ssv.network

SSV Network Simple DVT Testnet on Holesky

LIDO

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1. Introduction

The ssv.network DAO is happy to announce that SSV Network has performed above the requirements set by Lido LNOSG to participate in the SimpleDVT module on mainnet. With this, the ssv.nework DAO would like to share a performance report detailing the testing effort with the Lido protocol, SSV Network, and community node operators on the Holesky testnet.

Why Simple DVT? Benefits of DVT for Lido

Distributed Validator Technology (DVT) stands out as an important new primitive for Lido and the wider staking industry by enabling a single validator to be operated by multiple machines. The adoption of DVT within the SimpleDVT module enhances Lido's node operator resilience, scalability, and decentralization.

These advancements promote increased participation and collaboration, facilitating smaller operators' alignment with larger counterparts thereby fostering a more diverse and robust network. This inclusive approach sets the stage for a trustless future, allowing even at-home validators to integrate with Lido seamlessly.

DVT offers a rapid method for adding diverse Node Operators (NOs) to the Lido Node Operator set, including solo and community stakers. In addition to the current 37 Lido Ethereum Curated Node Operators, onboarding 250 new Node Operators on the mainnet would signify a notable 676% expansion of the Lido protocol operating mainnet validators. The module will also serve as a stepping stone for more permissionless models in the future, such as the Community Staking Module.
SSV provides baselayer security and decentralization for LSPs and LRTs alike.

2. Test Overview

The SSV testnet #3 was initiated on November 22nd with 32 clusters and a 5/7 threshold configuration involving 192 individuals and organizations.

Following infrastructure and tooling issues identified in late November and early December, the testnet resumed on January 3rd with 177 participants. The challenges primarily stemmed from issues involving Holesky SAFE, Walletconnect on Holesky, and the SSV Web app. The discrepancy in participants was attributed to certain participants becoming unresponsive or encountering difficulties in completing the setup process.

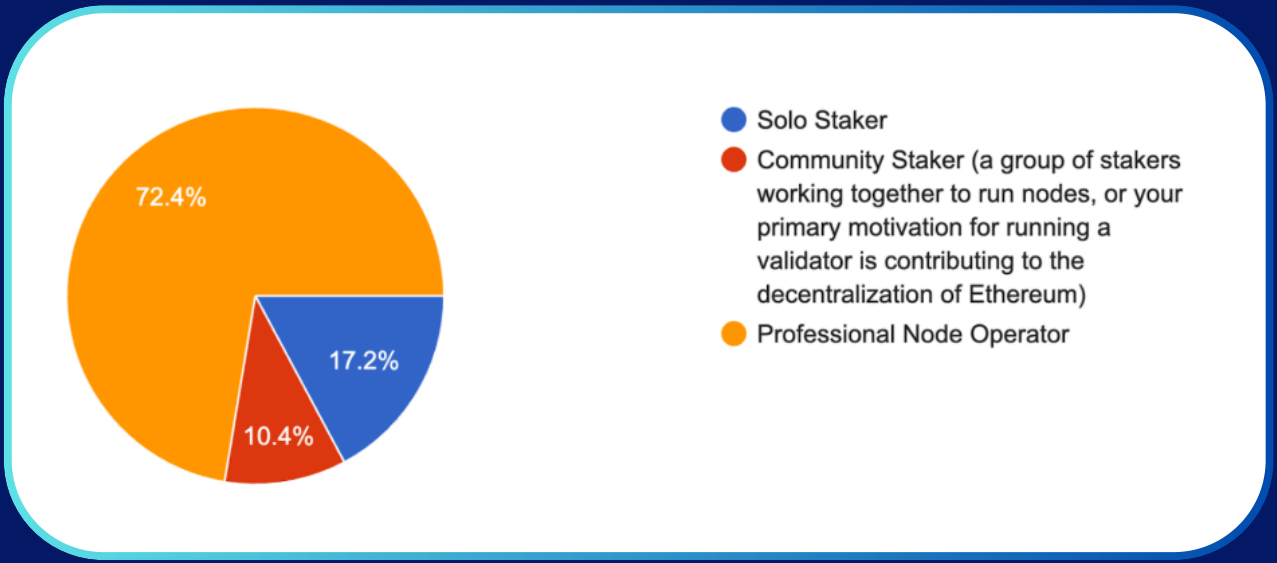
Metrics 30d (dates)	SSV performance	Holesky Network Average (30d)	Minimum Testnet Sucess Metric
Validator count	3200	1,5M	
Slashings	0	15	
Uptime (Effectiveness)	98.58%	71.47%	95%
Proposal Sucess Rate	94.38%	90.35%	70%
Attestation Effectiveness	80.65%	72.44%	72.44%

After the clusters were generated with DKG, the first round of testing saw each cluster register and deposit 5 validators. After the initial 5 validators, each cluster subsequently ran 50 and then 100 validators per cluster. Each round had a week-long monitoring period.

