new Global

status update & feedback request

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Problem statement

Minimal addition to the spec sufficient for implementing various ideas around lightweight isolation, including Compartment, in user code.

Differences with other approaches

Compared to Shadow Realm or exposing an Isolate constructor

- attempts no intersection with web standards
- enables isolation that doesn't undermine synchronous communication and shared prototypes
- avoids adding new concepts, reuses existing `Global` concept, allows replicas.
- while use cases may seem similar, this proposal being same-realm and avoiding duplicating large objects should allow more granular isolation/encapsulation

Motivation

- Domain Specific Languages
- Test runners
- Principle of Least Authority (Compartment)
- Emulating another host
- Isolation of unreliable code (AI)

Example - DSL

```
const dslGlobal = const new Global();
dslGlobal.describe = () => {};
dslGlobal.before = () => {};
dslGlobal.after = () => {};

const source = await import.source(entrypoint);
await dslGlobal.eval('s => import(s)')(source);
```

```
dslGlobal.document = mockDomApi;
```

currently, Node.js `vm` module is often used

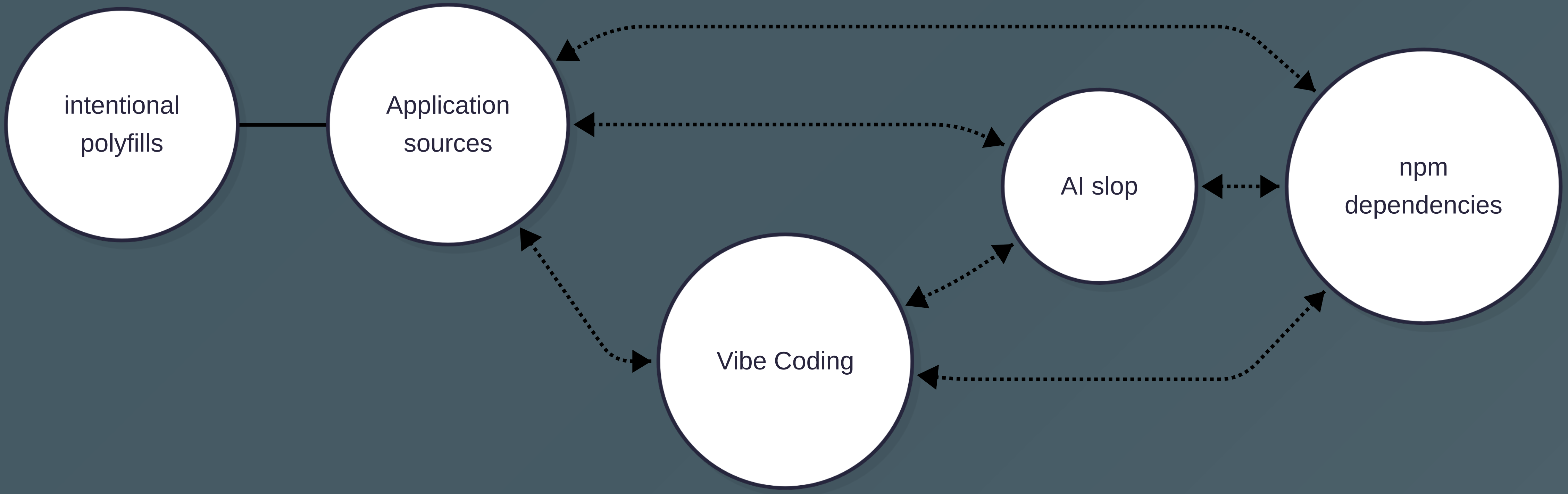
Isolation and AI

- AI agents generating code are here to stay
- Actors producing code in an application not aligned on intentions

`new Global` + freezing intrinsics OR `getIntrinsic`

- Encapsulate AI code to avoid it coming up with matching globals elsewhere or producing misguided attempts at polyfills inline
- Doesn't need to be security-grade isolation to contain impact of faulty code
- Generated code can interact, import and call functions regardless of the isolation

