-digital-wallet/>
13. "UK digital identity and attributes trust framework-beta version," policy paper, Department for Digital, Culture, Media & Sport, 13 June 2022. <https://gov.uk/government/publications/uk-digital-identity-attributes-trust-framework-updated-version/uk-digital-identity-and-attributes-trust-framework-alpha-version-2>
14. <https://norden.org/en/publication/nordic-digital-identification-eid>
15. "Unique Identification Authority of India: A Unique Identity for the People," UIAI brochure, 3 July 2022. https://uidai.gov.in/images/Aadhaar_Brochure_July_22.pdf
16. "'Aadhaar' most sophisticated ID programme in the world: World Bank," daijiworld.com, 16 March 2017. <https://daijiworld.com/news/newsDisplay.aspx?newsID=442948>
17. Aditya Tarar, "Aadhaar News Update: UID has reached 90 percent of the country's population, Aadhaar has become necessary in many services," Hindustan News Hub, 4 September 2022. <https://hindustannewshub.com/tech-news/aadhaar-news-update-uid-has-reached-90-percent-of-the-countrys-population-aadhaar-has-become-necessary-in-many-services/>
18. Comment from Sanjay Jain at Open Wallet Foundation roundtable, Dublin, 14 September 2022.
19. Vyjayanti T. Desai, Matthias Witt, Kamya Chandra, and Jonathan Marskell, "Counting the uncounted: 1.1 billion people without IDs," World Bank blog, 6 June 2017. <https://blogs.worldbank.org/digital-development/counting-uncounted-11-billion-people-without-ids>
20. Telephone interview with Gordon Graham, 14 October 2022.
21. Telephone interview with Gordon Graham, 14 October 2022.
22. Telephone interview with Gordon Graham, 30 September 2022.



Founded in 2021, [Linux Foundation Research](#) explores the growing scale of open source collaboration, providing insight into emerging technology trends, best practices, and the global impact of open source projects. Through leveraging project databases and networks, and a commitment to best practices in quantitative and qualitative methodologies, Linux Foundation Research is creating the go-to repository for open source insights for the benefit of organizations the world over.



The mission of the OWF is to develop an open source engine to enable secure and interoperable multi-purpose wallets anyone can use to build solutions. The OWF aims to set best practices for digital wallet technology through collaboration on open source code for use as a starting point for anyone who strives to build interoperable, secure and privacy-protecting wallets. To be part of this historic movement, go to [openwallet.foundation](#) and sign up.

 twitter.com/OpenWalletFdn



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