
CASE STUDY

Bhutan's National Digital Identity System

The world's first blockchain-based national identity infrastructure

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1. Executive Summary

What Bhutan built, how the system works, and what other governments can take from the experience

In the early 2020s, Bhutan designed, built, and deployed the world's first national digital identity (NDI) system anchored to a public blockchain, with the goal of delivering services to citizens efficiently and securely. Unlike in most countries with digital identity, citizens hold their personal information on their own smartphones rather than in a central government database. Interactions with individuals' data are moderated by a decentralized system that protects citizen privacy and ensures ongoing resilience from outages and security from breaches.

“In the modern world, we often feel forced to choose between only two options: disconnect to protect ourselves or connect by surrendering. But decentralized technologies give us another way to connect.”

Aya Miyaguchi
President, Ethereum Foundation

Decentralized implementation costs considerably less than maintaining physical identity cards, protects against the risks of breaches and bad actors, and forms a consistent base layer that further services including land registry, voting, and educational records can build upon. Citizens benefit from faster, cheaper, and broader access to services, while maintaining ownership of their own data.

Underpinning Bhutan's system is a set of reciprocal trusted relationships.

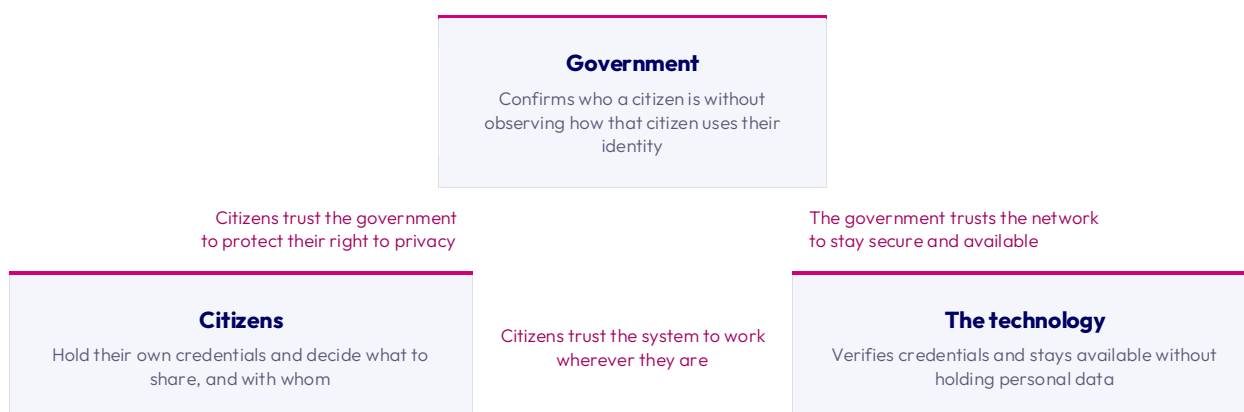


Figure 1. The trust relationships that a decentralized identity system is built upon.

This case follows Bhutan's national digital identity system from its strategic origins through its technical architecture and the value it delivers to citizens today. It examines the conditions that made the system possible, the Ethereum Foundation's role as a technical partner, and what the experience can offer other governments and development organizations considering similar options. The technology exists and mature platforms are available – what determines whether a country takes this path is intent.

2. Context: Bhutan's Digital Identity Journey

From a 2004 policy document to the world's first decentralized identity system in 2023

2004

The vision for digital service delivery

Bhutan went online within a single generation. The country welcomed television and the internet in 1999 and mobile phones in 2003. By 2024, nearly nine in ten people in Bhutan were using the internet. Bhutan's politics changed just as quickly. In 2008 the Fifth King handed governing authority to an elected parliament, making Bhutan a democratic constitutional monarchy. The new constitution also codifies Gross National Happiness, a philosophy the Fourth King introduced in the 1970s on the belief that a nation's happiness matters more than its gross domestic product.

Bhutan's journey toward digital identity can be traced back to as early as 2004, when an initial information and communication technology (ICT) policy document was published, with the goal of using technology to deliver public services more easily. Bhutan has a sparse population of roughly 21 people per square kilometer distributed across mountainous terrain, and the costs of physical accessibility can be high, in both money and time. Citizens seeking access to government, financial, and business services traveled to centralized locations over complex road systems, and moving access to services online would offer a way to reduce that burden.

