Run Your Own Beaconcha.in

The open source ethereum explorer
https://github.com/gobitfly/eth2-beaconchain-explorer

Patrick & Stefan
Developer, Bitfly
Contents

● Introduction
  ○ Who we are
  ○ A brief history
● Architecture
  ○ Initial setup
  ○ Design workshop
  ○ Post merge changes
● Setup your own explorer
  ○ Sync from provided nodes
  ○ Understand how the data is stored
Before we begin, let’s pray to the wifi-gods 🙏

Also we will setup all the things now so we do not have to do later:

- Install docker if you haven’t yet:
  - curl -fsSL https://get.docker.com -o get-docker.sh && sh get-docker.sh
  - sudo usermod -aG docker $USER
- git clone https://github.com/guybrush/explorer-workshop-bogota
- cd explorer-workshop-bogota
- (sudo) docker pull redis postgres bigtable
Introduction
Who we are

- We work for bitfly and are located in Vienna, Austria
- The company was incorporated in 2017
- Developed the first ethereum block explorer called etherchain.org
- Operated and retired ethermine.org
- Migrated the business model to offer custodial and non-custodial staking services (staking.ethermine.org & ethpool.org)
Brief History

The beaconcha.in explorer started as an open source block explorer for (Phase 0) the Beaconchain. It has since evolved to support a wide range of features.

- First commit in 2019
- We participated in the public test networks (Zinken, Spadina, Medalla)
- In the beginning the explorer could be used to understand and monitor validator duties.
- After the merge we also added execution data
Initial setup

Our initial architecture was relatively simple. It included a postgres database, a consensus node, an execution node and some golang code. Unfortunately it did not scale well.

- **State July 2021**
  - Prysm **567 GB**
  - Erigon Node **1.4 TB**
  - Postgres Database **2 TB**

- **State October 2022**
  - Lighthouse **5 TB** (32 slots)
  - Erigon **2.1 TB**
  - Postgres **10 TB**
Scaling challenges

- Table locking and contention
- Expensive indexing
- Data pressure increases with the number of validators
- No caching of frequently executed queries across frontend instances
- Read replica lag & downtime during merge
- Extract services from our monolithic binary into smaller micro services
- Manage technical debt
Partitioning postgres-tables helps only so much

a new week begins ;}
Indexing and serving large amounts of data is hard.

Design your own post merge block explorer

Technical Requirements

- Keep indexing times for epochs below 6.4 minutes
- Handle large tables
  - Attestation assignments (50 GB / week)
  - Validator balances (50 GB / week)
  - With one row per validator per epoch that's 90 million rows per day.
- Low latency queries
- Minimal contention between tables and operations
- High availability
The biggest change is the introduction of Bigtable, which is a sparsely populated database that can scale to billions of rows and thousands of columns.

- Consensus & Execution Nodes
- Consensus & Execution Indexer
- Postgres & Bigtable Databases
- Frontend Cache Updater
- Additional services and exporters
- Golang Webserver
- Mobile App
Export time improvements
Section 3

Local block explorer setup
Start the beaconchain explorer locally
At this point I will try to lead on my screen and cast it to the beamer

- ./run.sh init-dbs
- ./run.sh start-eth1indexer
- ./run.sh start-exporter
- ./run.sh start-statistics
- ./run.sh start-frontend
- Browse [http://localhost:8080](http://localhost:8080)
- ./run.sh explore-epoch <epoch>
- ./run.sh explore-address <addr>
- ./run.sh explore-block
Use **bogota50** for a one-time 50% off on beaconcha.in

- beaconcha.in/premium - Mobile
- beaconcha.in/pricing - API
Contribution

- Gitcoin Grant
- Github pull requests
- Create issues
- Tweet @beaconcha_in
- https://github.com/gobitfly/eth2-beaconchain-explorer
- https://gitcoin.co/grants/258/beaconchain-open-source-eth2-blockchain-explorer
Thank you!

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@mightiestpirate
**Overview**

<table>
<thead>
<tr>
<th>Address</th>
<th>0x388c818ca8b9251b393131c08a736a67ccb19297</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance</td>
<td>42,919,579,577,769,575,350 Ether</td>
</tr>
<tr>
<td>Ether Value</td>
<td>$55,409.18 at 1,291/ETH</td>
</tr>
<tr>
<td>ERC20 Tokens</td>
<td>3</td>
</tr>
</tbody>
</table>

**Tokens**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Balance</th>
<th>@ $0.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGS</td>
<td>$0.00</td>
<td>2</td>
</tr>
<tr>
<td>NPQ</td>
<td>$0.00</td>
<td>6,91753</td>
</tr>
<tr>
<td>V</td>
<td>$0.00</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**Transactions**

<table>
<thead>
<tr>
<th>Number</th>
<th>Age</th>
<th>Gas Usage</th>
<th>Reward</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,726,534</td>
<td>39 secs ago</td>
<td>12,512,177</td>
<td>0.037855 Ether</td>
</tr>
<tr>
<td>15,726,527</td>
<td>2 mins ago</td>
<td>16,069,739</td>
<td>0.038016 Ether</td>
</tr>
<tr>
<td>15,726,521</td>
<td>3 mins ago</td>
<td>24,029,960</td>
<td>0.060985 Ether</td>
</tr>
<tr>
<td>15,726,519</td>
<td>3 mins ago</td>
<td>28,029,274</td>
<td>0.102095 Ether</td>
</tr>
</tbody>
</table>
Validators can use Relays to outsource their Block Production to entities specialized in extracting extra revenue. These Relays exist as a means of minimizing required trust under the participating entities - they only have to trust the relay itself, and not each other.