Following the completion of the testing phase on 18 April, the data gathered from the clusters' performance was meticulously analyzed. With the promising outcomes of the testing phase, the team is now gearing up for the next stage, leveraging the learnings from the test to fine-tune the clusters and ensure their efficiency and reliability in real-world scenarios.

3. Cluster Setups

The 177 participants in 32 clusters were composed of advanced NOs, participants from prior testnets, solo stakers, and NOs from Lido's curated list.



To ensure optimal distribution of NOs in the Simple DVT module, it was crucial to test NOs from different geographical locations, EL/CL clients, MEV relays, and infrastructural components.

Locations: Node operators from all 6 continents participated.

Execution clients: Erigon, Besu, Nethermind, Geth

Consensus clients: Prysm, Lighthouse, Teku, Nimbus, Lodestar

MEV: MEV-Boost, Titan Relay, Flashbots, Eden

Infrastructure: Bare Metal in a Data Center, Public Cloud, Home Machine (NUC), Dappnode, Avado, On-Premises Server

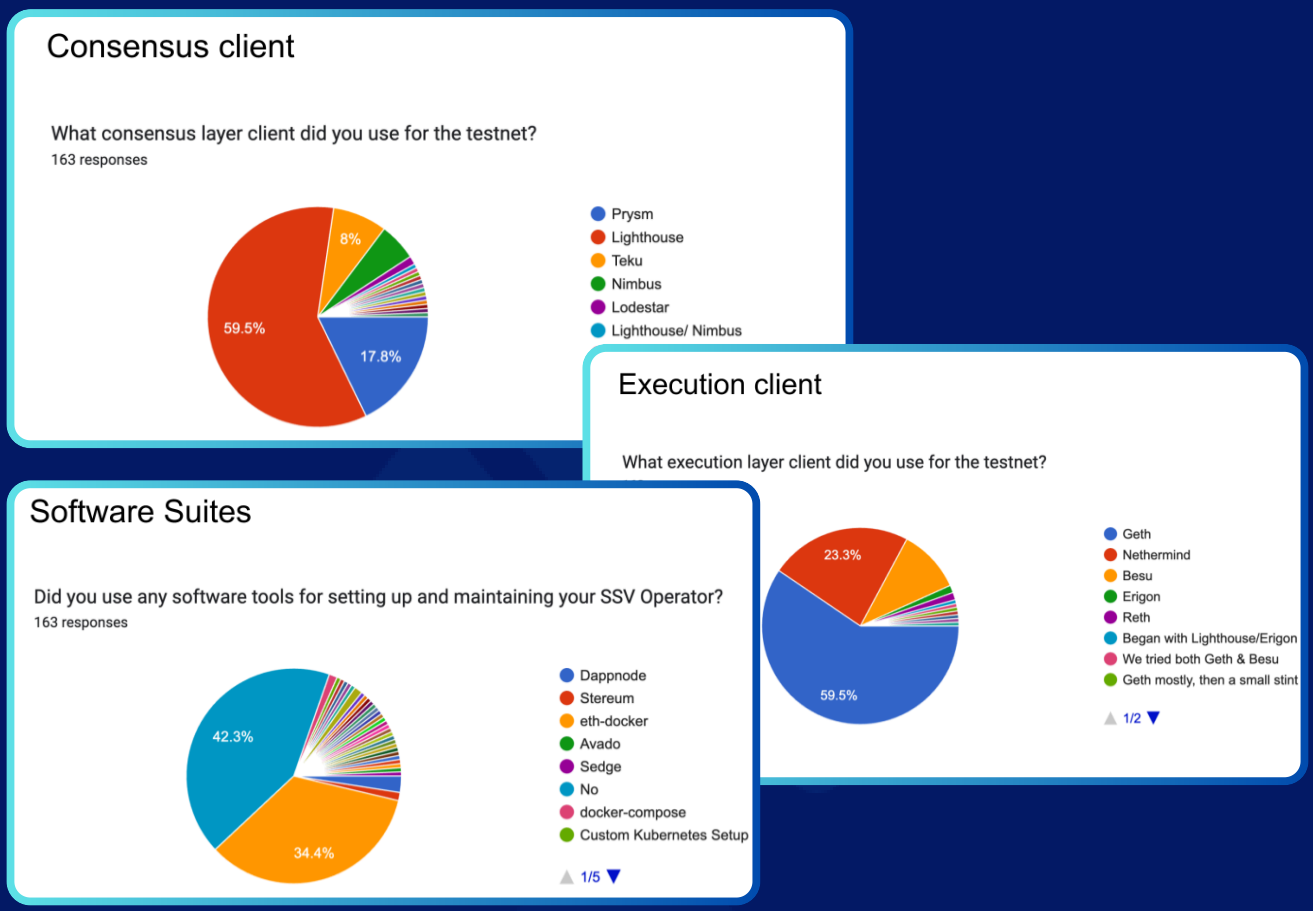
This test is a beautiful example of how DVT allows a cluster of node operators to be distributed according to all of the above criteria. Testing for maximum distribution is essential for the Simple DVT module to be as decentralized as possible, thus providing the maximum possible resilience to faults, bugs, jurisdictional issues, or even a data center going down.

