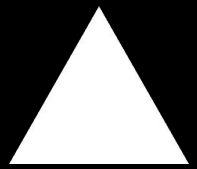

Where was I
a year ago today?

Muted

by Michael Arnaldi

on 𝕏.com

Well, well, well, how the turntables...

Vercel 🤝 Effect

A case study on vercel domains | Effect Days 2025

▲ ~/whois

Dillon Mulroy

I am a software engineer with 11 years of experience, primarily in the JavaScript, TypeScript, NodeJS, and React ecosystem(s). I currently lead Vercel's Domains product area and engineering team.

I have been using Effect since it's 3.0 release and it's become a foundational technology for me in building reliable and scalable applications.

→ x.com/dillon_mulroy

→ twitch.tv/dmmulroy

→ github.com/dmmulroy

▲ ~/agenda

The problem with TypeScript

▲ ~/agenda

- The problem with TypeScript
- Qualities of “production software” (imo)

▲ ~/agenda

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- Takeaways & the future

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- The problem with TypeScript
- Qualities of “production software” (imo)
- Why we’re betting on Effect
- The power of an Error
- TLD Metadata Service(s)
- Takeaways & the future
- Appendix: Useful patterns & code snippets

The problem with TypeScript

Only one?

Only one?

🤔

(just kidding)

▲ ~/the-problem-with-typescript

My hot take is that JS has the lowest bar of entry to building and being productive (a good thing) but one of the highest bars of any language and stack to building high quality, stable, and reliable software.

▲ ~/the-problem-with-typescript

The biggest problem with TypeScript/Node backends is that the language makes it far too easy to only ever consider the happy path

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Happy path blindness

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Happy path blindness

```typescript
function fetchDomainByNameForUser(
  domainName: string,
  userId: string,
): Promise<Domain> {
  await Auth.check({
    action: "query",
    resource: "domains",
    userId,
  });

  const domain = await db.query("domains", { name: domainName });

  if (!domain) {
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→ What happens if `Auth.check` throws? **Does it throw?** Can it throw **more than one kind** of error?

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→ What about `db.query`?

→ Can we **retry** on any errors?

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→ What about `db.query`?

→ Can we **retry** on any errors?

→ If so, do we need to consider a **backoff** interval for retrying?

→ How should we **communicate errors to callers**? Should we pass through errors? All of them? Should we wrap them with **custom errors**?

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  domainName: string,
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): Promise<Domain> {
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  const domain = await db.query("domains", { name: domainName });

  if (!domain) {
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  return domain;
}
```

Happy path blindness

"I'll just deal with errors in the calling code."

- Me, 6 months ago, probably

Happy path blindness

```
export async function GET(
  request: NextRequest,
  { params }: { params: { name: string } },
) {
  const domainName = params.name;
  const userId = getUserIdFromRequest(request);

  const domain = await fetchDomainByNameForUser(domainName, userId);

  return NextResponse.json(domain);
}
```

Happy path blindness

“I know this code works safely for my use case, catching the error at the route level will be fine, it’s just for an internal tool”

- Also me, 6 months ago, probably

Happy path blindness

"I need a function to fetch a domain. This looks useful, I'm sure it's safe to use."

- New developer on the team

Happy path blindness

```
import { fetchDomainByNameForUser } from "@/lib/domains"
```

Happy path blindness

```
import { fetchDomai
```

```
om "@/lib/domains"
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-with-typescript

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Only one?

🤔

(just kidding)

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(just kidding - only kinda)

▲ ~/the-problem-with-typescript/honorable-mentions

Errors are typed as unknown

Errors are typed as unknown

```
function getDnsRecords(dnsZone: string): Promise<DnsRecord[]> {}

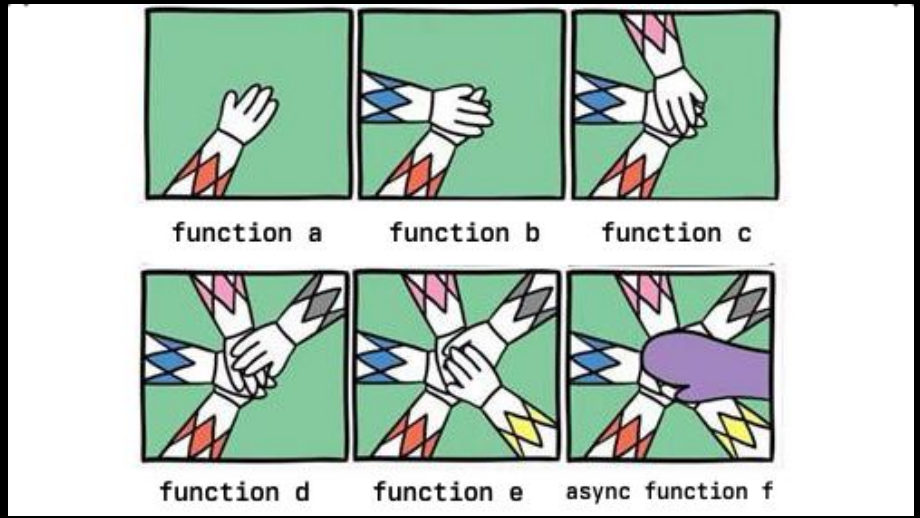
class DnsPropogationDelayError extends Error {}
class DnsZoneNotFoundError extends Error {}
class InvalidDnsZoneError extends Error {}