Bhutan's early approach to service delivery and validation combined physical attestation with paper-based systems, which functioned adequately in person but also meant fragmentation. The country needed a mechanism that would establish identity reliably at a distance, and delivering services online required solving the problem of remote verification. The internet lacks a trust layer, which produces impersonation risk and legal complications in online transactions.

"Because the internet lacks a trust layer, we felt that a robust, legally enforceable digital identity was necessary."

Jigme Tenzing
Secretary, Government Technology Agency Bhutan

2019

Opting for decentralized identity

To tackle this challenge, Bhutan created the Digital Drukyl Flagship Programme in 2019, which charted a path toward seamlessly delivering public services to all citizens online and framed digital identity as linking infrastructure for all sectors. The strategy envisioned an underlying digital

system serving banks, schools, licensing authorities, civil registration, and even private sector transactions.

The conventional response to remote verification is a centralized government database holding citizen records. Initially, officials in Bhutan were exploring a centralized approach when His Majesty the King intervened to prioritize citizen privacy and data security, in alignment with Bhutan's constitutional protection of the right to privacy. Concentrating citizen data in one location is risky because these crucial records can be compromised, coerced, or shut down.

Officials researched private sector use cases of self-sovereign decentralized identity and consulted the co-author of Self-Sovereign Identity, Dr. Drummond Reed, alongside other international experts. Self-sovereign identity places credentials in citizens' hands rather than in state storage. Public blockchains also do not experience the outages that centralized government databases periodically suffer.

PRIMER

Key terms

The vocabulary behind Bhutan NDI

IN ONE SENTENCE

Citizens hold digital versions of their official documents on their own phones, and a blockchain lets any service confirm those documents are authentic without contacting the issuer or seeing personal data.

Self-sovereign identity

A model in which citizens hold their own credentials and decide what to share, and with whom.

Verifiable credential

A digital version of an official document, such as a license or bank verification, signed by the organization that issued it.

Digital wallet

An app on a citizen's phone that stores their credentials.

Blockchain

In Bhutan NDI, a public register of approved issuers and credential templates. Services use the register to confirm a credential is authentic, and the register holds no personal data.



3. Technical Specifications

Three blockchain platforms, an independent evaluation, and a migration that required citizen consent



Figure 2. The blockchain platforms behind Bhutan NDI, and the reason for each change.

With a working national system in place, Bhutan reopened the question of the blockchain underneath it. Bhutan's original validation layer ran on Hyperledger Indy until the network's supporting organization was dissolved and catalyzed a migration. In response, the country moved to Polygon in 2024, a decision attributed to an ongoing developer pipeline because Polygon was being taught in Bhutanese schools.

In May 2024, an Ethereum Foundation member visiting Bhutan learned about Bhutan NDI, asked about the system's goals, and suggested that the properties Ethereum provides could serve as the system's foundation. Officials asked the Ethereum Foundation to evaluate the existing system, and external experts conducted a comparative evaluation. Members of the Ethereum Foundation visited Bhutan in September to discuss three blockchain evaluation metrics with government stakeholders: number of validators around the world, geographic diversity of servers, and software client diversity. Having high results for each of these criteria mitigates against potential outages or disruptions to the system. On the criteria applied, Ethereum was assessed as more decentralized and more secure at that time.

A team composed of Ethereum Foundation members and Bhutan developers co-created a proof of concept that demonstrated the system's functionality using Ethereum in October 2024, and the decision to transition from Polygon was taken on the basis of decentralization, security, developer ecosystem engagement, interoperability with other providers, and the potential for ongoing external support. The upcoming migration was announced at the Ethereum Foundation's annual conference, Devcon, which reinforced public commitment on both sides.



Figure 3. The technical metrics discussed in September 2024, and the factors the transition decision rested on.

While the technical requirements of the migration initially appeared modest, requiring changing hard-coded chain identifier variables in the existing system and utilizing an existing decentralized identifier contract that was already deployed, the surrounding work was more demanding.

All foundational credentials required reissuance to anchor them to Ethereum, so decisions about what to migrate first were based on risk. Non-foundational credentials such as licenses migrated first, with foundational credentials including passport data following. Testing extended the timeline, reflecting the NDI team's caution from previous migration experiences and government awareness of digitalization gaps still affecting some citizens. The system was audited before migration proceeded. Front-end changes were minimal, and the NDI team described the migration as smooth from a user experience standpoint.

