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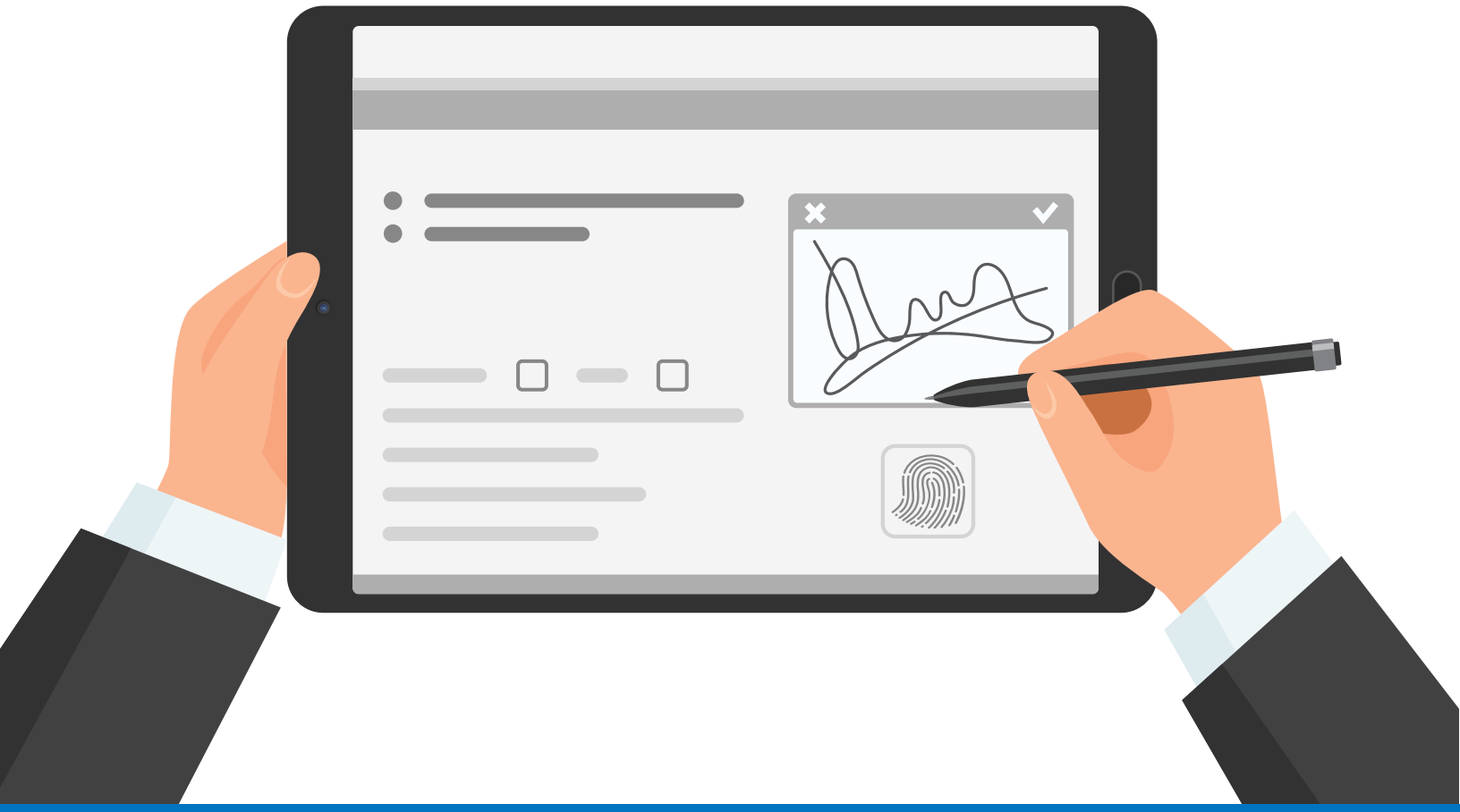
Verifying Digital Signatures on California DL/ID Documents



Technical Overview
December 2025

Verifying Digital Signatures on California DL/ID Documents

This document is intended for technical audiences interested in implementing the technologies listed herein; those interested in using an existing verifier to check the security features on a DL/ID document can do so by visiting https://verify-credentials.dmv.ca.gov/.