function handler(req, res) {
  try {
    // ...
    const dnsRecords = await getDnsRecords("v0.dev");
    //...
  } catch (error) {
    //     ^? `unknown`
  }
}
```

Function coloring

▲ ~/the-problem-with-typescript/honorable-mentions

Function coloring



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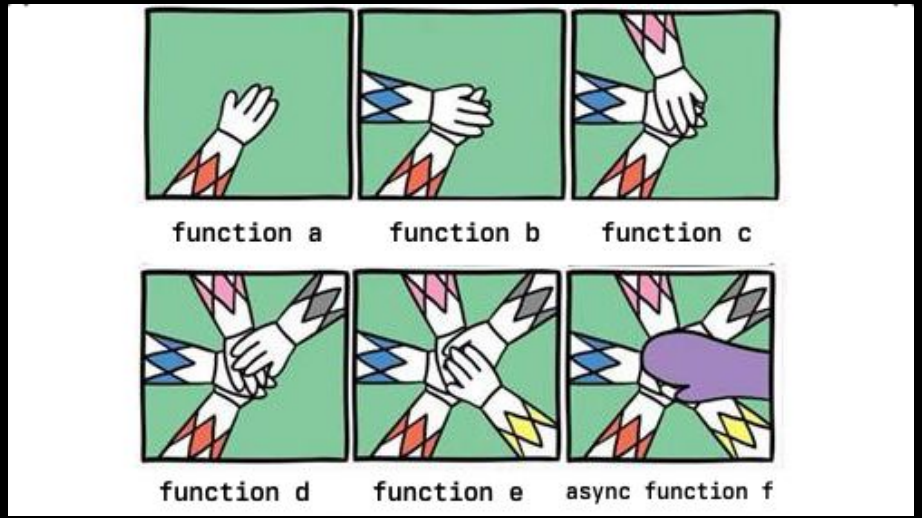

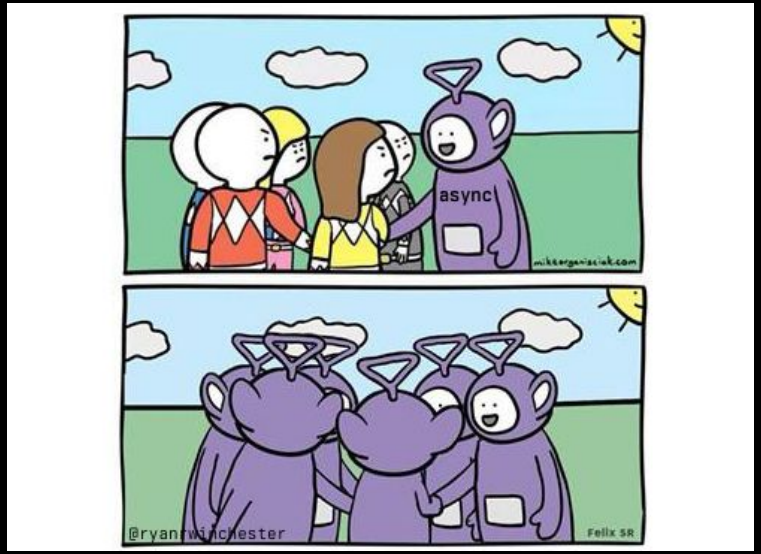

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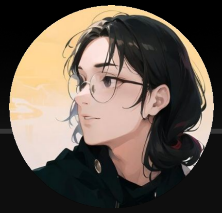
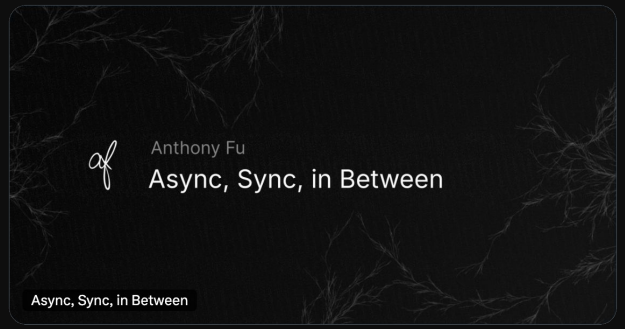


New blog post! Let's mess around with sync, async, and Schrödinger's Cat! 😼



From antfu.me

Function coloring

```
import { quansync } from "quansync";

export const readFile = quansync({
  sync: (filepath) => fs.readFileSync(filepath),
  async: (filepath) => fs.promises.readFile(filepath),
});

