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Implementing Passkeys in Oracle APEX

Building a Passwordless Future

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Agenda

- Passkey Overview
  - What, Why, How
- Oracle APEX Implementation
- Jump into some code samples
- Demo
- Q&A

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81%

of data breaches are caused by weak or stolen passwords

https://www.okta.com/identity-101/mistakes-that-lead-to-security-breach/

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What are Passkeys?

One sentence: Public/private key pairs + local device storage

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What Passkeys Fix

Secure, simple, phishing-resistant

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Key Principles of Passkeys

No shared secrets

Device-bound credentials

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How Passkeys Improve UX

Instant login with biometrics/FaceID/etc.

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Supported Browsers and Devices

- Chrome
  - Brave, Chromium, etc
- Safari
- Edge
- Firefox

- Android
- iOS
- Windows
- Mac

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How Passkeys Work?

WebAuthn API (W3C Standard)

Registration & Authentication Ceremonies

High-Level Flow

Registration

- Challenge → Device → Public key

Authentication

- Challenge → Private key sign → Server verifies

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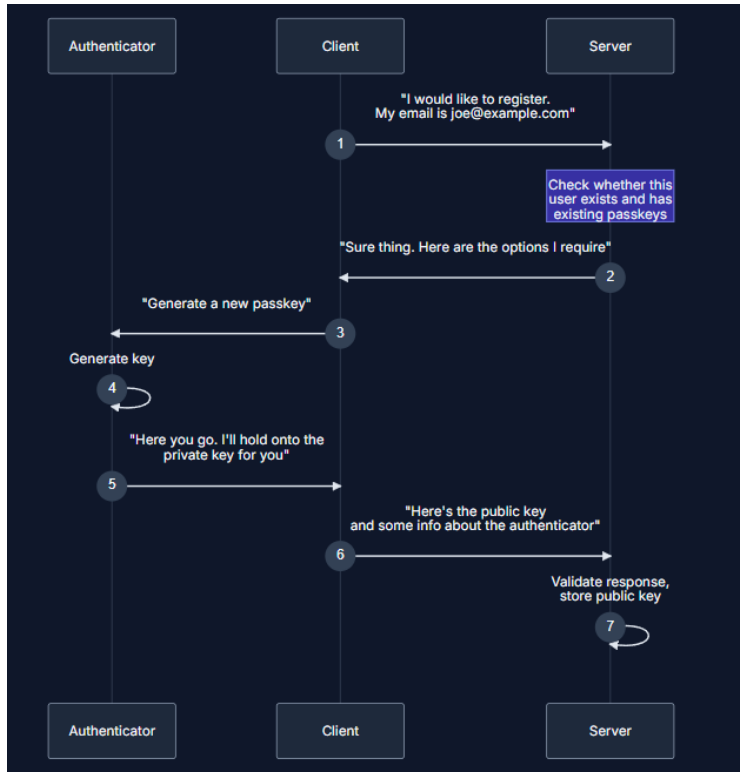
Ceremony: Registration Details



- User clicks “Register Passkey” in APEX page
- Client (JavaScript) calls PL/SQL AJAX to get a JSON “publicKeyOptions” object:
  - challenge (random bytes)
  - rp (relying party info)
  - user (user ID, name, displayName)
  - pubKeyCredParams (algorithms supported, e.g. -7 for ECDSA P-256)
- Browser’s navigator.credentials.create() invoked with publicKeyOptions
- Device shows biometric/PIN prompt, creates credential if user verifies
- Client sends attestationResponse to PL/SQL for validation and storage

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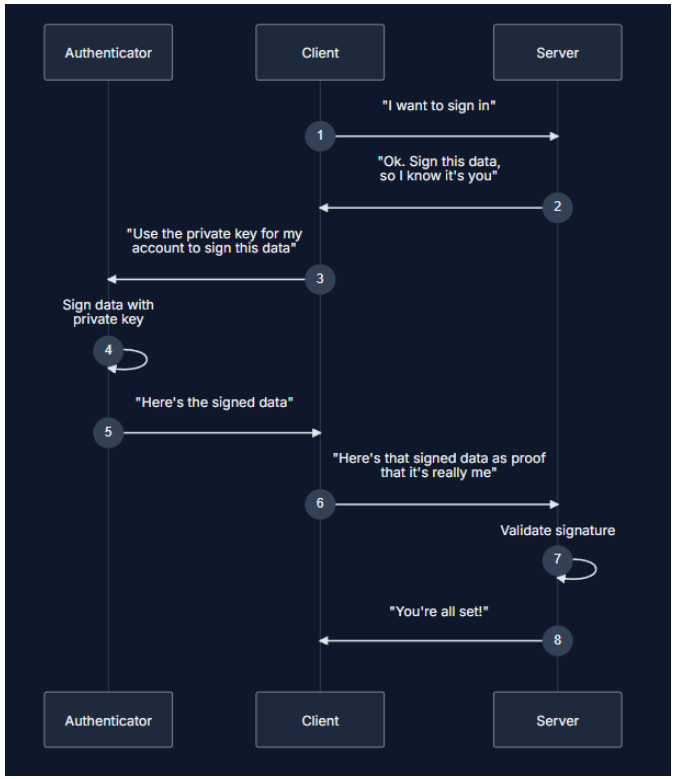
Ceremony: Authentication Details