This document references the following specifications:

- Verifiable Credential Barcodes 0.7
- CBOR-LD 1.0
- Bitstring Status List 1.0
- Verifiable Credential Data Integrity 1.0
- Verifiable Credentials Data Model 2.0
- Decentralized Identifiers 1.0

Overview

This purpose of this document is to provide a technical introduction into how the digital signature security feature on the 2025 California DL/ID Card Design can be checked when scanning the PDF417 barcode.

At a high level, the process is as follows:

1. Extract the digital signature payload from the PDF417.
2. Decode the compressed CBOR-LD bytes back to a JSON-LD Verifiable Credential.
3. Process the other data in the PDF417 to construct the data required to verify the digital signature.
4. Perform a Data Integrity cryptographic verification.
5. Check the Bitstring Status List status entry on the credential.

If the cryptographic verification operation succeeds and the status check indicates the DL/ID has not been revoked, the physical document has passed the advanced security check.

Extracting the digital signature payload from the PDF417

The following Driver's License PDF417 will be used as a running example in this document. This PDF417 is for test purposes only.

Reading the data from the PDF417 yields the following:

```
b'@\n\x1e\rANSI
636014100102DL00410287ZC03280220DLDAQI8887059\nDCSFIVENINE\nDDEU\nDACTOMTEST\nDDFU\nDADNONE\nDDGU\
nDCABM1\nDCBL80\nDCDNONE\nDBD08052025\nDBB01011980\nDBA01012030\nDBC1\nDAU070 IN\nDAYBLU\nDAG2415
1ST AVE 051\nDAISACRAMENTO\nDAJCA\nDAK958180000  \nDCF08/05/2025298TL/TLFD/30\nDCGUSA\nDAZBLN\
nDAW200\nDCUIV\nDCK25217I88870590401\nDDAN\nDDB05202024\rZCZCABLU\nZCBBLN\nZCC\nZCD\nZCE2csdghoB2QX
ApgGCAQIYnYIYdhikGK6jGJwYphjEQRUYxhrmdn0HGLCiGJwYoBioRHX/cGAYtEEUGLalGJwYbBjMARjWGNwY2FhBephqE+tby
DCJM7XgRUzmFAY41xQu1cBinSYoLAAx/k6284STfQ0g1arQCtDpTWsqa96BLDbWzvj0R4JIrk/K5AAY2kEW\r'
```

In California licenses, the signatures are in the **ZCE** field of the **ZC** subfile:

```
2csdghoB2QXApgGCAQIYnYIYdhikGK6jGJwYphjEQRUYxhrmdn0HGLCiGJwYoBioRHX/cGAYtEEUGLalGJwYbBjMARjWGNwY2F
hBephqE+tbyDCJM7XgRUzmFAY41xQu1cBinSYoLAAx/k6284STfQ0g1arQCtDpTWsqa96BLDbWzvj0R4JIrk/K5AAY2kEW
```

Decoding the Compressed CBOR-LD Bytes Back to a JSON-LD Verifiable Credential

California signatures are base64 encoded. Removing that encoding and expressing as hex:

```
d9cb1d821a01d905c0a601820102189d82187618a418aea3189c18a618c4411518c61ae6767d0718b0a
2189c18a018a84475ff706018b4411418b6a5189c186c18cc0118d618dc18d858417a986a13eb5bc8308933b5e0454c
e6140638d7142ed5c0629d26282c0031fe4eb6f384937d0d20d5aad00ad0e94d6b2a6bde812c36d6cef8f4478248ae4f
cae40018da4116
```

This CBOR-LD can then be converted back to JSON-LD (CBOR-LD spec, Javascript implementation).

California DL/ID CBOR-LD payloads use registry entry 31000000, so the CBOR-LD processor will need that metadata passed to it to decode correctly.