// Create a quansync with `function*` and `yield*`
export const readJSON = quansync(function* (filepath) {
  // Call the quansync function directly
  // and use `yield*` to get the result.
  // Upon usage, it will auto select the implementation
  const content = yield* readFile(filepath);
  return JSON.parse(content);
});
```

Fragmented ecosystem

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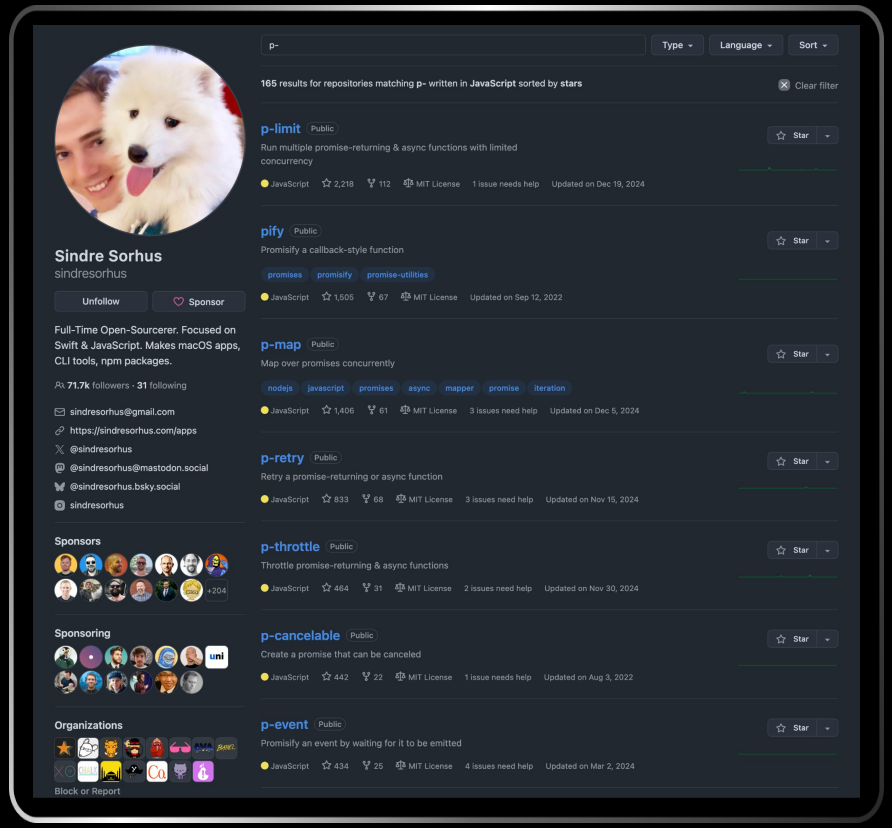

Qualities of “production software”

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(imo)

▲ ~/qualities-of-production-software

Predictable

▲ ~/qualities-of-production-software

- **Predictable**
- **Observable**

▲ ~/qualities-of-production-software

- **Predictable**
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- **Scalable**

▲ ~/qualities-of-production-software

Predictable

Consistent operation, **error handling**, and recovery.

Observable

Refactorable

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→ Teams and organizations require a high degree of **discipline**

→ Discipline on its own **does not scale**

▲ ~/qualities-of-production-software/consulting

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- FAANGs

Regardless of **organization/team size**, the **skill level** of engineers, or the type of product being built, I have not seen **TypeScript** scale in a **maintainable** way at the **people** & **process level**.

Why we're betting on Effect

▲ ~/betting-on-effect

TL;DR

It makes doing the hard, tedious, and error prone tasks that require discipline, easy, natural, first class, and fun.

Predictable

Predictable

The **Effect** type can **inform** of us of all the **guarantees** and **constraints** of our program(s) and code **at a glance**

Composable & Typed Error Tracking

Composable & Typed Error Tracking

```
function queryDomain(
  domainName: string,
): Effect.Effect<Domain, DomainNotFoundError>;

function enrichDomain(
  domain: Domain,
): Effect.Effect<EnrichedDomain, EnrichmentError>;

function renewDomain(
  enrichedDomain: EnrichedDomain,
): Effect.Effect<RenewedDomain, RenewalFailure>;
```

Composable & Typed Error Tracking

```
function renewDomainHandler(domainName: string) {
  return Effect.gen(function* () {
    const domain = yield* queryDomain(domainName);
    const enrichedDomain = yield* enrichDomain(domain);
    const renewedDomain = yield* renewDomain(enrichedDomain);

    return renewedDomain;
  });
}
```

Composable & Typed Error Tracking

```
function renewDomainAction(
  domainName: string,
): Effect.Effect<
  RenewedDomain,
  DomainNotFoundError | EnrichmentError | RenewalFailure
>;
```

Dependency Injection

Dependency Injection

```
function processUpstreamRegistrarTld(tldName: string) {
  return Effect.gen(function* () {
    const registrar = yield* UpstreamRegistrar;
    const db = yield* DomainsRegistryElectroDb;
    const priceCache = yield* PriceCache;

    const { tld_data } = yield* registrar.tlds.getTldMetadata(tldName);

    yield* Effect.all([db.persist(tld_data), priceCache.persist(tld_data)]);
  });
}
```

Dependency Injection

```
const processTlds = Effect.gen(function* () {
  // ... code excluded for brevity
  yield* processUpstreamRegistrarTld(".ai");
  // ... code excluded for brevity
});

const ProductionDependencies = Layer.empty.pipe(
  Layer.provide(UpstreamRegistrar.Default),
  Layer.provide(DomainsRegistryElectroDb.Default),
  Layer.provide(PriceCache.Default),
);

Effect.runPromise(processTlds.pipe(Effect.provide(ProductionDependencies)));
```

Dependency Injection

```
const processTlds = Effect.gen(function* () {
  // ... code excluded for brevity
  yield* processUpstreamRegistrarTld(".ai");
  // ... code excluded for brevity
});

const TestDependencies = Layer.empty.pipe(
  Layer.provide(UpstreamRegistrar.Test),
  Layer.provide(DomainsRegistryElectroDb.LocalStack),
  Layer.provide(PriceCache.InMemory),
);

