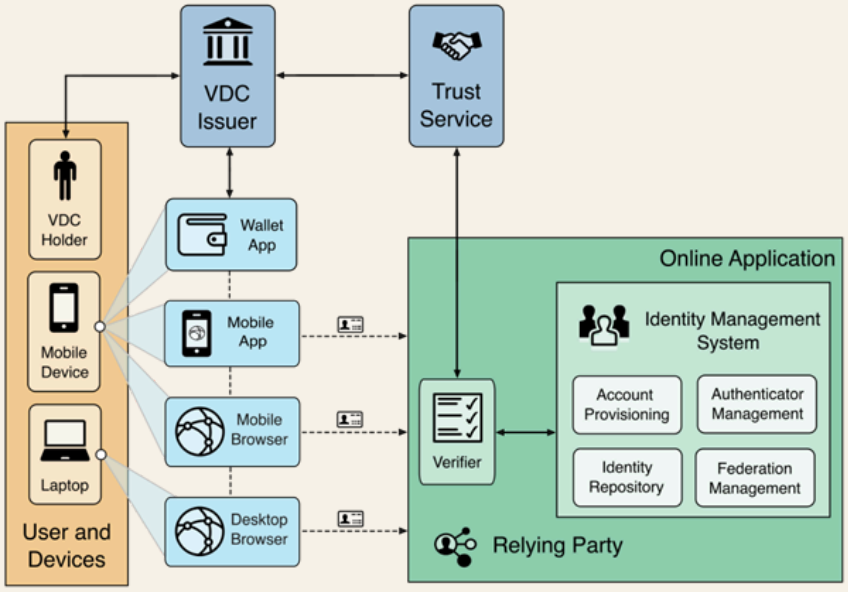
Whitepaper

# Verifiable digital credentials: A technical overview

Learn the technical advantages, supported protocols, and why to trust VDCs

# The VDC ecosystem

Verifiable digital credentials (VDCs) operate within a defined ecosystem of participants who work together to ensure secure, portable, and privacy-preserving sharing of identity data. Holders have control over their information and what they share with whom. When a holder shares information with a relying party, the verifier can perform real-time verification and check for authenticity without needing to communicate with the issuer. The VDC ecosystem comprises issuers, wallets, verifiers, and a verifiable data registry




Users may present VDCs online to relying parties through a mobile application or through a browser. [1]

**Issuer**

An entity trusted to assert claims about a subject, such as age, state of residence, employment status, or skill qualifications. The issuer issues and cryptographically signs credentials with its private key.

**Credential Manager (Wallet)**

A secure digital wallet controlled by the individual (the **holder**), storing credentials and responding to verifier requests. Wallets and specific credential formats may support selective disclosure, enabling holders to share only the claims needed to perform a specific action, and not the entire document. Wallets primarily facilitate a cryptographic chain of custody between the issuer and verifier. Wallet provenance can be shared with the issuer on credential issuance and with the verifier when a credential is ultimately presented.

[1] Credit: NIST diagram https://www.nist.gov/blogs/cybersecurity-insights/digital-identities-getting-know-verifiable-digital-credential-ecosystem

## Cont'd

**Verifier**
An entity that acts on behalf of a **relying party** — the organization or service, e.g. bank, employer -- that wants to accept a credential and requests proof of specific claims from a holder. It cryptographically validates the credential's signatures to confirm authenticity and integrity. Verifiers are configured by the relying party to enforce policy, including which issuers are trusted and which claims are required. This allows verifiers to ensure that only credentials from approved issuers are accepted, while still preserving holder control over which claims are shared.

**Verifiable data registry**
A trust list or trust registry that maintains metadata about issuers, importantly their public key or reference thereto, and optionally status information regarding credential revocation.

## What's a VDC technically?

Modern VDCs are built on industry standards to ensure interoperability and a cohesive security profile.

