

# Edelweiss

## A decentralized protocol compiler

[github.com/ipld/edelweiss](https://github.com/ipld/edelweiss)

Petar Maymounkov

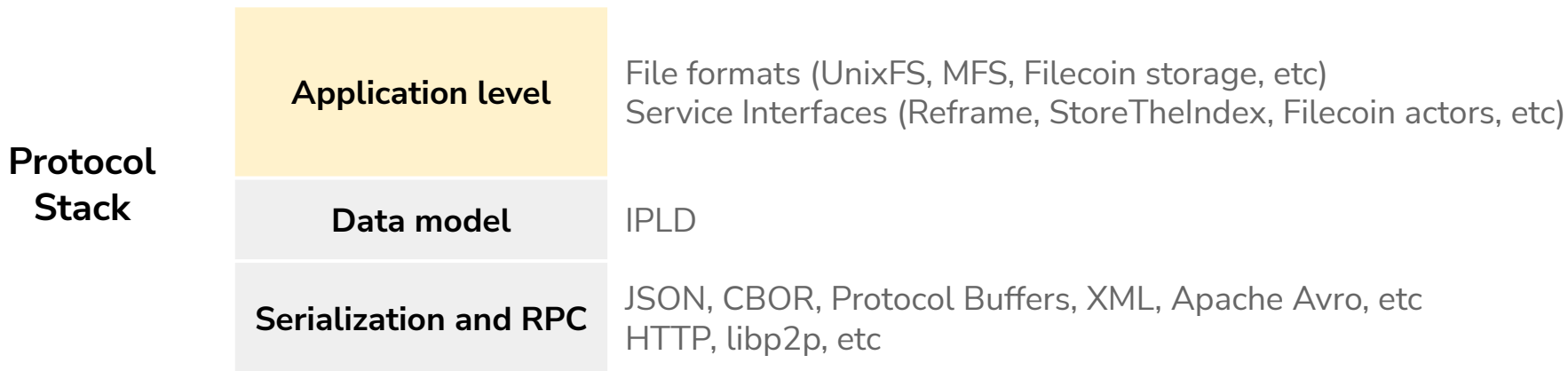
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# History blitz

Decentralized data structures require a new data model.

**IPLD** = decentralized JSON = content-addressed links + JSON

Data model is **agnostic** to application abstraction (above), and serialization (below).



# Application developers need

- Define higher-level **data abstractions**
  - E.g. file system, content provider, signed peer record
- Define **service interfaces**
  - E.g. Reframe API, StoreTheIndex API, Filecoin multisig actor API
  - E.g. IPFS **command-line interface**
- Get **language bindings**
  - Go, JavaScript, Rust at minimum
  - Python, Lean, Julia as well

# System developers need

- To use context-specific **serialization, networking and RPC backends** e.g.
  - Synchronous JSON-over-HTTP (Reframe)
  - Asynchronous JSON-over-HTTP (FVM)
  - CBOR-over-HTTP (Reframe)
  - CBOR-over-libp2p (IPFS?)

# Prior work

Application **data abstractions** modelled using schema definition languages  
(Protobuf, XML Schema, JSON Schema)

- **Drawbacks:**

- Awkward for uncoordinated decentralized work (e.g. protobuf field indices)
- Serialization-specific features (don't apply to IPLD)

**Service interfaces** modelled using interface definition languages  
(Protobuf, Apache Thrift)

- **Drawbacks:**

- Lack of decentralized abstractions like **links** and **lambdas** (e.g. FVM actors and EVM smart contracts pass **callbacks**)
- Hard to change the backend (network stack and call semantics)

# Our approach

## Data and service definition language

- Higher data and service abstractions (e.g. file system state and API) modelled as types
- Types are composed from a standard set of generic building blocks (maps, lists, structures, unions, lambdas, links, singletons, etc) from programming
- Types have IPLD representations (encode to and decode from IPLD)

## Bindings to programming languages

- Compiler generates code
- Simple, language-aware framework for defining code generation templates (novel)

## Developer tools

- Compiler can check if two user types (e.g. file format, service API) are interoperable
- Compiler can generate type descriptors (not implemented yet)
- Support for generic, dependent types (e.g. “link to a file system of CAR files”)

# Basic types

**Primitive:** Bool, Float, Int, Byte, Char, String, Bytes, Int128, UInt256, Float64, ...

**Special:** Any, Nothing

**Composite:** Link, List, Map, Structure, Tuple, Inductive/Enum (*Lean, OCaml, Rust*)

**Functional:** Lambda, Service, Method

**Predicate:** Singleton, Union (*Lean, OCaml, Julia, Rust*)

# Decentralization and interoperability features

**SemVer is all-or-nothing.** Inappropriate for Web3.

## Interoperability type checking

- Developers can check whether two different protocols (e.g. an old client and a new server) can work together from their type descriptors
  - Fine- and coarse-grain (e.g. method, data, and service)
  - At compile-time and run-time

**Schema definition language can express all possible IPLD tree patterns** (novel)

- Singleton type decodes by exact match (e.g. used for magic numbers in protocols)
- Union type decodes one of a few of alternatives



# Schemas for parsing IPLD

Web3 developers need to write schemas for existing IPLD protocols.

**Use types as schemas for parsing desired IPLD tree patterns.**

Can user-defined types describe all possible IPLD tree patterns?

This depends on the set of basic types. Existing schema languages lack:

- Type for exact matching (singleton), eg  
*“this field must have the value 3”*
- Type for sequential alternatives (union), eg  
*“this field must either parse as a PeerRecord or else as an IPNSRecord”*

Same needs when extending current protocols in backwards compatible ways.

# State of affairs

## Current users

- Reframe API, IPFS, DHT Hydra Booster, StoreTheIndex, SomeGuy

## What's behind us

- Generation of high-performance data type serialization in Go
- Generation of asynchronous JSON/HTTP and CBOR/HTTP backends in Go

## What's ahead of us

- Source syntax parsing
- Data and network backends for TypeScript/JavaScript
- Prototype a backend for FVM actors

**We are hiring a compiler engineer!**

Reach out to [petar@protocol.ai](mailto:petar@protocol.ai)