Effect.runPromise(processTlds.pipe(Effect.provide(TestDependencies)));
```

You can just `yield*` things

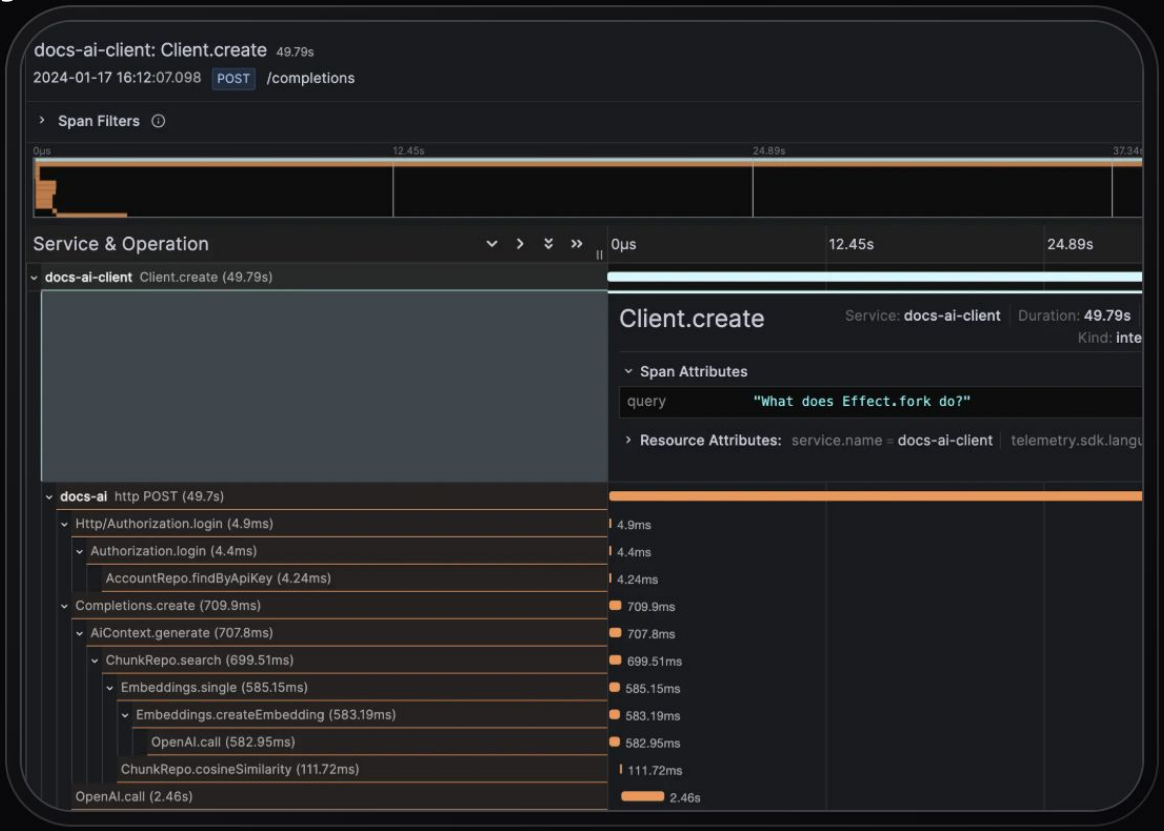
Observability

Observability

```
export const syncTlds = (tlds: Tld[]) => {
  return Effect.gen(function* () {
    // ... implementation ...
  }).pipe(
    Effect.withSpan("upstream_registrar.sync_tlds", {
      attributes: {
        tlds,
      },
    }),
  );
};
```

▲ ~/betting-on-effect

Observability



Harmony

▲ ~/betting-on-effect

Harmony

Case Study

Adopting Effect for Domains

▲ ~/case-study

The Timeline

▲ ~/case-study

The Timeline

December

Self-Serve Renewals

▲ ~/case-study

The Timeline

December

Self-Serve Renewals

January

TLD Metadata Service(s)

▲ ~/case-study

The Timeline

December

Self-Serve Renewals

January

TLD Metadata Service(s)

February

Domains Search/Buy Revamp

▲ ~/case-study

The Timeline

December

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Domains Search/Buy Revamp

March

Effect Days

▲ ~/case-study

The Actual Timeline

▲ ~/case-study

The Actual Timeline

December

Self-Serve Renewals work starts

▲ ~/case-study

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Refactor Availability & Buy APIs to support urgent Billing/Money team initiative

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The Domains Team becomes official. We add two engineers and a designer 🎉

▲ ~/case-study

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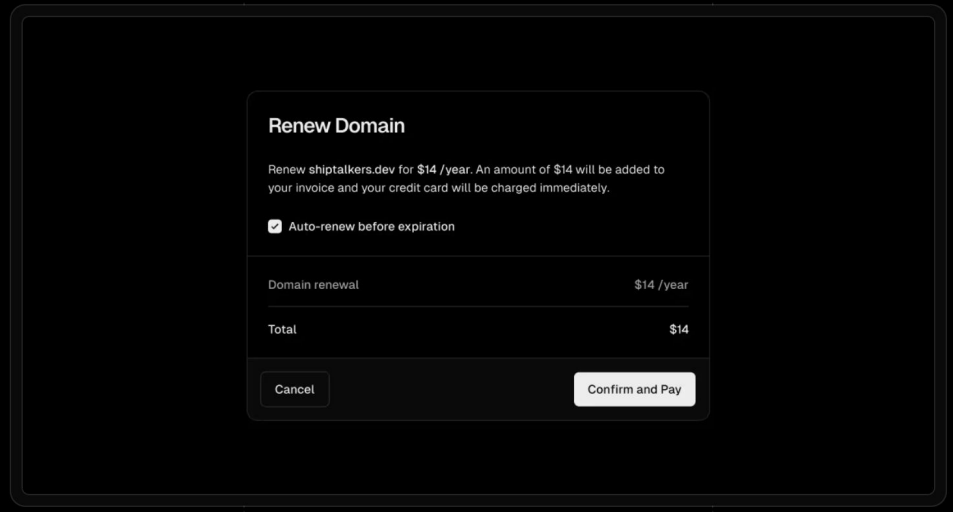
March

TLD Metadata Service ships & Search/Buy planning kick off.

TIMELINES
HD
HISTORY.COM

The power of an Error

Self-serve domain renewals and redemptions now available



▲ ~/case-study/the-power-of-an-error

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→ The domains product area had the **second highest amount** of CSE tickets month/month, with **a majority resulting from renewal issues**.

→ **3 distinct error types**, a deprecated logger, and little to **no telemetry**.