4. Lesson Learnt & Recommendations

Optimal NO Setups & Hardware

During the testnet, differences in performance were observed based on how NOs maintained node software and hardware. Execution and Consensus clients need to be monitored and updated to ensure intra-cluster health. Having the optimal amount of resources to run software is equally important.

It was observed that disk I/O is a critical component of a successful setup and that performant choices like NVMe offers an edge. During the test, a few bare metal node operators had to make substitutes due to the stress they were under. Regrettably, certain operators were utilizing outdated HDDs, resulting in significantly lower performance than expected. It is recommended to ensure viability of physical setups and resources allocated to run a node.



Holesky Testnet Environment Readiness

The network's nascent stage presented several challenges, including the absence of adequate SAFE and MEV Boost support, with the Titan relay being a new addition lacking prior mainnet or testnet experience. Since only Titan relay was available in the early stages of testnet, it caused issues when no bids were available or when the relay itself faced some challenges. When an MEV-Boost version compatible with Holesky was released, three different relays were selected. Since some operators were faster than others in switching configurations, block proposals were briefly negatively impacted because of the lack of correlation between relays in some cluster configurations. This scenario highlights the importance of relay support and correlation between cluster participants to ensure optimal liveness.

Additionally, the occurrence of the Deneb fork significantly disrupted clients and notably affected the average performance on Holesky. Furthermore, the lack of comprehensive developer tooling further compounded these difficulties. These collective factors significantly prolonged processes and undermined participant performance.

Recommendations for future improvements include prioritizing the development of robust network support structures, enhancing tooling capabilities, and fostering resilience to potential network disruptions. Implementing these measures will be vital in ensuring smoother operations and improved performance in subsequent endeavors.

Geographical Distribution is not a Factor

Contrary to expectations, latency emerged as a negligible factor, evidenced by the high block proposal rate. Given that block proposal, particularly with MEV considerations, represents the most time-sensitive task for validators, the SSV cluster's proficient performance underscores minimal latency influence.

Nevertheless, the test revealed a minor issue concerning the reporting of missed consensus duties for individual operators. This discrepancy likely stems from the remainder of the cluster achieving consensus before the operator can submit the final message. While the impact on operator statistics is marginal, it remains perceptible, prompting the team to conduct further investigation.

Tooling for Cluster Coordination

The SSV Network serves as a marketplace for node operation, utilizing smart contracts to establish clusters seamlessly without manual coordination. Notably, the SSV DKG process itself requires no coordination, which is a significant advantage over other implementations.

For specialized modules like Simple DVT, effective coordination tools are essential to foster streamlined collaboration among node operators (NOs). While traditional Multisig frameworks may not suffice, off-chain platforms play a crucial role in facilitating collective operations, particularly for tasks like key generation and transaction signing.

While communication tools like Gnosis Safe and transaction-alerting wallets are indispensable, they often necessitate manual coordination via email or Discord, introducing the potential for human error. Given the inherent fallibility of human involvement, particularly in scenarios where operators serve multiple clusters or fail to adhere to instructions, mistakes can occur, exacerbating issues. This is compounded by the inability of multisig participants to verify the transactions they are signing.

To address these challenges, instructions were streamlined, and Lido developed a tool to verify payload, mitigating the risks associated with manual coordination.

However, it is evident that further research and development efforts should be directed towards creating automated or semi-automated coordination mechanisms to enhance efficiency and reduce the likelihood of human errors.

Timing of Trials

In retrospect, it is evident that the timing of the trials significantly impacted communication and coordination efforts. The trials coincided with the end of the year and various holidays, including the Chinese New Year, which resulted in reduced availability and responsiveness among participants. This situation exacerbated any issues encountered, as clusters struggled to coordinate effectively and address challenges promptly.

Moving forward, it is advisable to schedule trials during periods with fewer holidays to minimize disruptions and enhance coordination opportunities. Selecting timeframes that align with periods of higher participant availability can help mitigate potential challenges and ensure smoother trial operations.