- User clicks “Sign In with Passkey” on login page
- Client calls PL/SQL AJAX to get a JSON “publicKeyRequestOptions” object:
  - challenge (new random bytes)
  - allowCredentials (list of registered credentialId values)
  - timeout, userVerification flags
- Browser’s navigator.credentials.get() invoked with publicKeyRequestOptions
- Device prompts for biometric/PIN and returns assertion including signed data
- Client posts assertionResponse to PL/SQL to verify signature and create APEX session

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Oracle APEX Implementation

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What We Need in APEX?

WebAuthn on client + PL/SQL server logic

What We Need in APEX

- Database Table to store passkey credentials
  - **Columns:** credential_id, public_key, user_id
- Cryptographic package
  - AS_CRYPTO
- Backend
  - **PL/SQL** that handles ceremonies
- Frontend
  - **JavaScript** on APEX pages to invoke WebAuthn API
  - **Dynamic Actions** to trigger registration/authentication flows

Generating the Challenge

- Use AS_CRYPTO.RANDOMBYTES
- Convert to Base64 URL-encoded string for JSON payload
- Store challenge temporarily

```
l_challenge := AS_CRYPTO.RANDOMBYTES(32);
l_challenge_b := UTL_RAW.CAST_TO_VARCHAR2(UTL_ENCODE.BASE64_ENCODE(l_challenge));
```

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Returning the PublicKeyOptions (JSON)

- Build JSON server-side
- Return JSON to client via APEX's *apex_json* or CLOB directly

```
FUNCTION get_registration_options (p_user_id VARCHAR2) RETURN CLOB IS
  l_challenge   RAW(32);
  l_challenge_b VARCHAR2(100);
  l_json        CLOB;
BEGIN
  l_challenge := AS_CRYPTO.RANDOMBYTES(32);
  l_challenge_b := UTL_RAW.CAST_TO_VARCHAR2(UTL_ENCODE.BASE64_ENCODE(l_challenge));
  apex_util.set_session_state('P_REG_CHALLENGE', l_challenge_b);

  l_json := JSON_OBJECT(
    'challenge' VALUE l_challenge_b,
    'rp' VALUE JSON_OBJECT(
      'id' VALUE 'apex.oracle.com',
      'name' VALUE 'My APEX App'
    ),
    'user' VALUE JSON_OBJECT(
      'id' VALUE TO_BASE64(p_user_id),
      'name' VALUE p_user_id,
      'displayName' VALUE p_user_id
    ),
    'pubKeyCredParams' VALUE JSON_ARRAY(
      JSON_OBJECT('type' VALUE 'public-key','alg' VALUE -7)  -- ES256
    )
  ).to_clob;

  RETURN l_json;
END;
```

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Storing the Credential

- Client posts *attestationResponse* to an AJAX callback, e.g. *save_credential_response*
- Decode Base64 URL-encoded credentialId → RAW
- Verify that client *challenge* matches original *challenge*
- Verify signature using publicKey and Cryptographic package
- Save credentialId and publicKey into table

```
insert into apex_passkeys(user_id, credential_id, public_key)
values (:APP_USER, :CREDENTIAL_ID, :PUBLIC_KEY);
```

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Signature Verification with AS_CRYPTO

- Decode Base64 URL-encoded credentialId, authenticatorData, clientDataJSON, signature → RAW
- Reconstruct signedData = authenticatorData || HASH(clientDataJSON)
- Convert ASN.1 ECDSA signature to raw format (concatenated R + S values).
- Use AS_CRYPTO.VERIFY with stored public_key to validate signature over signedData
- Create APEX session manually

```
as_crypto.verify ( p_signed_data -- expected value (original msg)
                  ,convert_asn1_to_raw(base64url_decode(p_signature)) -- signature
                  ,utl_raw.cast_to_raw(base64url_to_base64(p_public_key)) -- encoded public key
                  ,as_crypto.KEY_TYPE_EC -- key algo
                  ,as_crypto.SIGN_SHA256withECDSAinP1363 -- key algo
                  );
```

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Retrieving Credentials for Authentication

- Query *apex_passkeys* for this user_id → fetch credential_id
- Generate a new challenge (random bytes)
- Build JSON:

```
{
  "challenge": "Base64Url(...)",
  "allowCredentials": [
    {
      "id": "Base64Url(credential_id)",
      "type": "public-key"
    }
  ],
  "userVerification": "preferred"
}
```

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Building UX in APEX

- Registration
  - On your Profile page, an ‘Enable Passkey’ button triggers registration.
  - Dynamic Action → *navigator.credentials.create()* with *publicKeyOptions*
  - On success → PL/SQL *save_credential_response* with *attestationResponse*
- Authentication
  - On your Login page, a ‘Sign in with Passkey’ button triggers authentication.
  - Dynamic Action → *navigator.credentials.get()* → post assertion to PL/SQL *verify_assertion_response*
  - On success, redirect to home page; on failure, show error message region