Appendix A of this document contains an example script that uses the above implementation to correctly decode the payload. This results in the following JSON-LD Verifiable Credential:

```
{
 '@context':
  [
   'https://www.w3.org/ns/credentials/v2',
   'https://w3id.org/vc-barcodes/v1'
  ],
 credentialStatus: {
  terseStatusListBaseUrl: 'https://api.uat-credentials.dmv.ca.gov/status/dlid/1/status-lists',
  terseStatusListIndex: 3866524935,
   type:'TerseBitstringStatusListEntry'
 },
 credentialSubject: {
  protectedComponentIndex: 'u_3Bg',
   type:AamvaDriversLicenseScannableInformation'
 },
 issuer:'did:web:uat-credentials.dmv.ca.gov',
 proof: {
  cryptosuite: 'ecdsa-xi-2023',
   proofPurpose:'assertionMethod',
  proofValue: 'z43jxJrDSKCMo83ki5FWSjV7CTugPzco4g4xT2X2RegvyjJwpRS59U2nHbvdtLo9R9Xejvy7HqwaYU6Ngn-
HJEAo6F',
   type:'DataIntegrityProof',
  verificationMethod: 'did:web:uat-credentials.dmv.ca.gov#vm-vcb-1'
 },
 type: ['VerifiableCredential', 'OpticalBarcodeCredential' ]
}
```

Processing the Data in the PDF417 to Prepare to Verify the Digital Signature

The digital signature in the Verifiable Credential does not only sign over the credential itself - it also signs over other data from the PDF417.

To prepare for cryptographic verification, apply this algorithm to the PDF417 contents to construct *opticalDataHash*.

From our example, using the fields corresponding to a *protectedComponentIndex* value of u_3Bg:

```
canonicalizedData = 'DACTOMTEST\nDADNONE\nDAG2415 1ST AVE
051\nDAISACRAMENTO\nDAJCA\nDAK958180000  \nDAQI8887059\nDAU070
IN\nDBA01012030\nDBB01011980\nDBC1\nDCGUSA\nDCSFIVENINE\n'
```

NOTE: There is a "double hash" that occurs here for security purposes – *canonicalizedData* should be hashed to construct *opticalDataBytes*, which will then need to be hashed again to construct *opticalDataHash*.

Example DL/ID PDF417 processing from the Verifiable Credential Barcodes specification

Performing Cryptographic Verification

Once you have processed the barcode to construct opticalDataHash, a Verifiable Credential Data Integrity verification with the ecdsa-xi-2023 cryptosuite can be performed, which is essentially an ecdsa-rdfc-2019 verification with the addition of opticalDataHash, the hash of the signed data in the PDF417 other than the credential itself.

The location of the key material required for verification can be found in the credentialSubject.proof.verificationMethod property. In our example:

did:web:uat-credentials.dmv.ca.gov#vm-vcb-1

This Decentralized Identifier indicates that the key used for verification is the one found at https://uat-credentials.dmv.ca.gov/.well-known/did.json and labeled vm-vcb-1.

Production Identifiers

The running example in this document uses test cryptographic material and status infrastructure that differ from what is on production DL/ID documents. The correct values to use for production documents are described here.

In production, verifiers **must** enforce checks at this point that the Decentralized Identifier in the issuer and credentialSubject.proof.verificationMethod properties are the expected production California Department of Motor Vehicles Decentralized Identifier:

did:web:credentials.dmv.ca.gov

This DID document can be retrieved from

https://credentials.dmv.ca.gov/.well-known/did.json

Similarly, production Bitstring Status List locations will have the prefix "api.credentials.dmv.ca.gov/status/dlid", and verifiers must enforce that the data in the Verifiable Credential conforms with this requirement during verification.

api.credentials.dmv.ca.gov/status/dlid

Checking the Bitstring Status List Status Entry on the Credential

The status entry on our example credential is a TerseBitstringStatusListEntry. This is an application of Bitstring Status List for status tracking where the expression of the status list and index on the credentials themselves are more compact than in a regular BitstringStatusListEntry.

```
credentialStatus: {
    terseStatusListBaseUrl:   'https://api.uat-credentials.dmv.ca.gov/status/dlid/1/status-lists',
    terseStatusListIndex: 3866524935,
    type: 'TerseBitstringStatusListEntry'
  }
```

To get the status list URL, we do the following:

$$listIndex = floor\left(\frac{terseStatusListIndex}{statustListSize}\right) = floor\left(\frac{3866524935}{67108864}\right) = 57$$

statusIndex = 3866524935 % 67108864 = 41319687

For status purpose “revocation”, the location of the status list for this credential is then:
https://api.uat-credentials.dmv.ca.gov/status/dlid/1/status-lists/revocation/57

Fetch this list, process it per the Bitstring Status List specification, and check bit 41319687. If this bit is set to 1, the credential has been revoked. Appendix B of this document contains an example PDF417 containing a digital signature that has been revoked.

