Burrow Validators

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1 Fees

We want to validators to earn a fee in proportion to network transaction volumes (of a kind relevant to our domain), their bonded voting power, and their availability. This sets out a way to do this by looking at smoothed validator signing history.

1.1 Fee calculation

For each transaction we charge a fee dependent on the contract being called. Each account may have a fee associated with it (possibly 0). When a transaction is executed we look up the fee associated with the callee and subtract it from the value being sent in the call. This fee then needs to be disbursed across validators of the network...

1.2 Fee disbursement

We distribute the fee on a per transaction basis according to a 'rolling average of relative available power'; it is rolling because it is calculated across the previous B blocks, it is relative because for each block we are interested in the power of each validator divided by the total power of all validators, and it is available in that we only count the validator's power at a given block height if the validator was available for that round, i.e. it has signed a valid precommit for the block committed at that height.

When a block is committed the fee distribution is finalised, but it is calculated per transaction based on *previous* blocks.

We distribute the fee from each transaction according to weights $\lambda_i(h)$ for the ith validator at block height h (summing to unity). So for each transaction $fee(tx) = \sum_{i=1}^{N} fee_i(tx)$ where $fee_i(tx) = \lambda_i(h) fee(tx)$.

The weights are calculated according to:

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\begin{aligned}
N &\coloneqq \text{notional total number of validators that will ever be encountered} \\
B &\coloneqq \text{number of previous blocks over which to average} \\
v_i(h) &\coloneqq \text{validator power at height h} \\
\mathbb{1}_i(h) &\coloneqq \begin{cases} 0 & i\text{th validator was absent for block h} \\ 1 & i\text{th validator was present for block h} \end{cases} \\
P_i(h) &\coloneqq \sum_{b=1}^{B} \mathbb{1}_i(h) v_i(h-b) \ \textit{(rolling absolute available power)} \\
\lambda_i(h) &\coloneqq \frac{P_i(h)}{\sum_{i=1}^{N} P_i(h)} \ \textit{(rolling relative available power)}
\end{aligned} \tag{1}
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By construction the weights at each height sum to unity so we distribute the entire fee for each transaction. Computationally we can maintain sliding windows over the summand of $P_i(h)$ for each validator and for all validators representing the B block lookback, which we can use to calculate the $\lambda_i(h)$ ratios efficiently.