A VDC is a cryptographically signed digital document issued by a trusted authority (issuer) to a holder. It contains verified claims about the holder (e.g. age, employment status, etc.) and can be stored in a digital wallet.

These claims can represent anything ranging from a ticket ID and seat number to a full driving license or national identity. The primary driving use cases for VDCs are surrounding human-centric identity verification. What is a user's legal name? Is a user over the age of 21? The focus is on proving claims about a real person, which involves support for selective disclosure, and includes biometric indicators that can be used when stronger assurance is required. Key features of a VDC:

- **Cryptographically signed:** Ensures tamper-proof integrity and authenticity.
- **Supports selective disclosure:** Holders share only the claims required for a transaction
- **Is bound to a holder:** Verifiers can confirm that the credential is being presented by the authorized holder.
- **Adheres to standards and protocols:** Supports multiple formats (e.g. SD-JWT, mdoc) and protocols (e.g. OID4VP[3] for presentation, OID4VCI[4] for issuance).
- **Held in a wallet:** Credentials are stored client-side in the holder's wallet which can respond to verifier requests using the DCQL and DC_API.[2] The holder controls what information is shared and when.

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**[2]** DC_API https://www.w3.org/TR/digital-credentials/

**[3]** OID4VCI https://openid.net/specs/openid-4-verifiable-credential-issuance-1_0.html

**[4]** OID4VCI httSD-JWT VC https://www.ietf.org/archive/id/draft-ietf-oauth-sd-jwt-vc-10.html

# A word on trust

A ton of work has been done to ensure VDCs are more capable and secure compared to their traditional physical document counterparts. In addition, the VDC ecosystem is designed to mitigate the type of problems that digital systems bring exposure to, like monitoring of communications individually and at scale, and collection of privacy invasive personally identifying information. VDCs use asymmetric cryptography ensuring secrets are never transmitted over the wire. And VDCs support selective disclosure and zero knowledge proofs which limit the information a user needs to disclose to pass verification checks. The technology works to better protect both online services and their users conferring privacy and security benefits to both.

**Issuance**

VDCs are issued by traditionally trusted institutions both public and private, like government agencies and banks, respectively. The same entity printing e.g. physical driving licenses is responsible for minting the digital version. If you would trust a state DMV to make claims about a person's name, age, appearance, and address, normally, then there is no functional difference when it comes to VDCs–they are issued by the same state authority. The key technical difference is that the digital document is secured using the same battle-tested cryptography used to keep prying eyes off communications with your bank or email provider, ensuring the VDC cannot be forged or stolen by a hacker.

**Verification**

VDCs are trusted by relying parties because verifiers can cryptographically confirm their authenticity. The digital nature of the document means this is done with certainty without relying on fuzzy mechanisms like OCR or manual human reviews. If you would trust a document scan of a driver's license today, you should trust a digital presentation of a driver's license in VDC format. But you would be better off with the VDC presentation because it cannot be forged and because the user's wallet protects them against drive-by phishing attacks since it cryptographically binds credentials to the user.

## Tying it together

When the holder needs to prove a claim, they present the VDC to a relying party or their verifier. The verifier:

(1) **Cryptographically validates** the credential is signed by the issuer's private key. This (2) **ensures the credential hasn't been tampered** with. The verifier (3) checks whether the credential **has been revoked or is expired** and (4) ensures the credential is being **presented by the same holder to whom it was issued** (holder binding).

The verifier can confirm the integrity and authenticity of the information all without contacting the issuer directly, a boon for user privacy.