“If you imagine it like a train, they upgraded a train from diesel to electric while it was going down the tracks without the passengers even noticing.”

Austin Griffith

Builder Enablement, Ethereum Foundation

The nature of a decentralized system placing ownership in citizens' hands also meant the migration required user consent rather than an automatic system update. This necessitated citizen awareness efforts as well as ongoing technical support for Polygon to continue to serve users who had not yet migrated. While the architecture's central promise of citizen agency may have extended the migration timeline, already over 95% of the eligible population has transitioned to using the latest technology within two years.

4. How the System Works

Credentials held by citizens, with the blockchain managing only what is needed to verify them

The building block of Bhutan's system is the verifiable credential, a digital equivalent of a document citizens use to prove information about themselves. An authorized organization issues a credential to a citizen and signs it cryptographically, and any organization receiving that credential can confirm that it is authentic and unaltered.

Bhutan's system follows the decentralized identity standards published by the World Wide Web Consortium, which describe three roles. The issuer creates and signs a credential, the holder is the citizen who stores it, and the verifier is the entity that checks the credential's validity. Royal Bank of Bhutan, Bhutan Telecom, and a range of government entities currently issue credentials within the system.

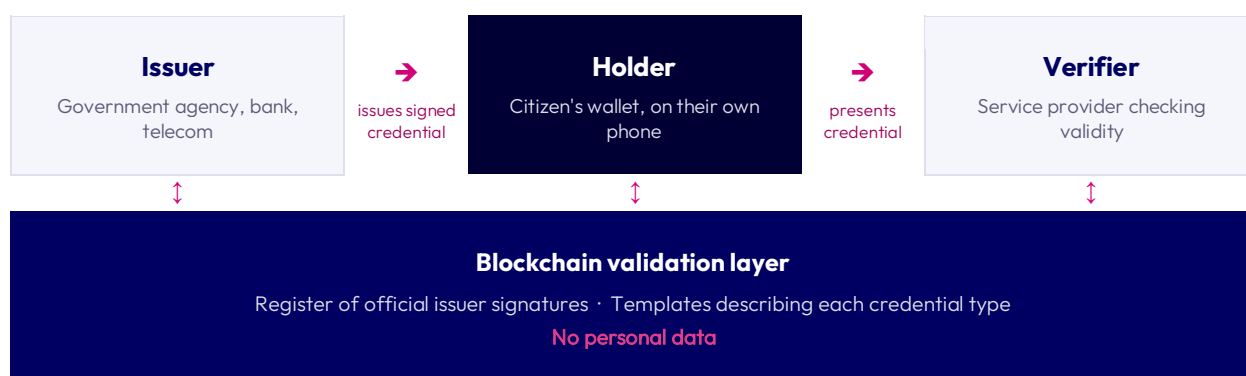


Figure 4. How a credential moves between the issuer, the holder, and the verifier.

Foundational credentials establish passport-level identity and are derived from the citizen registry maintained by the Department of Civil Registration and Census. Non-foundational credentials build on that foundation and cover bank credentials, driver's licenses, vehicle registrations, school records, and more.

Citizen data is stored at the edge, in digital wallets on citizens' smartphones, rather than in a centralized government database. Citizens control their credentials within that wallet, and the government's role is limited to issuing records.

The blockchain acts as the validation layer, holding the information needed to check whether a credential is genuine. The blockchain contains a register of the official signatures belonging to every organization permitted to issue credentials, which allows anyone receiving a credential to confirm it came from a recognized authority such as a government agency or a licensed bank. The blockchain also contains sets of templates describing what information each type of credential contains, in the way a blank form specifies which fields a document includes. Neither the signatures nor the templates reveal anything about individual citizens.

A bank checking a citizen's credential can therefore confirm that the government issued it, without the bank or the government consulting the central record of that citizen.

This system involves minimal writing and heavy reading. Writes occur only when a new issuer or schema is registered and cost less than US\$1, while reads are free and visible only to participating parties. Most cryptographic signature verification happens off-chain. Decentralized implementation costs considerably less than maintaining physical identity cards and supporting infrastructure.

This division produces the system's most consequential property for citizens. Because verification occurs between citizen and service provider without a central record, the government cannot track how, when, or where citizens use their identity, therefore guaranteeing their privacy.