Appendix A: Example CBOR-LD Decode Interface

Implementation: https://github.com/digitalbazaar/cborld

The following is a simple Javascript example of how to use the decode() interface in the above implementation of CBOR-LD.

```
---------- ---------- ----------
// credential data
const hex =
'd9cb1d821a01d905c0a601820102189d82187618a418aea3189c18a618c4411518c61ae6767d0718b0a
2189c18a018a84475ff706018b4411418b6a5189c186c18cc0118d618dc18d858417a986a13eb5bc
8308933b5e0454ce6140638d7142ed5c0629d26282c0031fe4eb6f384937d0d20d5aad00ad0e94d6b2a6bde
812c36d6cef8f4478248ae4fcae40018da4116'
const cborldBytes = Uint8Array.from(Buffer.from(hex, 'hex'));

// prepare CBOR-LD registry entry metadata for decoding
const contextTable = new Map([
  ["https://www.w3.org/ns/credentials/v2", 1],
  ["https://w3id.org/vc-barcodes/v1", 2]
]);

const cryptosuiteTable = new Map([
  ["ecdsa-xi-2023", 1]
]);

const urlTable = new Map([
  ["did:web:credentials.dmv.ca.gov", 1],
  ["https://api.credentials.dmv.ca.gov/status/dlid/1/status-lists", 2],
  ["https://api.credentials.dmv.ca.gov/status/dlid/2/status-lists", 3],
  ["https://api.credentials.dmv.ca.gov/status/dlid/3/status-lists", 4],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-1", 5],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-2", 6],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-3", 7],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-4", 8],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-5", 9],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-6", 10],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-7", 11],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-8", 12],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-9", 13],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-10", 14],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-11", 15],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-12", 16],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-13", 17],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-14", 18],
  ["did:web:credentials.dmv.ca.gov#vm-vcb-15", 19],
  ["did:web:uat-credentials.dmv.ca.gov", 20],
  ["https://api.uat-credentials.dmv.ca.gov/status/dlid/1/status-lists", 21],
  ["did:web:uat-credentials.dmv.ca.gov#vm-vcb-1", 22],
```

```
  ["did:web:uat-credentials.dmv.ca.gov#vm-vcb-2", 23],
  ["did:web:uat-credentials.dmv.ca.gov#vm-vcb-3", 24],
  ["did:web:uat-credentials.dmv.ca.gov#vm-vcb-4", 25],
  ["did:web:uat-credentials.dmv.ca.gov#vm-vcb-5", 26],
  ["https://api.uat-credentials.dmv.ca.gov/status/dlid/2/status-lists", 27],
  ["https://api.uat-credentials.dmv.ca.gov/status/dlid/3/status-lists", 28],
]);

const typeTable = new Map();
typeTable.set('https://w3id.org/security#cryptosuiteString', cryptosuiteTable);
typeTable.set('context', contextTable);
typeTable.set('url', urlTable);

// prepare JSON-LD contexts for decoding
const CREDENTIALSV2 = {...} // JSON-LD found at https://www.w3.org/ns/credentials/v2
const VCBV1 = {...} // JSON-LD found at https://w3id.org/vc-barcodes/v1

const documentLoader = url => {
  if(url === 'https://www.w3.org/ns/credentials/v2') {
    return {
      contextUrl: null,
      document: CREDENTIALSV2,
      documentUrl: url
    };
  }
  if(url === 'https://w3id.org/vc-barcodes/v1') {
    return {
      contextUrl: null,
      document: VCBV1,
      documentUrl: url
    };
  }
  throw new Error(`Refused to load URL "${url}".`);
};

// use decode interface
const jsonldDocument = await decode({
  cborldBytes,
  documentLoader,
  typeTableLoader: () => typeTable
});

console.log(jsonldDocument);
---------- ---------- ----------
```

Appendix B: Example PDF417 with revoked digital signature