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Building UX in APEX

```
apex.server.process( "ENROLL", {
  pageItems: "#P1_USERNAME"
}, {
  success: async function( data )  {
    const credential = await navigator.credentials.create({
      publicKey: { // publicKeyOptions JSON
        challenge: new Uint8Array(data.challenge), // base64url-encoded
        rp: {
          id: data.rpId,
          name: "My APEX Application"
        },
        user: {
          id: new Uint8Array(data.userId), // base64url-encoded
          name: "John Doe",
          displayName: "John Doe"
        },
        pubKeyCredParams: [
          {
            alg: -7, // ES256
            type: "public-key"
          }
        ],
      }
    });

    // send credential to server ...
  },
  error: function( jqXHR, textStatus, errorThrown ) {
    // handle error
  }
} );
```

```
apex.server.process( "AUTHENTICATION", {
  pageItems: "#P1_USERNAME"
}, {
  success: async function( data )  {
    const assertion = await navigator.credentials.get({
      publicKey: {
        challenge: data.challenge, // challenge from server base64 url-encoded
        allowCredentials: data.allowCredentials, // array of credentials
        timeout: 60000,
        userVerification: "preferred",
      }
    });

    // send assertion to server ...
  },
  error: function( jqXHR, textStatus, errorThrown ) {
    // handle error
  }
} );
```

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Managing Sessions Post-Authentication

- Set APEX session context manually using *APEX_AUTHENTICATION.POST_LOGIN*
- Redirect user to “Home” page

```
APEX_AUTHENTICATION.POST_LOGIN(
    p_username => l_username,
    p_password => 'fake password',
    p_uppercase_username => TRUE
  );
```

Optional: Check Enrollment Status

- Show biometric button only if enrolled
- In the login page's "On Load" process:
  - Query apex_passkeys table for user_id = :APP_USER
  - If row exists → enable "Sign in with Passkey" button (display icon)
  - If no row → hide passkey button
- Dynamic Action can show/hide APEX region or button based on SQL condition

Where Things Can Break

- Challenge Mismatch:
  - Dev must store and compare the exact challenge (little/big-endian issues)
- Origin Mismatch:
  - WebAuthn requires exact “origin” (scheme + hostname + port) match. Test in dev URL vs prod.
- Encoding/Decoding Errors:
  - Extracting publicKey from attestation requires correct parsing.
- Browser/Device Compatibility:
  - Some older browser versions may not fully support WebAuthn.

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Handling Errors Gracefully

- On Client Side (JavaScript):
  - Capture exceptions from navigator.credentials.create/get()
  - Show user-friendly message: “Passkey authentication failed. Please try again.”
- On Server Side (PL/SQL):
  - Wrap signature verification in BEGIN … EXCEPTION to return clear JSON error code
- UX Tips:
  - Provide fallback to “Login with password” if passkey fails repeatedly
  - Log exceptions in APEX debug logs to troubleshoot

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We have a Plug-In for that…

Plugin Introduction

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Challenges of Manual Implementation

Complexity in handling edge cases

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Why We Built the Plugin

Simplify life for APEX developers

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What the Plugin Automates

Enrollment, Authentication, Silent Checks

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How to Use the Plugin

Simple configuration & Dynamic Actions

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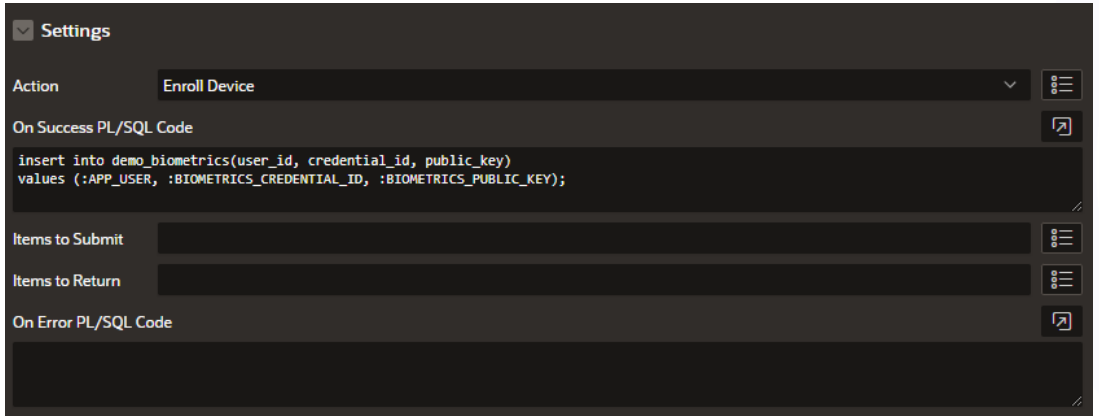
Real Example: Plugin Setup



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Live Demo

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Summary of Key Takeaways

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Try it out, integrate it, go passwordless

Next Steps

Any Questions?

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Where to Get the Plugin?

Scan QR Code to get the Code + Documentation

https://linktr.ee/kevintech.ninja

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Thank You!

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