5. Performance Review Deep-Dive

At the conclusion of the testnet, SSV Network NOs passed the minimum requirements with flying colors. However, performance varied considerably compared to mainnet metrics. This was due to the various factors that will be discussed below

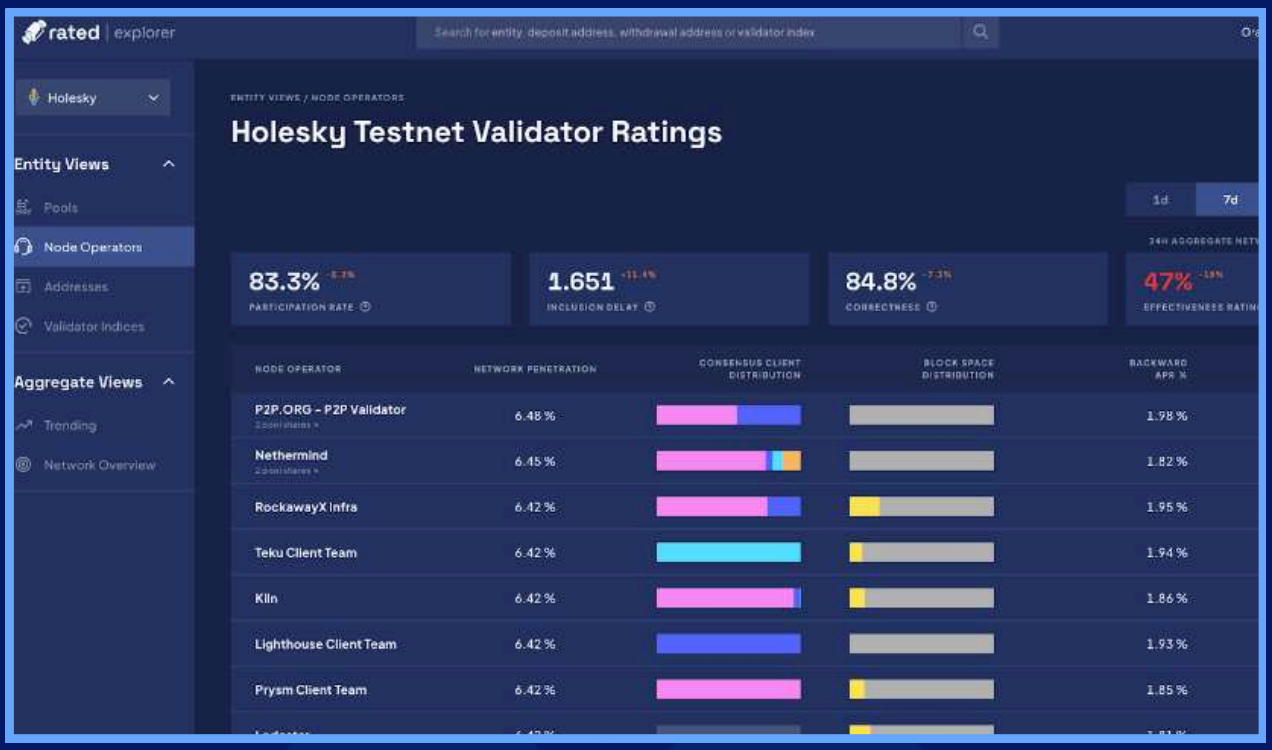
Metric	Mainnet	Simple DVT Testnet
Attestation Rate	99.86%	98.58%
Effectiveness	99.07%	80.65%
Proposal Rate	99.10%	94.38%

During 8 weeks of monitoring, there was ± 40% variability in performance between best and least performant NOs. The difference in performance can be attributed to multiple factors.