```
type RenewDomainError =
  | ApiError
  | StripePaymentError
  | StripePaymentMethodError
```

Enter

`Data.TaggedError`

```
class DomainsMutexError extends Data.TaggedError("DomainsMutexError")<{
  domainName: string;
  cause?: unknown;
}> {}

const error = new DomainsMutexError({ domainName: "v0.dev" });

error._tag;
//    ^? `DomainsMutexError`
```

▲ ~/case-study/the-power-of-an-error

Self-Serve Renewals

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Self-Serve Renewals

→ As part of extracting our renewal from the auto-renewal cron, we **audited our errors** and introduced **neverthrow** and Effect's **Data.TaggedError**

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→ This resulted in a **dramatic reduction** in CSE tickets, **customer empowerment**, and improved time to fix issues/bugs thanks to improved **telemetry**, **tracing**, and **observability**.

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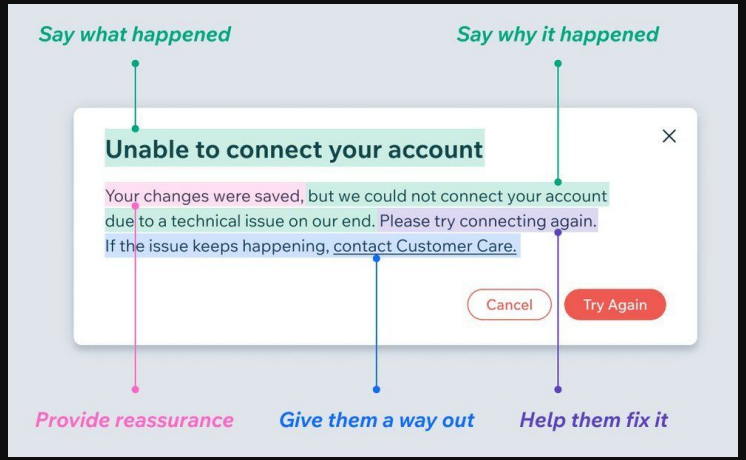
```
export type RenewDomainError =
  | CannotRenewError
  | CustomerIdNotFoundError
  | DomainsMutexError
  | DraftInvoiceError