Why decentralize?

What changes when citizen records are not held in one place

Security

No single location holds citizen data, so there is no comprehensive target to reach for breaches.

Privacy

Verification occurs between citizen and service provider, so usage leaves no central record.

Reliability

Public blockchains are distributed and remain available when centralized systems have outages.

Citizen control

Citizens hold credentials in their own wallet and decide what to present.

Open source

Open standards and open-source components let anyone inspect how verification works and let other countries reuse the same building blocks.

Auditability

A public register records every approved issuer, so anyone can check who may issue credentials without seeing any citizen data.

PLANNED CAPABILITIES

Digital identity forms a foundational layer that further privacy safeguards can be built upon.

Selective disclosure allows a citizen to share only the relevant parts of a credential rather than the whole document. A citizen confirming eligibility for a service could transmit their name and citizenship status while withholding their address and date of birth, in contrast to a paper document, which reveals everything printed to anyone reading.

Zero-knowledge proofs go further by allowing a citizen to prove a statement is true without transmitting any of the underlying information. A citizen could simply demonstrate that they meet an age requirement without disclosing their date of birth or even their age, in the way a bar attendant needs confirmation that a patron is old enough to be served.

Both capabilities are potential future avenues for Bhutan NDI, reducing what an organization learns about a citizen during a transaction, protecting citizen privacy, and limiting their exposure to scams and unwanted solicitation. These advancements have particularly beneficial implications for protecting the rights and safety of children and are beneficial for all citizens.

5. Public Value

What changed for citizens across public services, connectivity, finance, and control of personal data

Service access

With the widespread use of Bhutan NDI, citizens no longer travel to district centers to have their identity confirmed for a service. When accessing a service, citizens are able to scan a QR code rather than completing repetitive paper forms, and credentials are verified online in seconds. Verifiable credentials are portable across compatible services, so a citizen holding a verified credential can present it wherever it is accepted rather than repeating the underlying verification each time.

Approximately 30 agencies and services currently use NDI, and most government systems rely on the system for validation and service delivery. NDI also supports public transactions including government procurement and business services.

“You'll save time, you'll save money. You don't have to go to the banks to open an account, you can do it remotely.”

Pallavi Sharma
Chief Operations Officer, Bhutan NDI Ltd.

Connectivity and digital inclusion

To enable digital inclusion, Bhutan invested substantially in national fiber infrastructure and high-speed fiber now connects 204 of 205 administrative blocks, with the remaining northern geography served by one gigabit microwave connectivity and 4G. Nearly all schools are connected by high-speed fiber, with three schools using Starlink. Citizens in villages use the Bhutan NDI application with QR codes even where internet service is less reliable.

The government of Bhutan also recognized that not all citizens may want to use Bhutan NDI and built access routes for citizens who do not use smartphones as part of the program rather than as a

subsequent correction. Community centers across all 205 geographies still provide assisted access to services in person. Physical identity cards are also issued and include biocrypto QR codes enabling service access without a smartphone. Digital literacy and safety training campaigns teach citizens how to use their identity safely, and the IT curriculum in schools embeds digital identity education so that young students can learn the skills needed to use Bhutan NDI and even help aging parents use services.

Financial inclusion

Bhutan NDI enables electronic know-your-customer processes with stronger biometric verification than physical methods provide, which allows financial institutions to establish customer identity without requiring a branch visit. Bhutan Development Bank remotely onboarded more than 7,000 customers through its NDI integration. Citizens purchased Gelephu Mindfulness City bonds within minutes using NDI for compliance, completing a process that conventionally involves substantial documentation and delay. The national pension fund implemented liveness and biometric verification to prevent fraudulent claims. The digital identity platform can also reduce transaction costs and improve efficiency for the private sector.

Citizen agency and safety

The Bhutanese government is taking significant action to guard citizen security and prevent scams. In-app one-time passcodes have replaced SMS-based passcodes, addressing a category of scam that exploits mobile number changes.

Residual risks require continued attention. Scammers attempt to induce citizens to scan their NDI app without disclosing why, and QR code scams remain possible when a citizen approves a request without checking what information it seeks. Bhutan's response has been scam awareness education focused on helping citizens understand what is requested before granting access.