Isolation by actor



Emulating another host

- https://webcontainers.io/
- varius web IDEs
- use of Node.js built-ins in other environments
- DOM emulation in test runners

new Global

```
interface Global {
  constructor({
    keys?: string[],
    importHook?: ImportHook,
    importMetaHook?: ImportMetaHook,
  })
  // Unique to the new global:
  Global: typeof Global,
  eval: typeof eval,
  Function: typeof Function,
  // internal slots for *Function as well

  // + properties copied from globalThis filtered by keys
}
```

Properties

- minimum change sufficient for implementing `Compartments` in user code.
- avoids adding new concepts (eg. `Evaluators`), reuses existing `Global` concept.
- no new categories of global object, just replicas
- host creates the global object
- not opinionated on minimal set of properties

> “ `Global` picks up from the previous proposal for `Evaluators` and results from an observation that an object conveniently containing all evaluators alreaedy exists in the spec and all we need to do is expose a constructor for it.
> It also eliminates the concern where evaluators accepting any globalThis to use would clash with the host implementation's desire to use special objects only the host can create.
> No API to set a custom reference as global context for evaluators if it's not created via `new Global`
> When a new global is created it inherits all properties from parent global unless user specifies a list. Spec offers no opinions on minimal global, only demands that all evaluators are present. ”

Details

- allows mutating `(new Global()).globalThis` before evaluation
- by default copy all properties from `globalThis`
- properties: `Global` and all evaluators have their internal slots relating them to the new *global*, that includes all `*Function` slots.

```
(async () => {}).constructor !==
new Global().eval('async () => {}').constructor
```

Details - All properties grafted by default

```
globalThis.x = {};
const newGlobal = new globalThis.Global();
newGlobal.Object === globalThis.Object;
newGlobal.x === globalThis.x;
```

Details - Properties can be selectively grafted

```
globalThis.x = {};
globalThis.y = {};
const newGlobal = new Global({
  keys: ['y'],
});
newGlobal.x === undefined;
newGlobal.y === globalThis.y
```

Details - Some properties undeniable

```
const newGlobal = new Global({
  keys: []
});
newGlobal.Object === globalThis.Object;
```

Details - Own unique evaluators

```
const newGlobal = new Global();
newGlobal.eval !== thisGlobal.eval;
newGlobal.Global !== thisGlobal.Global;
newGlobal.Function !== thisGlobal.Function;
```

Details - Other unique intrinsic evaluators

```
const newGlobal = new Global();
newGlobal.eval("Object.getPrototypeOf(async () => {})") !==
  Object.getPrototypeOf(async () => {});
newGlobal.eval("Object.getPrototypeOf(function *() {})") !==
  Object.getPrototypeOf(function* () {});
newGlobal.eval("Object.getPrototypeOf(async function *() {})") !==
  Object.getPrototypeOf(async function* () {});
```

Details - Inherits host import hook and module map by default

```
const newGlobal = new Global();
const fs1 = await import("node:fs");
const fs2 = await newGlobal.eval('import("node:fs")');
fs1 === fs2; // if present
```

Details - Can override import hook

```
const newGlobal = new Global({
  async importHook(specifier) {
    if (specifier === 'node:fs') {
      return import.source('mock-fs.js');
    } else {
      return import.source(specifier);
    }
  }
});
const fs = await newGlobal.eval('import("node:fs"))');
```

Details - Closed holes

```
const fs = await (0, eval)('import("node:fs")');
```

```
const AsyncFunction = (async () => {}).constructor;
const fs = await new AsyncFunction('return import("node:fs"))');
```

```
const fs = await import(new ModuleSource(`
  export default new Function('return import("node:fs")')();
`));
```

Closing every escape gadget requires rigor — but is possible!

Overlap with Module Harmony

```
const globalThat = new Global({
  importHook(specifier) {
    log(`global ${specifier}`);
    return new ModuleSource("");
  },
});
const source = new globalThat.ModuleSource(
  `
  import 'static-import';                            // local static-import
  eval('import("direct-eval-import")');              // local direct-eval-import
  globalThis.eval('import("indirect-eval-import")'); // global indirect-eval-import
  new Function('return import("function-import")');  // global function-import
`,
  {
    importHook(specifier) {
      log(`local ${specifier}`);
    },
  }
);
await import(source);
```