  | ExpirationDateOutOfRangeError
  | GetDomainInvoiceError
  | GetDomainPriceError
  | GetUpstreamRegistrarDomainError
  | InvalidDomainStatusError
  | UpstreamRegistrarDomainNotFoundError
  | UpstreamRegistrarRenewDomainError
  | PayInvoiceError
  | RefundDomainInvoiceError
  | RenewFailureError
  | SyncDomainError
  | TLDConfigNotFoundError
  | UpdateVercelDomainError;
```

WIX
ENGINEERING



TLD Metadata Service(s)

The Problem

▲ ~/case-study/tld-metadata-services

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→ Our **TLD portfolio**, each TLD's **metadata**, and their **prices** were all managed via a private npm package and various **one off json files**.

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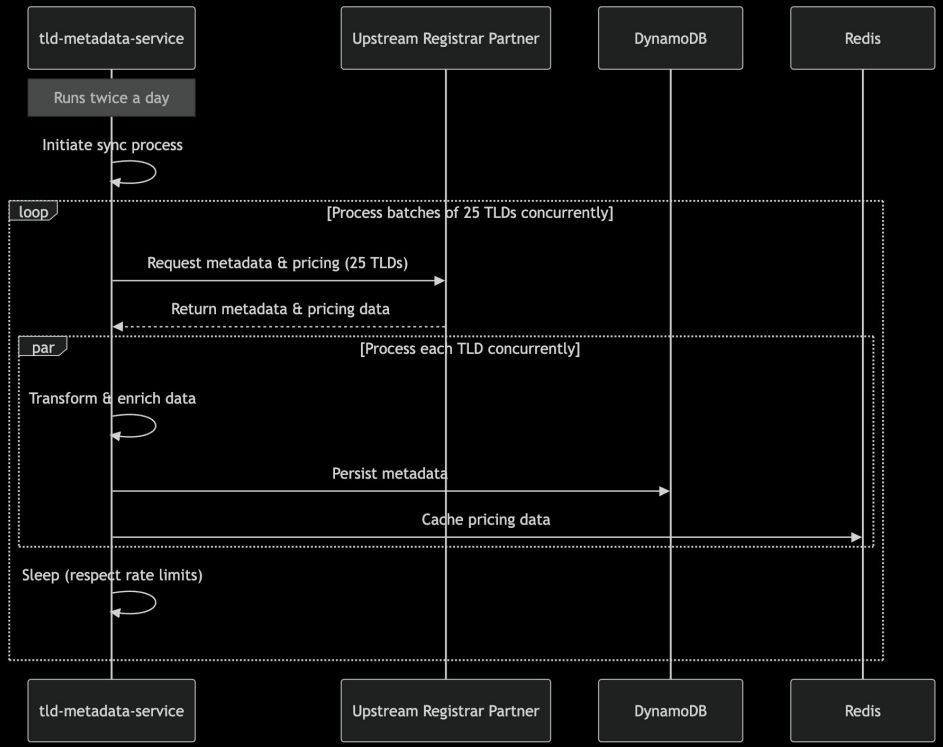

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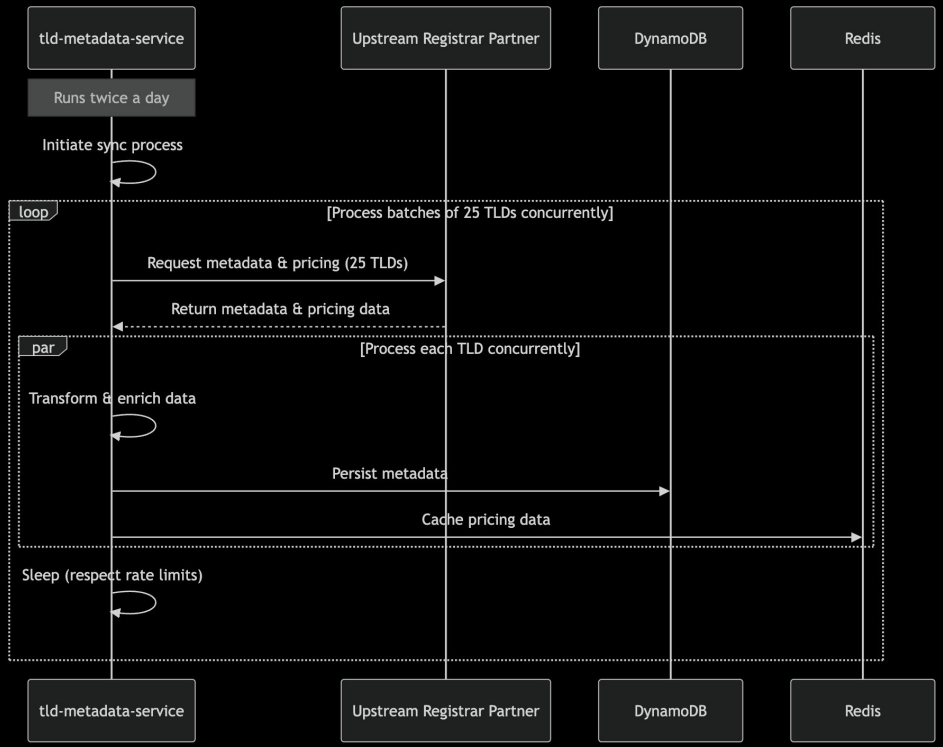

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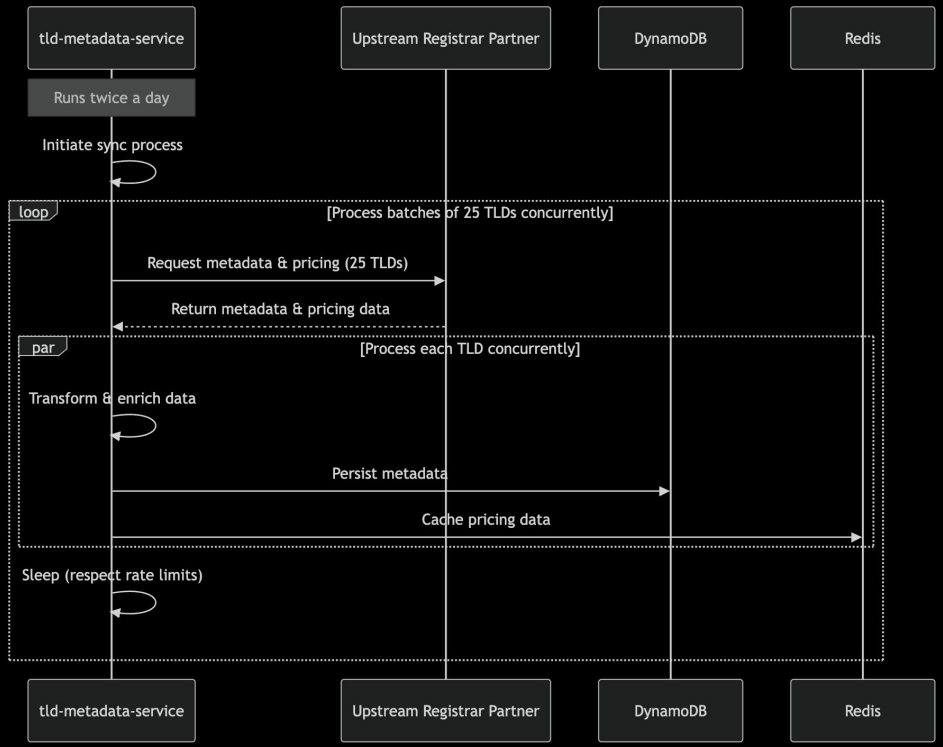

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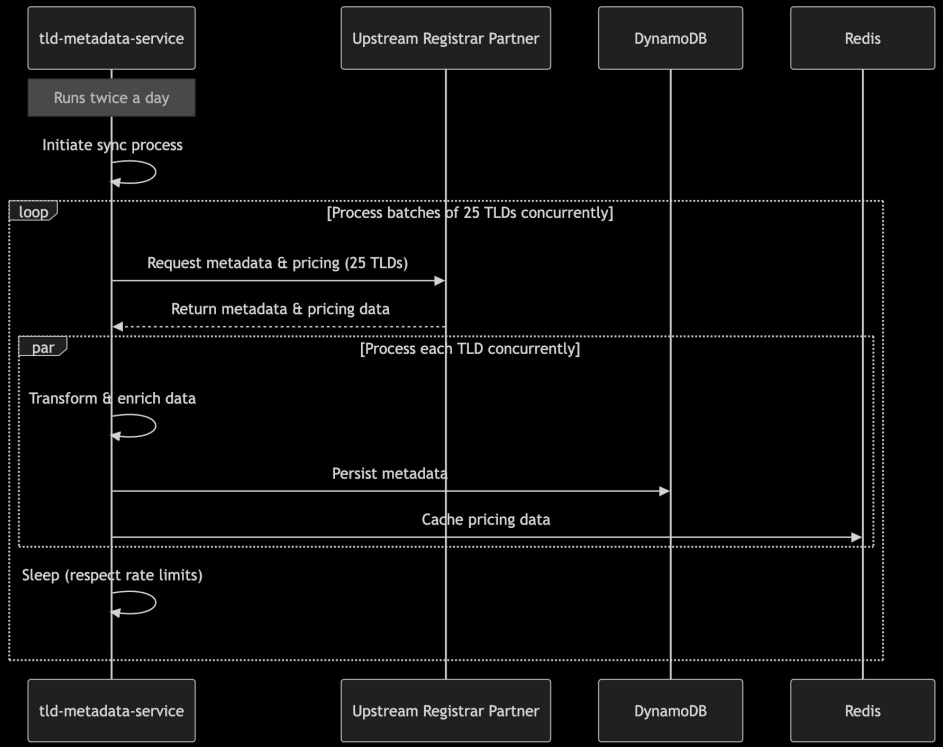

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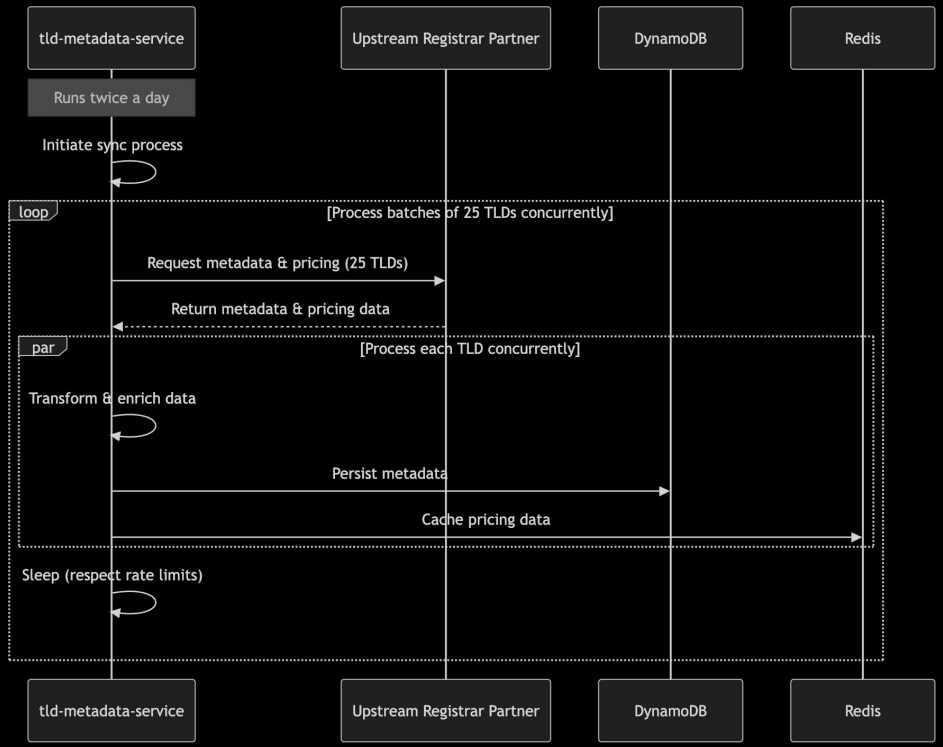