## VDCs compared to existing technology

VDCs don't aim to compete with existing authentication technology. A general rule of thumb is, A VDC should never be used for authentication. VDCs should be used to verify information about users during low volume events like registration or step-up checks, and any required verification checks should simply be flagged on the user account and re-checked as [in]frequently as required. All authentication should happen using existing protocols and standards designed for authentication, like Passkeys and OAuth. VDCs aim to replace physical analog credentialing systems like plastic cards and badges.

| | **Physical Document** | **VDC** |
|---|---|---|
| **Readability** | Human | Machine |
| **Speed** | Human-in-the-loop | Instant |
| **Integrity** | Physical tamper resistant at best / Sometimes physically signed | Digitally signed / Originally encrypted at time of presentation |
| **Disclosure** | Full document | Full document / Selective / Zero knowledge |
| **Issuer Trust** | Fixed | Fixed / Discoverable |
| **Holder Binding Options** | Biometric | Crypographic (Proof of possession) / Biometric / Claims based |

# Okta's VDC capabilities

As a leading identity company, Okta is committed to supporting all digital identity verification needs spanning from verification of existing credentials, like mobile drivers licenses, to issuance of bespoke credentials that a company or service might have authority over, such as digital employee badges or concert tickets. Okta's VDC platform is designed with the latest standards that govern the digital identity space to ensure security, integrity and interoperability between all parties. We're piloting out VDC support with verification use cases and will focus on those details below. We will expand to include details on issuance capabilities in the future.

| Document format | Verification protocols | Verifiable data registry |
|---|---|---|
| mdoc<br>• ISO/IEC 18013-5[5] | ISO/IEC 18013-7[6]<br>• Annex B (Custom schemes + OID4VP)<br>• Annex C (DC API + mdoc)<br>• Annex D (OpenID HAIP (DC API + OID4VP[5] + mdoc)) | AAMVA Digital Trust Service (DTS)8 or manually sourced issuer certs; supports custom trust anchor lists<br><br>Bespoke state DMV trust anchors |
| SD-JWT VC<br>• IETF | OpenID[7]<br>• OID4VP (dc+sd-jwt)<br>W3C<br>• DC API (dc+sd-jwt) | URL-based issuer metadata discovery via .well-known endpoints; supports pre-baked issuer lists, custom URL lists, and offline mappings |

**[5]** ISO/IEC 18013-5 https://www.iso.org/standard/69084.html

**[6]** ISO/IEC 18013-7 https://www.iso.org/standard/91154.html

**[7]** OID4VP https://openid.net/specs/openid-4-verifiable-presentations-1_0.html

# Glossary of terms

**Document Format**
The Okta VDC platform can verify the common document formats: SD-JWT VC and mdoc.

**Verification**
Okta supports the verification of SD-JWT VCs using the OID4VP, OpenID for Verifiable Presentation, protocol. Okta supports mdoc over the OID4VP protocol. Both of these options can be used with the W3C Digital Credentials API. Okta currently supports cryptographic holder binding at presentation time.

**Trust Registry**
Trust is configured via individual presentation templates. The allowed issuer trust anchors/metadata-urls are configured granularly for each instance of a verification the service is configured to perform.

**Mdoc**
Mdocs are supported generically by issuer CA or direct end-cert configuration. For each verification template a list of allowed CAs/Issuers may be provided. For US use cases, we've integrated support for the American Association of Motor Vehicle Administrators' Verified Issuer Certificate Authority Lists, AAMVA - VICAL. For states that don't participate in AAMVA - VICAL, we source the issuer certificates manually. Other instances of mdoc verification will use the same model where the platform sources trust lists or the user can manually specify.

**SD-JWT VC**
The ITEF dc+sd-jwt is specified to be URL-based. The issuer is indexed by a url and the issuer metadata is discovered by querying .well-known endpoints. Note dc+sd-jwt does not adopt arbitrary distributed identifier (DID) support. Our platform supports pre-baked lists of issuers, like "all Okta verified workforce customers". Additionally, custom trusted issuer URL lists can be configured. And, for offline issuers, custom mappings between issuer url and issuer key can be specified.

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**[8]** AAMVA-VICAL
https://vical.dts.aamva.org/

**[9]** SD-JWT
https://www.ietf.org/archive/id/draft-ietf-oauth-selective-disclosure-jwt-22.html