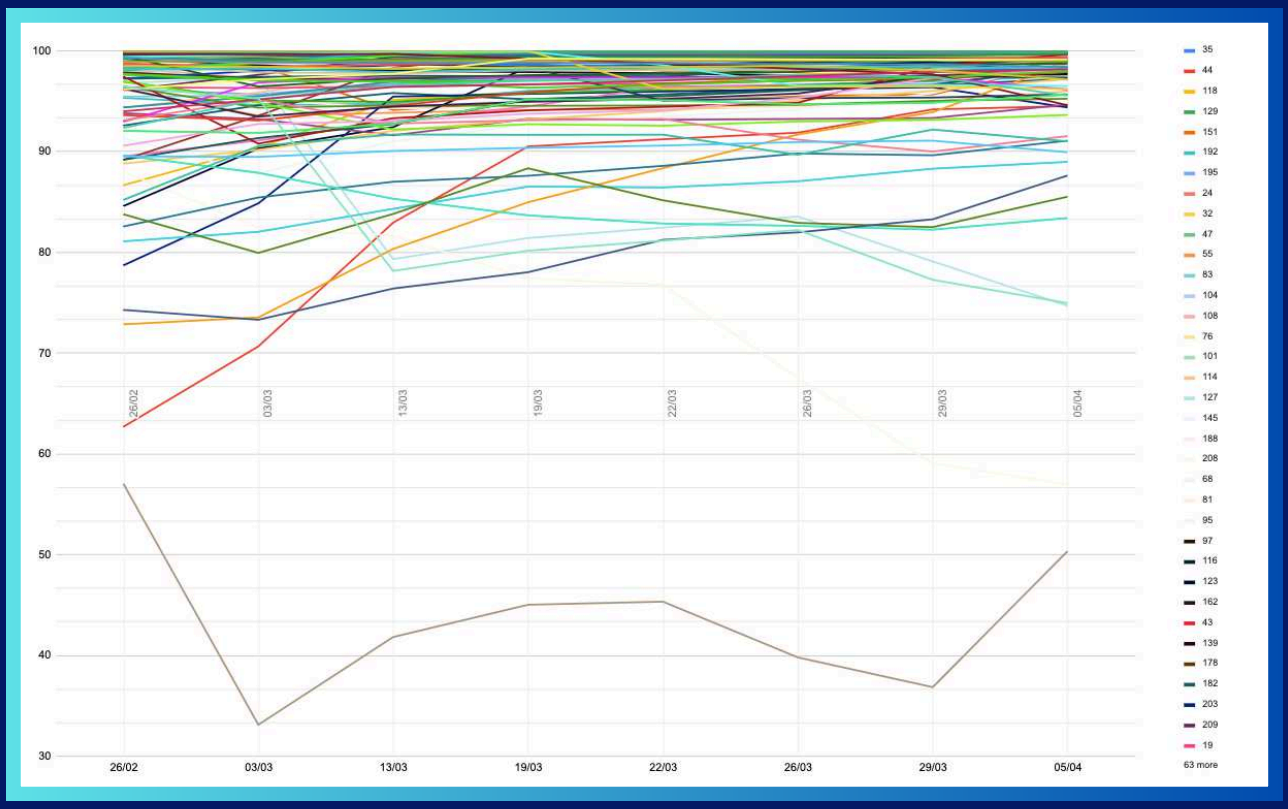
5.1 Holesky Testnet

Effectiveness

The natural evolution of the Holesky testnet caused considerable turbulence during the start of the monitoring period. During week 2 of testing, the Holesky effectiveness rating hovered around 47%, effectively bringing down the average for the network participants. It was noted that even though Holesky's average effectiveness during this time was low SSV cluster effectiveness averaged around 81%.



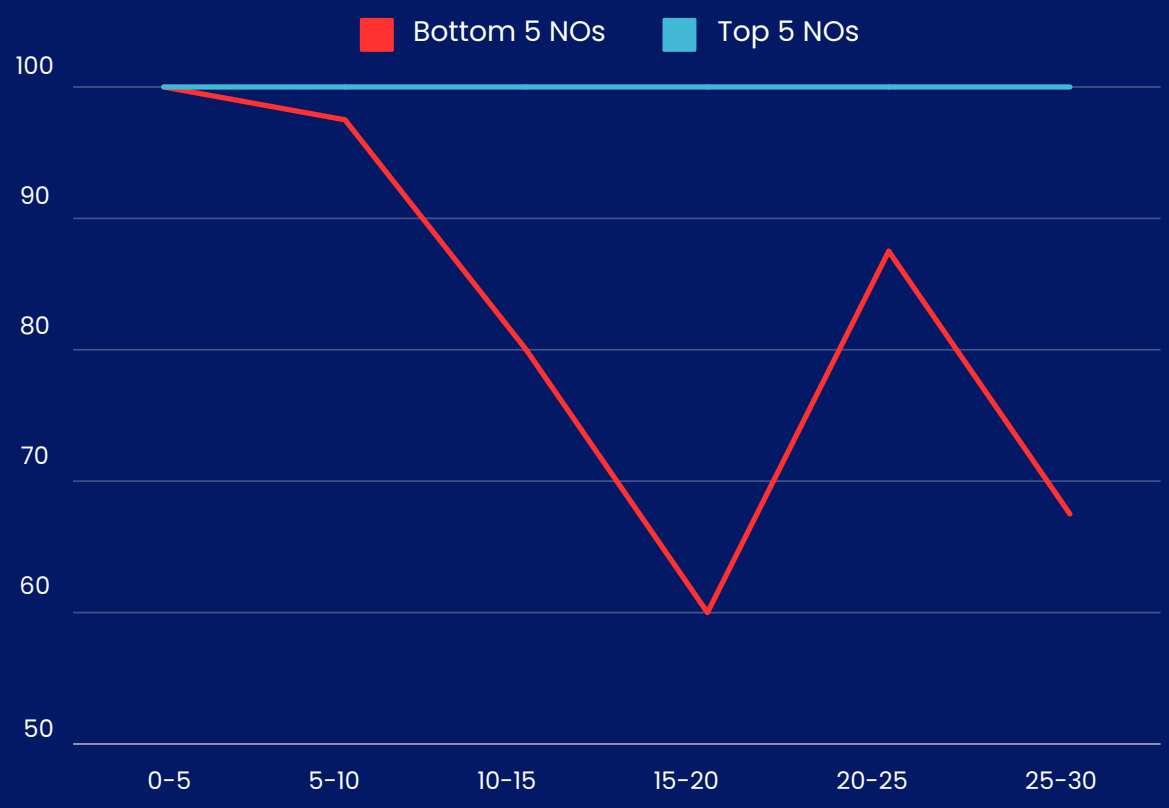
Following the Deneb fork, minor issues were identified with Nimbus, Teku, and Prysm. The SSV client's performance was restored after the v1.3.2 update, and network-wide trends saw gradual improvement.