Takeaways & the future

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Vercel 🤝 Effect

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→ Answers to the **most common problems** we have at Vercel in our **TypeScript Monorepos**

Vercel

🤝

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→ There is a **large API surface** (it is TypeScripts missing standard library after all) and when **APIs aren't documented** you have to **rely on the Effect Team** or **Discord**. **AI** also currently **struggles** with Effect.

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→ Some APIs and abstractions feel too **"low-level"** and aren't as **intuitive** as the rest of the ecosystem

Vercel

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Effect

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I am very excited, eager, and optimistic about the future of Effect, especially at Vercel.

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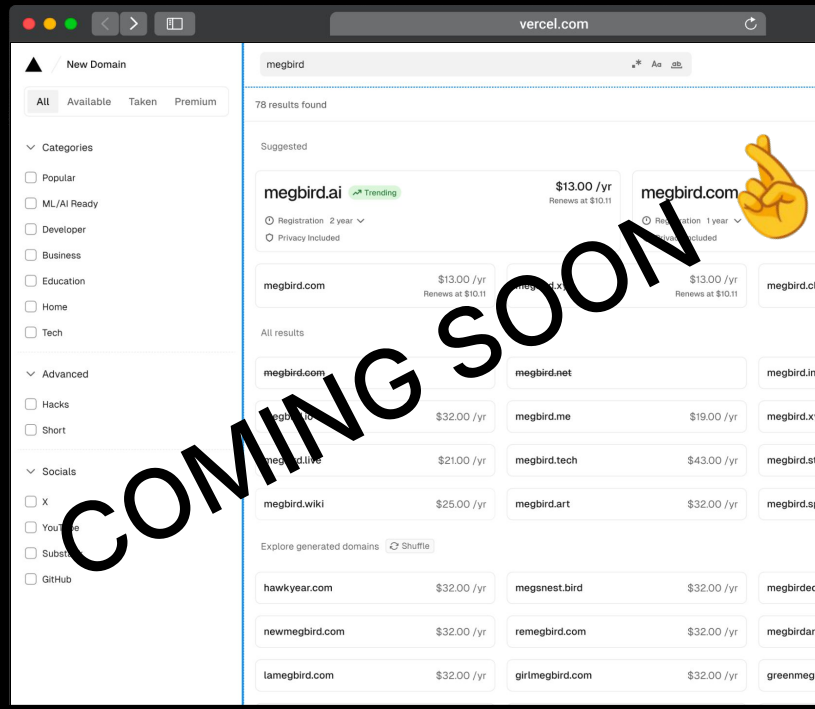

Thank you

Appendix:
Useful patterns & code snippets

▲ ~/patterns/with-instrumentation