CURRENT LIMITATIONS

High demand can cause scaling issues that affect user experience, and services can encounter difficulties when many citizens use them simultaneously. Apparent lags may originate in application performance or database behavior rather than in the blockchain itself, which is a useful distinction for governments evaluating similar systems.

Impact in numbers

Bhutan NDI at the time of writing



Figure 5. Bhutan NDI adoption and reach at the time of writing.

6. The Role of the Ethereum Foundation

Technical guidance and support, with the system owned and maintained in Bhutan

The Ethereum Foundation is a nonprofit organization that supports the development, research, and growth of the Ethereum blockchain ecosystem, framing Ethereum as sanctuary technology that offers a third option beyond disconnecting from the global digital economy or connecting on terms that require surrendering citizen rights. When Bhutan was exploring partnership options, the Ethereum Foundation's core principles of open-source development, censorship resistance, privacy, and security corresponded closely with the priorities Bhutan had already set for its identity system.

While the Foundation provided technical advice to support Bhutan's strategic decision-making, the Foundation positions itself as a steward rather than an owner of the network, and measures part of its own success by how far an ecosystem can operate without the Foundation's involvement. Members of the Bhutanese government and the Bhutan NDI team point to three benefits in particular that the Ethereum Foundation offered through collaboration.

- **Strengthening government literacy on blockchain evaluation criteria** – The Foundation assisted in building the government's understanding of how to evaluate a blockchain. Teaching the evaluation method rather than supplying a recommendation left both the assessment and the decision that followed with Bhutan.
- **Providing technical expertise** – Ethereum Foundation members supported an initial prototype and shared guidance throughout the latest migration. Foundation members also translated technical considerations into terms that supported policy decisions.
- **Building relationships and community** – Working relationships advanced through hackathons in Bhutan, connecting Ethereum Foundation members directly with NDI developers. The Foundation also invited the NDI team to its annual conference, Devcon, which connected Bhutan's developers to the wider decentralized technology community.

The Ethereum Foundation describes its approach as a philosophy of subtraction, offering expertise while ensuring local ownership, learning, and decision-making. Officials credited the Ethereum Foundation's supportive approach as a key reason for Bhutan NDI's most recent shift to using Ethereum.

7. Enablers and Lessons

The conditions that made Bhutan NDI possible, and opportunities for other governments

The NDI team and government stakeholders identified a set of conditions that made the system possible, alongside challenges encountered along the way.

Legal and institutional foundations	1 Establish a legal foundation that recognizes digital credentials 2 Create an empowered lead agency with a cross-cutting mandate 3 Secure ongoing top-level political sponsorship
Reaching citizens	4 Ensure a reliable foundational identity source 5 Build access pathways to citizens in remote areas
Connectivity and inclusion	6 Invest in baseline digital connectivity 7 Design options for non-digital and non-smartphone populations
Communication and citizen understanding	8 Pair technology rollout with digital literacy and citizen education 9 Assess cultural fit around privacy
Technical capacity and long-term maintenance	10 Access outside expertise while maintaining build and maintenance ownership 11 Cultivate an ongoing national talent pipeline 12 Remain committed to ongoing backend and frontend improvement

Legal and institutional foundations

1. Establish a legal foundation that recognizes digital credentials

Bhutan built an enabling legislative framework in parallel with the technology, drew on privacy provisions already present in the constitution, and consulted best practices from global experts. Legal recognition also extended into the institutions that apply the law, with the judiciary receiving training to validate digital credentials.

2. Create an empowered lead agency with a cross-cutting mandate

Consolidating a lead agency with a cross-cutting mandate also contributed to Bhutan's success. While work with the government still involves multiple departments as well as a technology vendor, having a centralized authority bolsters efficiency and maintains oversight.

3. Secure ongoing top-level political sponsorship

In Bhutan, top-level political sponsorship provided the mandate for adoption and government stability supplied continuity over the multi-year program. Working with the same people who have authority to make commitments over time allowed decisions to hold. Governments considering this approach may assess whether they can supply sustained sponsorship across the life of the program, as decentralized systems still require a centralized decision to mandate adoption.

Reaching citizens

4. Ensure a reliable foundational identity source

A prerequisite for successful Bhutan NDI implementation was initial biometric validation, and Bhutan's civil registry made this possible. Governments beginning this work can confirm whether an authoritative population record exists or can be assembled before designing the foundational credentials.