Block Proposal Success Rate

During the early stages of the test, a dip in block proposal success rate within clusters was caused by MEV & Relays in some cases. These stemmed from certain client versions being impacted by the Deneb fork, resulting in heightened communication delays with Titan relay. Consequently, proposers resorted to vanilla blocks, potentially leading to missed blocks if communication between the Beacon Chain and clusters was prolonged. As support for MEV-Boost was rolled out this became less of an issue since more relays were available. This also underscored the importance of using multiple correlated relays in a cluster.

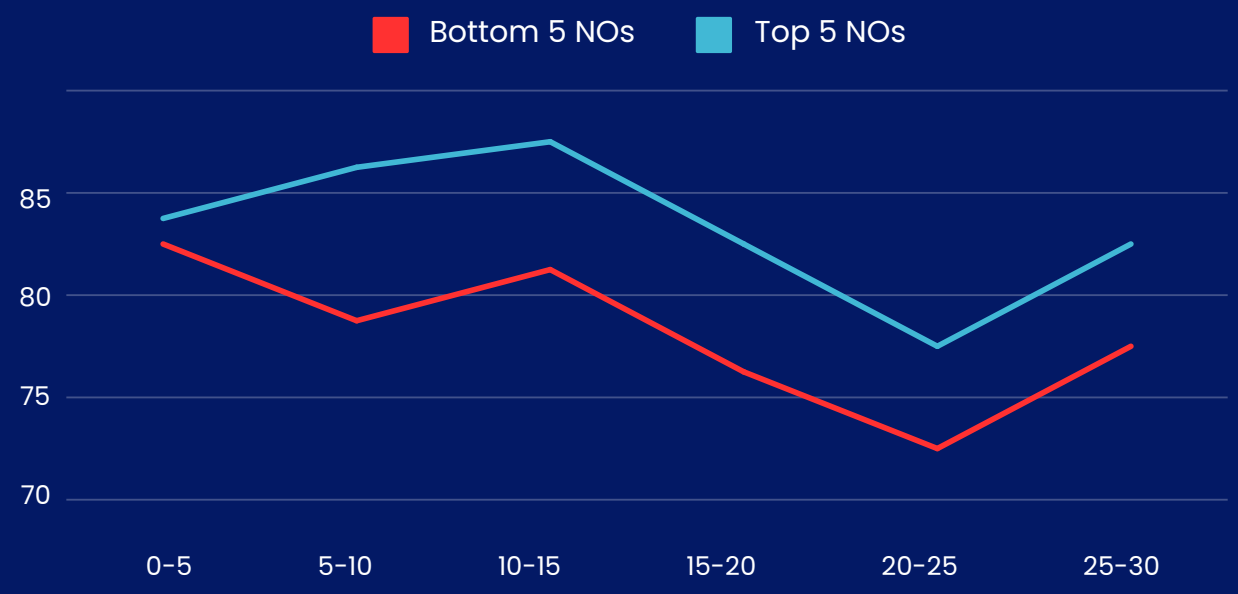
Upon further investigation, geolocation latency was marked as a non-impactful factor. This was due to the lack of evidence to support latency between widely distributed NOs. For example, in cases where an APAC cluster would achieve 100% proposals and a EUR and US cluster would achieve 80%, even in a geolocation latency “worst case” scenario, the APAC/EUR cluster only missed one proposal in a 30-day monitoring period.



The flexibility afforded by Distributed Validator Technology (DVT) enables clusters to employ multiple clients, mitigating risks associated with client issues and ensuring validators remain operational, highlighting the criticality of diverse client configurations for optimal cluster performance and resilience.

Network Attestation Effectiveness

The chart below shows that all clusters achieved a high level of average attester effectiveness across the entire testing period, averaging 80.65% compared to the Holesky average of 72.44%.



For the above observation period of March 5th - April 4th the top 5 clusters vs the least performant 5 clusters saw a significant difference. This was mainly attributed to operator setup. However, the decline in both good and bad clusters attestation effectiveness is due to fluctuation in overall network performance.

