# LibreS3: design, challenges, and steps toward reusable libraries

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## Concepts

LibreS3's architecture is not novel: it is based on existing, well-established concepts. What is interesting is how these all work together in a real application.

## Monad with exception handling

```
type +α t (* the type of deferred computations *)
val return : α → α t (* immediate value to deferred value *)
val (>>=) : α t → (α → β t) → β t (* chain *)
val fail : exn → α t (* exception to deferred value *)
val try_bind : (unit → α t) → (α → β t) → (exn → β t) → β
t (* [try_bind m f g] either f or g *)
```

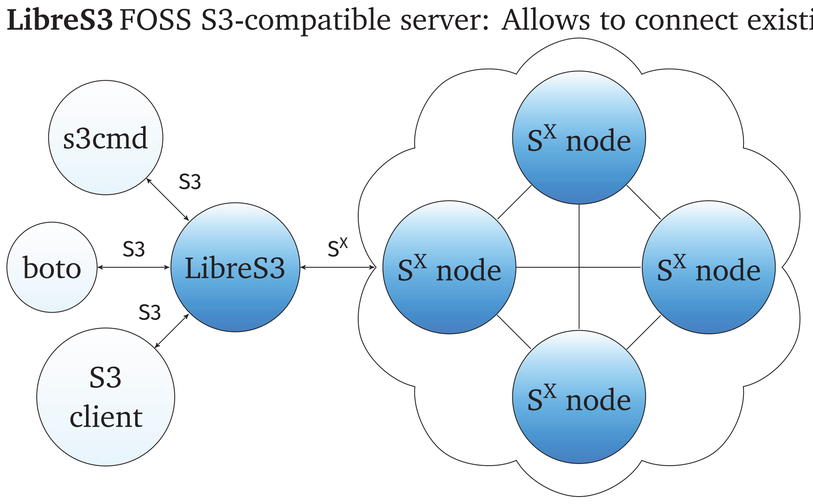
Implementable by monadic concurrency libraries: Lwt, Async, but also by the Result monad.

## Object storage HTTP(S) REST API

**Amazon S3 server** proprietary, runs on Amazon's hardware

**SX server** FOSS cluster storage backend: supports deduplication, no vendor lock-in

**LibreS3** FOSS S3-compatible server: Allows to connect existing S3 clients to an S$^X$ cluster.




- an HTTP(S) server that implements the S3 REST API on one side
- an S$^X$ client on the other side
- both LibreS3 and S$^X$ runs on your own hardware

## Libraries

Reusable components of LibreS3, parametrized by a monad: it is not tied to one particular implementation, or to the use of a monadic concurrency library. See also Cohttp, Mirage, ...

## any-cache: Least Recently Used cache with 2 Queues.

**Implemented as a result monad functor**

```
module Make(R:Result) : sig
type ('ok, 'err) t
val create : int → ('ok, 'err) t
val get : ('ok, 'err) t → notfound:'err → string → ('ok, 'err) R.t
val set : ('ok, 'err) t → string → ('ok, 'err) R.t → unit
val lookup : ('ok, 'err) t → string →
        (string → ('ok, 'err) R.t) → ('ok, 'err) R.t
end
```

**monad transformer provided internally**

```
let lift f v = M.try_bind (fun () → f v) return fail
```

**usable with monadic concurrency libraries**

```
val lookup_exn: (α, exn) t → string → (string → α M.t) → α M.t
```

**Testing (same code for Lwt, Async and direct mode)**

```
module Make(Monad: MonadTest) = struct
  (* *)
    Monad.run (lookup cache key1 (compute_data_direct cnt))
```

## any-http

Somewhat similar to how Mirage applications are built

```
module MyApp(H : Httpintf.S) = struct (* ... *)
let uri = Uri.make ~scheme:"http" ~host ~port ~path () in
H.Client.call meth uri (H.Headers.init ()) (H.Body.empty)
>>= fun (status, headers, bodystream) →
H.Body.to_string bodystream >>= fun body →
 (* ... *)
module App = MyApp(Httpservice_cohttp_async)
module App = MyApp(Httpservice_ocsigenserver)
module App = MyApp(Httpservice_cohttp_lwt.Make
  (Cohttp_lwt_unix.Server) (Cohttp_lwt_unix.Client))
```

## Work in progress

**any-io** abstract over Unix vs Lwt_unix (Async and Mirage too in the future)

**ioconvcomb** combinators for describing Json/Xml to OCaml type conversion
Ideas from: "Type-safe functional formatted IO" (Oleg Kiselyov), `cconv`, `meta_conv` and `dyntype`. Benefits: don't have to choose between Yojson/Jsonm, unified tree/streaming interface and error reporting.

## Issues

**double-release of runtime lock** OCamlNet < 3.7.4, ocaml-ssl 0.4.6a
tracked down using a debug patch for OCaml's runtime and submitted patch

**`Unix.fork` in Ocsigenserver** must use `Lwt_unix.fork`
otherwise it hangs if an error message is printed, patched upstream

**`ocamlbuild` SIGPIPE on *BSD** worked around in 4.02

**Lwt readdir crash** fixed in 2.4.2

**OCamlnet SSL persistent connections** fixed in 3.7.4

**PUT/DELETE support in Ocsigenserver** implemented in 2.4.0

**Ocsigenserver default worker threads** 1000 too much, using 64

**Mirage** XSA-90 / CVE-2014-2580 (crashed Dom0 kernel), not used yet

## Packaging

**If user has OPAM it is easy, but ...**

**User may not have "new enough OCaml"** RHEL/CentOS 6
rebuilt .spec file from Fedora on CentOS6 and provide binary rpm

**Libraries requiring newer versions** ~~3.11.2~~ 3.12.1 4.00.1

**"portable" Linux binaries** `4.01.0+lsb` and `4.01.0+musl+static`
opam switches if you really need them

**Full source tarball** embedded 3rdparty libraries
custom build script, but very slow

**Automation** lack of a full OASIS/OPAM workflow

- **Existing** oasis2deb, oasis2opam
- **Missing** (oasis|opam)2rpm, (oasis|opam)2bsd
- **Wishlist** opam2release (to build full source tarball, .deb, .rpm and *BSD)

## Additional materials

**Paper, bibliography, sample code**

http://goo.gl/jmFOcn

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http://www.skylable.com/tag/libres3/