5. Build access pathways to citizens in remote areas

More than 60,000 volunteers enabled access to citizens in remote areas for initial biometric data gathering. Ensuring enrollment can be distributed across the entire population is crucial, and Bhutan benefited from existing networks of people for onboarding.

Connectivity and inclusion

6. Invest in baseline digital connectivity

Baseline digital connectivity determines whether the system is usable. Bhutan had invested in national fiber and ensured internet access for all citizens before rolling out the identity program.

7. Design options for non-digital and non-smartphone populations

Inclusion pathways for citizens who do not use smartphones require deliberate design as some citizens are illiterate, lack access to smartphones, or may choose not to use them. Bhutan responded with community centers in all 205 geographies offering fourth-generation physical identity cards that include biocrypto QR codes. The country also offers regular skilling campaigns teaching the population how to use the tool. Designing options for citizens into the initial vision enhances system resilience.

Communication and citizen understanding

8. Pair technology rollout with digital literacy and citizen education

Digital literacy and citizen education, together with a communication strategy capable of conveying complex concepts, proved among the harder conditions to satisfy. Decentralized and self-sovereign technologies are not part of everyday language, and citizens did not readily see why a decentralized approach mattered compared with a centralized system.

Two responses proved effective. Concrete examples and analogies communicated benefits more successfully than technical explanations. The communication strategy also shifted from a security framing to highlight the benefit of time and cost savings, directly aligning the message with citizens' lived experience.

9. Assess cultural fit around privacy

Bhutan's constitution already protected the right to privacy, and the priority His Majesty the King placed on citizen privacy gave the decentralized approach a foundation that citizens recognized. Governments considering this model may assess local understandings of privacy and trust as a key benefit.

Technical capacity and long-term maintenance

10. Access outside expertise while maintaining build and maintenance ownership

The developer team in Bhutan benefited from access to technical expertise and a mature external platform. The government was able to upskill quickly, gain advisory support, and explore prototypes while ultimately managing the platform and contracting development to an external but locally formed organization, ensuring ongoing system ownership and sustainability.

11. Cultivate an ongoing national talent pipeline

Bhutan planned for local talent capacity and long-term system support from the outset. Bhutan has both strengthened capacity within the NDI team and planned for a pipeline of student developers by ensuring blockchain technologies are a part of the curriculum in schools.

12. Remain committed to ongoing backend and frontend improvement

A national identity system is not finished at launch. Bhutan has upgraded the backend blockchain technology twice since the original launch, each time to strengthen decentralization, security, and long-term reliability.

User experience also requires sustained iteration. Significant demand occasionally produces interface problems, and the application has been redesigned multiple times with a fourth iteration forthcoming. Governments introducing unfamiliar technology will need to budget for repeated interface work rather than treating launch as the completion of the design process.

ASSESSING TRANSFERABILITY

While every government may not need a decentralized identity system, countries that already operate a robust digital identity system can assess whether the change is advantageous, as migration from established infrastructure may present a challenge. Countries building new systems benefit immediately from the decentralized approach, and Bhutan's experience represents a substantial forward advance from a position of not having digitalized identity.

Larger countries have their own incentive to decentralize, since centralized systems require an attacker to target only one location to obtain comprehensive data, and cybersecurity and privacy risks increase as AI capabilities advance. Incumbent power and financial interests can, however, be expected to resist a move away from centralized systems.

The most frequently cited barrier for other governments is neither technical nor financial. Adopting this model requires a government to intend to give citizens control over their own data, which involves a mindset shift and a willingness to relinquish apparent institutional control for a more resilient system. Three components appear necessary together: government buy-in, a team capable of executing, and a partner able to support and coordinate.

Digital identity also works best as part of a broader strategy rather than as an isolated project. Land registry, voting, driver's licenses, and tamper-proof credentials all build on the same foundation, and Bhutan approached identity as a system rather than a standalone solution.

8. Looking Ahead

Where the identity layer goes next, and what remains for other governments to decide

Bhutan built an identity layer, and the value of that layer grows with what the country builds on top of it. Land registry, voting, driver's licenses, and educational records can all rest on the same foundation, and digital signing services are in development as a linked capability. Further options for citizens to selectively disclose only essential information would extend the privacy protections available to citizens, and extending access to new services in collaboration with other sectors is ongoing.

"I hope they keep making it accessible for all services – like medical appointments, banking overseas, passport renewals – because it saves so much time."