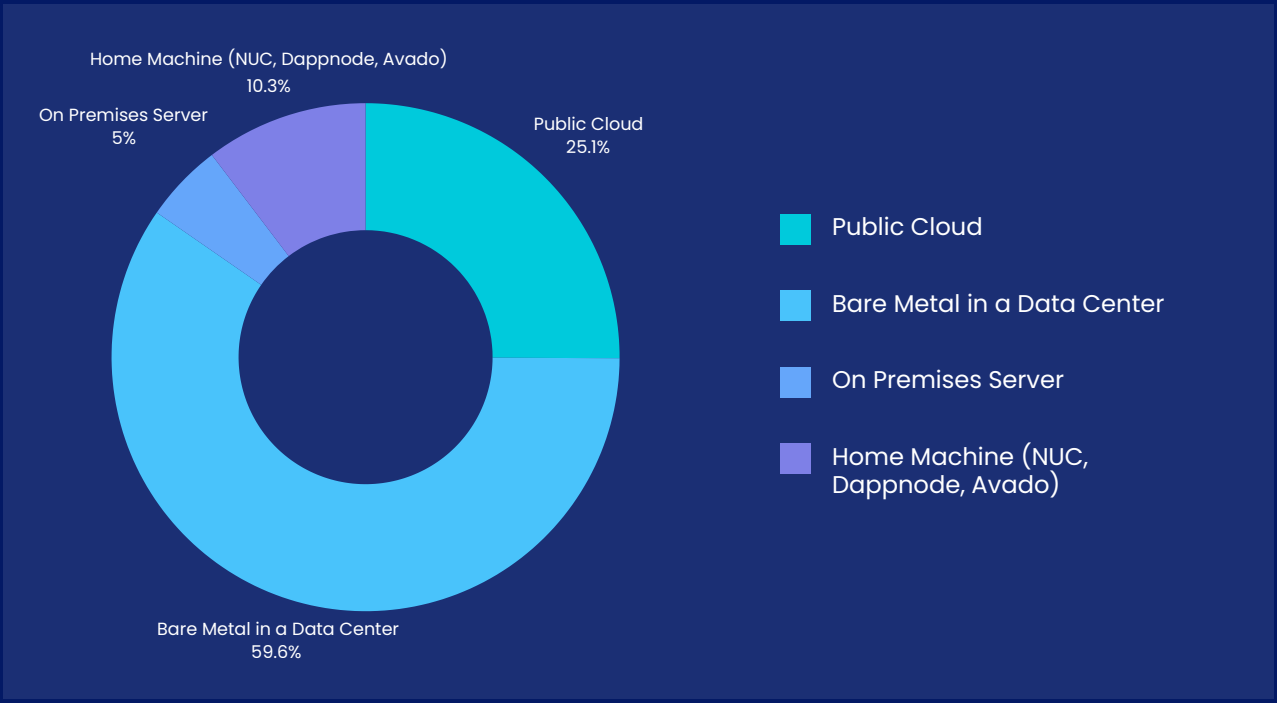
5.2 DKG

Following deliberations among Lido DAO contributors and SSV Testnet Participants, it was decided to extend the testnet to incorporate the upgraded and audited version of the DKG tool. The most significant change was how the DKG initiator provided proof that cluster participants participated in past ceremonies. Future updates to the DKG tool will incorporate resharing and resigning, allowing cluster participants to reshare keyshares with the same operator set.

Actionable improvements that the Core team will investigate are adding DKG to Eth-docker and Stereum, docker-compose examples, daemon examples, and other improvements to the node setup user experience.

5.3 Node Setup Hardware

It was noted that clusters with higher numbers of participants using home-based hardware or low-performance VPS offerings generally saw lower performance results.



The Contabo VPS appears to have contributed to performance degradation. Observations indicate a notable decline in uptime among at least four operators utilizing Contabo services. Subsequent migration to alternative cloud providers resulted in an end to the problems.

5.4 Adapting to Change & NO Autonomy

The Deneb fork served as a pivotal moment, increasing awareness within the community. Initially, performance suffered due to delayed adaptation efforts, revealing client bugs and network performance issues. However, this event spurred proactive measures as participants evaluated their setups, scrutinized client performance, and rectified identified issues. Instances of cluster participants autonomously identifying offline participants marked a positive shift towards self-regulation, alleviating the need for constant external intervention.

Moreover, as the network accommodated a greater number of validators, fluctuations decreased, diminishing the influence of randomness and resulting in more stabilized operational values.

6. What's Next?

The ssv.network DAO would like to extend a heartfelt thank you to all of the participating node operators, Lido DAO contributors, and the SSV Core team for their time and effort during testing round #3.