```
getOrdersByDomain(domain, options) {
  return opensrs
    .use((client) =>
      client.lookupCommands.getOrdersByDomain(domain, options),
    )
    .pipe(
      withInstrumentation(
        'registrar.lookup_commands.get_orders_by_domain',
        {
          annotateSpansWith: {
            domain,
          },
          attributes: {
            'order.type': options?.type,
            'order.status': options?.status,
            'order.from': options?.order_from,
            'order.to': options?.order_to,
          },
          retryPolicy: RetryPolicy.exponentialBackoffPolicy,
        },
      ),
    );
},
```

```
export const withInstrumentation =
  (
    spanName: string,
    options: InstrumentationOptions = defaultInstrumentationOptions,
  ) =>
  <Success, Failure, Requirements>(
    effect: Effect.Effect<Success, Failure, Requirements>,
  ) => {
    return Effect.gen(function* () {
      const opts = { ...defaultInstrumentationOptions, ...options };

      const currentSpan = yield* Effect.orElseSucceed(
        Effect.currentSpan,
        () => undefined,
      );

      const logAnnotations = Object.assign(
        {
          'dd.trace_id': currentSpan?.traceId,
          'dd.span_id': currentSpan?.spanId,
        },
        opts.annotateLogsWith,
        opts.annotateSpansWith,
      );

      return yield* effect.pipe(
        Effect.tapError((error) =>
          Effect.annotateCurrentSpan(
            isError(error)
              ? {
                  'error.name': error.name,
                  'error.stack': error.stack,
                  'error.message': error.message,
                  'error.cause': error.cause,
                }
              : flatten(error),
          ),
        ),
        Effect.retry(opts.retryPolicy),
        Effect.annotateLogs(logAnnotations),
        Effect.withSpan(spanName, {
          attributes: opts.attributes,
          kind: opts.spanKind,
          links: opts.spanLinks,
          parent: opts.spanParent,
          root: opts.isRootSpan,
        }),
        Effect.annotateSpans(opts.annotateSpansWith ?? {}),
      );
    });
  };
```

▲ ~/patterns/neverthrow-to-effect

```
/**
 * Converts a `Result` from the `neverthrow` library into an `Effect`.
 *
 * This function transforms a `Result<A, E>` into an `Effect.Effect<A, E, never>` by
pattern matching
 * on the result. If the `Result` is a success, it creates a succeeding `Effect`
with the value.
 * If the `Result` is an error, it creates a failing `Effect` with the error.
 *
 * @template A - The type of the success value.
 * @template E - The type of the error.
 *
 * @param {Result<A, E>} result - The `Result` to convert into an `Effect`.
 * @returns {Effect.Effect<A, E, never>} The resulting `Effect` representing either
success or failure.
 */
export function neverthrowResultToEffect<A, E>(
  result: Result<A, E>,
): Effect.Effect<A, E> {
  return result.match(Effect.succeed, Effect.fail);
}
```

▲ ~/patterns/effect-promise-settled-result

```
/**
 * Converts an Effect into a `PromiseSettledResult`.
 *
 * Runs the provided Effect using the given runtime and converts the result
 * into a settled promise result. If the effect succeeds, it returns a fulfilled
 * result. If it fails, the error is squashed and returned as a rejected result.
 *
 * @param {Runtime.Runtime<never>} runtime - The Effect runtime to execute within.
 * @returns A function that takes an effect and returns a settled promise result.
 */
export const effectToPromiseSettledResult =
  (runtime: Runtime.Runtime<never>) =>
  async <Success,>(
    effect: Effect.Effect<Success>,
  ): Promise<PromiseSettledResult<Success>> => {
    return runtime.runPromiseExit(effect).then((exit) => {
      if (Exit.isSuccess(exit)) {
        return PromiseSettledResult.succeed(exit.value);
      }

      return PromiseSettledResult.fail(Cause.squash(exit.cause));
    });
  };
```