Extra Revenue is generated by reordering and/or inserting transactions in an otherwise normal block. This is often referred to as MEV, or "Maximum-Extractable-Value". The validator which gets to propose a block by a relay will get a cut of this revenue in exchange, shown below as the "block reward".

A Relay can consist of a single builder, in which case the relay builder will accept transaction bundles from searchers, or many builders, where the relay operator will pick the the block of the builder with the highest block reward.

<table>
<thead>
<tr>
<th>Name</th>
<th>Block Count</th>
<th>Unique Builders</th>
<th>Average Reward</th>
<th>Highest Reward</th>
<th>Overall Rewards</th>
<th>Uncensored</th>
<th>Unfiltered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashbots (Relay)</td>
<td>19719</td>
<td>24</td>
<td>0.12309005 ETH</td>
<td>27.10751361 ETH (Slot 4,860,149)</td>
<td>2,427,21268804 ETH</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>BioXroute [Max-Profit] (Relay)</td>
<td>1550</td>
<td>2</td>
<td>0.08767855 ETH</td>
<td>10.29742219 ETH (Slot 4,860,151)</td>
<td>135,90174964 ETH</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Blocknative (Relay)</td>
<td>1265</td>
<td>2</td>
<td>0.0685902 ETH</td>
<td>8.45228874 ETH (Slot 4,846,853)</td>
<td>84,23860738 ETH</td>
<td>No</td>
<td>???</td>
</tr>
<tr>
<td>BioXroute [Ethical] (Relay)</td>
<td>796</td>
<td>2</td>
<td>0.05724768 ETH</td>
<td>0.88801248 ETH (Slot 4,854,216)</td>
<td>45,58915452 ETH</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Eden Network (Relay)</td>
<td>715</td>
<td>3</td>
<td>0.51154951 ETH</td>
<td>278.29152063 ETH (Slot 4,867,314)</td>
<td>365,75790317 ETH</td>
<td>No</td>
<td>???</td>
</tr>
<tr>
<td>Manifold (Relay)</td>
<td>695</td>
<td>2</td>
<td>0.06212564 ETH</td>
<td>1.13689442 ETH (Slot 4,880,148)</td>
<td>43,17732285 ETH</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>BioXroute [Regulated] (Relay)</td>
<td>362</td>
<td>2</td>
<td>0.10821261 ETH</td>
<td>10.81853595 ETH (Slot 4,861,499)</td>
<td>39,17296383 ETH</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Blocks:
Blocks proposed using Relays contain a block reward paid out to the validator. Blocks themselves can be published by builders/relays to other relays as well, causing them be tagged under multiple Relays.

<table>
<thead>
<tr>
<th>Slot</th>
<th>Proposer</th>
<th>Relays</th>
<th>Block Reward</th>
<th>Block Extra Data</th>
<th>Proposer Fee Recipient</th>
<th>Builder</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,867,314</td>
<td>371162</td>
<td>Eden Network (Relay)</td>
<td>278.29152083 ETH</td>
<td></td>
<td>0x388c81...b19297</td>
<td>0xb19297</td>
</tr>
<tr>
<td>4,702,849</td>
<td>245856</td>
<td>Flashbots (Relay)</td>
<td>43.9140042 ETH</td>
<td>Illuminate Democratize Distribute</td>
<td>0x388c81...b19297</td>
<td>0xa1dead...ef27fc</td>
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<tr>
<td>4,768,529</td>
<td>4448</td>
<td>Flashbots (Relay)</td>
<td>40.91641779 ETH</td>
<td>Illuminate Democratize Distribute</td>
<td>0xe988d2...1ce621</td>
<td>0xa1dead...ef27fc</td>
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<tr>
<td>4,767,666</td>
<td>67588</td>
<td>Flashbots (Relay)</td>
<td>36.53754998 ETH</td>
<td>@builder69</td>
<td>0xe94f1f...86ca0c</td>
<td>0xb194b2...2d3027</td>
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<tr>
<td>4,738,717</td>
<td>79139</td>
<td>Manifold (Relay)</td>
<td>31.9242307 ETH</td>
<td>Ø gethgo1.19.6.linux</td>
<td>0x535b91...2990a3</td>
<td>0xa25f5d...64e943</td>
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<td>4,838,986</td>
<td>385120</td>
<td>Flashbots (Relay)</td>
<td>30.89565557 ETH</td>
<td>Illuminate Democratize Distribute</td>
<td>0x388c81...b19297</td>
<td>0xb19297</td>
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<tr>
<td>4,824,087</td>
<td>191756</td>
<td>Flashbots (Relay)</td>
<td>29.32735946 ETH</td>
<td>Illuminate Democratize Distribute</td>
<td>0x7a1a48...5390d6</td>
<td>0xa1dead...ef27fc</td>
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<tr>
<td>4,860,149</td>
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<td>Flashbots (Relay)</td>
<td>27.10751361 ETH</td>
<td>Ø gethgo1.19.1.linux</td>
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<td>4,852,498</td>
<td>275895</td>
<td>Flashbots (Relay)</td>
<td>23.93986197 ETH</td>
<td>Illuminate Democratize Distribute</td>
<td>0xffe098...b1143b</td>
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<tr>
<td>Validator</td>
<td>Subscriptions</td>
<td>Most Recent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>282468</td>
<td>attestation missed, got slashed, proposal missed</td>
<td>attestation missed, 3 days 5 hrs ago</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>282469</td>
<td>attestation missed, got slashed, proposal missed</td>
<td>attestation missed, 3 days 17 hrs ago</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>282470</td>
<td>attestation missed, got slashed, proposal missed</td>
<td>attestation missed, 37 days 10 hrs ago</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>