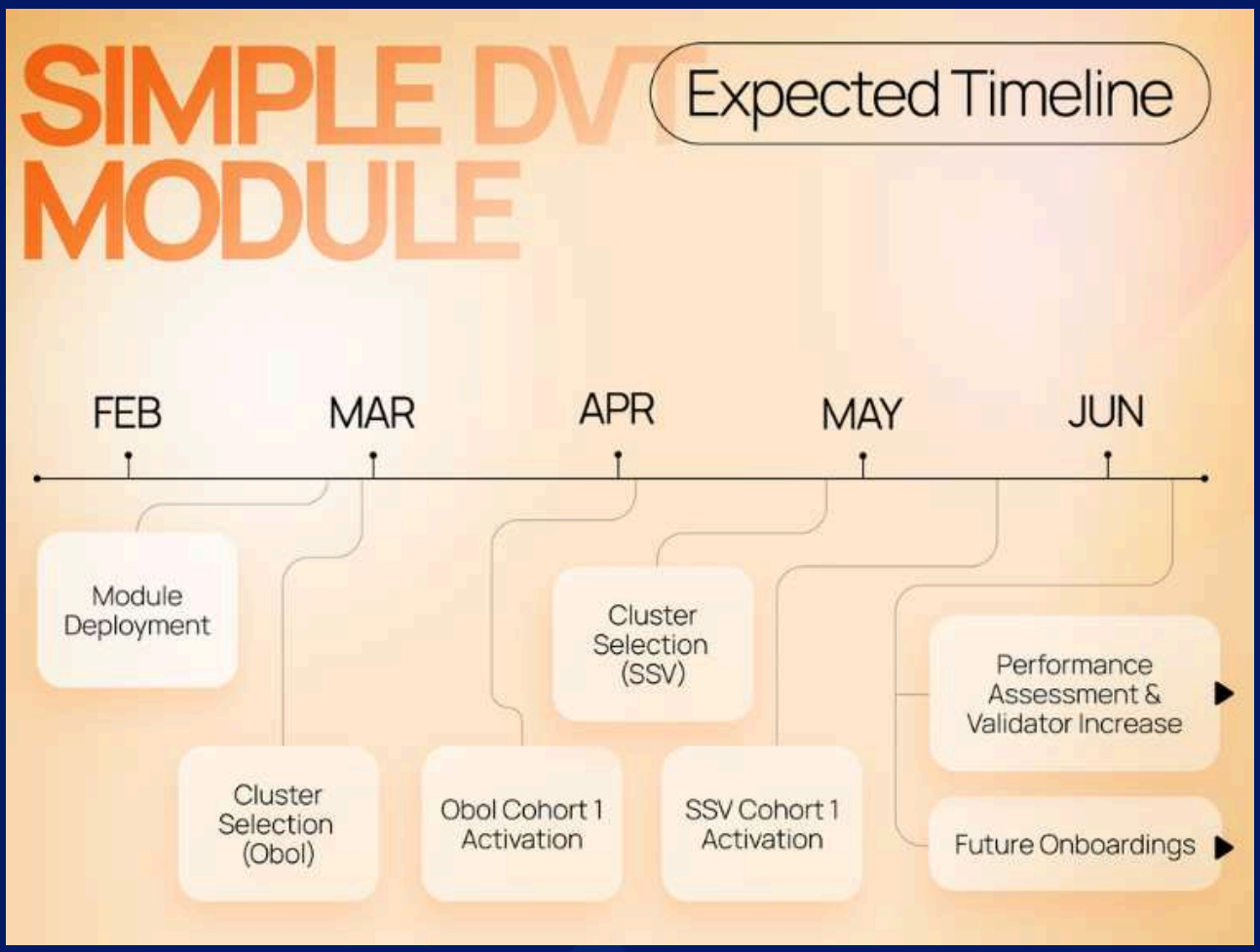
6.1 The Road to mainnet

In the coming weeks, the LNOSG will review the trial's quantitative performance outcomes at the aggregate, cluster, and participant levels, along with qualitative metrics derived from surveys and trial notes provided by Lido DAO and SSV contributors.

Following their evaluation, a forum post will be published on the Lido research forums to propose the advancement of clusters and participants to mainnet in Cohorts 1 and Cohort 2. Each participant will be notified via email, receiving individual feedback on their status and an invitation to participate in the next testnet, should they opt to do so.

To foster involvement from Node Operators and back DVT providers, the Simple DVT Module put forth a structure comprising a 2% treasury fee and an 8% module fee, compared to 5%/5% for the curated module. These fees are distributed among both Node Operators and DVT providers. This economic framework recognizes the distinctive hurdles faced by operators managing a limited number of validators. For the test, the ssv.network DAO received SSV tokens via the network fee.

While the module will start with a 0.5% stake share ceiling, the Lido DAO may elect to raise that ceiling should it be found to operate well and increase the number of node operators participating and the profitability of each cluster.



6.2 Join SSV Simple DVT Testnet #4

For the participants who were not proposed to move forward to the mainnet or new candidates, another Lido x SSV testnet will begin in late May/early June. Provable experience running an SSV Operator is required to participate. All solo stakers, community stakers, and professional node operators are invited to apply.

Please fill out this form if you are interested in participating.

7. Notes and References

- Data was retrieved using Rated Network's API for Holesky Testnet.