Proposer-builder separation {#proposer-builder-separation}

Present-day Ethereum validators create and broadcast blocks. They bundle together transactions that they have heard about through the gossip network and package them into a block that is sent out to peers on the Ethereum network. **Proposer-builder separation (PBS)** splits these tasks across multiple validators. Block builders become responsible for creating blocks and offering them to the block proposer in each slot. The block proposer cannot see the contents of the block, they simply choose the most profitable one, paying a fee to the block builder before sending the block to its peers.

This is an important upgrade for several reasons. First, it creates opportunities to prevent transaction censorship at the protocol level. Second, it prevents hobbyist validators from being out-competed by institutional players that can better optimize the profitability of their block building. Third, it helps with scaling Ethereum by enabling the Danksharding upgrades.

PBS and censorship resistance {#pbs-and-censorship-resistance}

Separating out block builders and block proposers makes it much harder for block builders to censor transactions. This is because relatively complex inclusion criteria can be added that ensure no censorship has taken place before the block is proposed. As the block proposer is a separate entity from the block builder, it can take on the role of protector against censoring block builders.

For example, inclusion lists can be introduced so that when validators know about transactions but don't see them included in blocks, they can impose them as must-haves in the next block. The inclusion list is generated from the block proposers local mempool (the list of transactions it is aware of) and sent to their peers just before a block is proposed. If any of the transactions from the inclusion list are missing, the proposer could either reject the block, add the missing transactions before proposing it, or propose it and let it get rejected by other validators when they receive it. There is also a potentially more efficient version of this idea that asserts that builders must fully utilize the available block space and if they don't transactions are added from the proposer's inclusion list. This is still an area of active research and the optimal configuration for the inclusion lists has not yet been determined.

[Encrypted mempools](#) could also make it impossible for builders and proposers to know which transactions they are including in a block until after the block was already broadcast.

Powerful organizations can pressure validators to censor transactions to or from certain addresses. Validators comply with this pressure by detecting blacklisted addresses in their transaction pool and omitting them from the blocks the propose. After PBS this will no longer be possible because block proposers will not know which transactions they are broadcasting in their blocks. It might be important for certain individuals or apps to comply with censorship rules, for example when it is made law in their region. In these cases, compliance happens at the application level, while the protocol remains permissionless and censorship free.

PBS and MEV {#pbs-and-mev}

Maximum extractable value (MEV) refers to validators maximizing their profitability by favorably ordering transactions. Common examples include arbitraging swaps on decentralized exchanges (e.g. frontrunning a large sale or purchase) or identifying opportunities to liquidate DeFi positions. Maximizing MEV requires sophisticated technical know-how and custom software appended to normal validators, making it much more likely that institutional operators outperform individuals and hobbyist validators at MEV extraction. This means staking returns are likely to be higher with centralized operators, creating a centralizing force that disincentivizes home staking.

PBS solves this problem by reconfiguring the economics of MEV. Instead of the block proposer doing their own MEV

searching, they simply pick a block from many offered to them by block builders. The block builders might have done sophisticated MEV extraction, but the reward for it goes to the block proposer. This means that even if a small pool of specialized block builders dominate MEV extraction, the reward for it could go to any validator on the network, including individual home stakers.

Individuals could be incentivized to stake with pools rather than on their own due to the enhanced rewards offered by sophisticated MEV strategies. Separating the block building from the block proposal means that the MEV extracted will be distributed over more validators rather than centralizing with the most effective MEV searcher. At the same time, allowing specialized block builders to exist takes the burden of block building away from individuals, and also prevents individuals from stealing MEV for themselves, while maximizing the number of individual, independent validators that can check the blocks are honest. The important concept is "prover-verifier asymmetry" which refers to the idea that centralized block production is fine as long as there is a robust and maximally decentralized network of validators able to prove the blocks are honest. Decentralization is a means, not an end goal - what we want are honest blocks.

PBS and Danksharding {#pbs-and-danksharding}

Danksharding is the way Ethereum will scale to >100,000 transactions per second and minimize fees for rollup users. It relies upon PBS because it adds to the workload for block builders, who will have to compute proofs for up to 64 MB of rollup data in less than 1 second. This will probably require specialized builders that can dedicate fairly substantial hardware to the task. However, in the current situation block building could become increasingly centralized around more sophisticated and powerful operators anyway due to MEV extraction. Proposer-builder separation is a way to embrace this reality and prevent it from exerting centralizing force on block validation (the important part) or the distribution of staking rewards. A great side-benefit is that the specialized block builders are also willing and able to compute the necessary data proofs for Danksharding.

Current progress {#current-progress}

PBS is in an advanced stage of research, but there are still some important design questions that need to be resolved before it can be prototyped in Ethereum clients. There is no finalized specification yet. This means PBS is likely a year away or more. Check the latest [state of the research](#).

Further Reading {#further-reading}

- [State of research: censorship resistance under PBS](#)
- [PBS-friendly fee market designs](#)
- [PBS and censorship resistance](#)
- [Inclusion lists](#)