Kinley Yangzom
Citizen of Bhutan

Advances in artificial intelligence strengthen the case for secure, digitally verifiable identity. AI-generated profiles and deepfakes make proving identity more valuable to citizens and institutions alike. Privacy protection also becomes more pressing as AI capabilities reduce the practical anonymity people once assumed they had.

Bhutan's experience also points to the value of open source in foundational digital infrastructure. Bhutan NDI rests on open standards and open-source components. When governments treat core infrastructure as a public good that others can build on and adapt, they can gain transparency, adaptability, and interoperability, depending less on any single technology provider. Open code still calls for clear governance, independent security audits, and a local team able to maintain the system, all of which shaped Bhutan's own migrations.

For governments considering a comparable path, establishing a legal framework alongside a guiding agency, connected citizens, and ongoing sponsorship can help set the groundwork. Countries already operating a robust digital identity system may see significant security benefits in decentralizing, and countries building from an earlier position have much to gain.

Bhutan's achievement is that verification grew stronger while requirements for disclosure grew smaller. Banks can establish who a customer is without that customer traveling to a branch, and pension funds can confirm a claimant is a living person with a rightful claim. Governments have long treated assurance and privacy as a tradeoff. Bhutan's system suggests the trade was never as fixed as it appeared.

References

Documents and sources consulted in the preparation of this case study.

- Bhutan NDI. *Issuance Service*. dashboard.ngotag.com/ndi-services-landing-page/issuance-detail
- Bhutan NDI. *NDI Services Overview*. dashboard.ngotag.com/ndi-services-landing-page
- DataReportal. *Digital 2024: Bhutan*. datareportal.com/reports/digital-2024-bhutan
- Developer Report. *Crypto Developer Data*. developerreport.com
- Druk Holding and Investments. *Newsroom*. dhi.bt/newsroom/news/6945632b151590a78f28aedef
- Encyclopedia Britannica. *Bhutan: Government and Society*. britannica.com/place/Bhutan/Government-and-society
- Ethereum Foundation Blog. *The Promise of Ethereum: Introducing the EF Mandate*. blog.ethereum.org/2026/03/13/ef-mandate
- European Decentralization Institute. *Digital Identity as the Foundation of European Sovereignty*. eudecentralisation.org/policy-brief-digital-identity-as-the-foundation-of-european-sovereignty/
- Government Technology Agency of Bhutan. *Who We Are*. tech.gov.bt/about-2/
- Hyperledger Foundation. *Introduction to Hyperledger Indy*. github.com/hyperledger-archives/education/blob/master/LFS171x/docs/introduction-to-hyperledger-indy.md
- Our World in Data. *Bhutan: Population and Demography*. ourworldindata.org/profile/population-demography/bhutan
- Oxford Poverty and Human Development Initiative. *Gross National Happiness*. ophi.org.uk/gross-national-happiness
- PBS Frontline/World. *Bhutan: The Last Place. Journey to the Hidden Kingdom*. pbs.org/frontlineworld/stories/bhutan/journey.html
- Polygon. *How Many Validators Can Be Active Concurrently?* support.polygon.technology/support/solutions/articles/82000907083-how-many-validators-can-be-active-concurrently-
- Tenzing, Jigme. *Digital Drukyl: An ICT Masterplan for Bhutan*. The Druk Journal. drukjournal.bt/digital-drukyl-an-ict-masterplan-for-bhutan/
- The Bhutanese. *Right to Privacy*. thebhutanese.bt/right-to-privacy/
- Trust over IP Foundation. *Case Study: Bhutan NDI National Digital Identity, Digital Trust Ecosystems, V1.0*. 21 May 2024. trustoverip.org
- World Wide Web Consortium. *Verifiable Credentials Data Model v2.0*. w3.org/TR/vc-data-model-2.0/

Annex A. Methodology

How this case study was researched

Approach	Semi-structured interviews with participants directly involved in designing, building, governing, supporting, or using Bhutan NDI.
Interviews	Conversations with ten interviewees conducted remotely.
Participants	Bhutan NDI leadership and product staff, Government Technology Agency representatives, Ethereum Foundation members, Bhutanese citizens.
Period	July – September 2026
Verification	Figures checked against the public Bhutan NDI dashboard and confirmed with the NDI team and government officials.