



Lightning Network Usage Statistics

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Introduction

We started OpenNode in the earliest days of the Lightning Network because of our conviction. Our conviction about Bitcoin as the future of money had long been established, but our belief in Lightning Network was fresh and new. We saw the potential: a secondary peer-to-peer payments network using only the authority of Bitcoin as arbiter.

For the first several months, the network consisted of hobbyists. OpenNode planted itself right at the center of these second layer enthusiasts and committed capital to the network in order to help it flourish, meanwhile establishing itself as one of the network's most reliant participants. Since then, the Lightning Network has evolved but much of the evolution cannot be statistically analyzed from the outside like Bitcoin can be. Lightning Network's architecture makes detailed transaction analysis difficult if one isn't operating a node of economic importance.

At OpenNode, our node goes beyond economic importance. We operate one of the top nodes in the network. This gives us a tremendous insight into the Lightning Network and all its activity. In our debut report for OpenNode Research, we'd like to share findings from one peer's perspective. Our early, prominent, and capital-dedicated node allows us to decipher Lightning Network usage, analyze the network's architecture, and provide insight for the future.

The difference between Bitcoin transactions and Lightning Network transactions

OpenNode processes Lightning Network transactions on behalf of merchants and developers. Our early decision to begin with full Lightning Network capabilities allowed us to be a pivotal node in the payment network. Before we delve into some of the network's important metrics and share our findings, we believe it's important to first understand why transactions in the Bitcoin network are more transparent than transactions in the Lightning Network.

Bitcoin is a distributed ledger, in which all participants running the Bitcoin software can audit and verify every confirmed transaction. This network architecture is an essential component of Bitcoin's functionality – it ensures that everybody can determine the validity of a transaction on their own. Said in simpler terms, Alice must be able to check if Bob is sending her bitcoin, and she does this by running a Bitcoin fully validating node. She doesn't have to trust another entity for verification.

The Lightning Network is not a distributed ledger; it's more like a network of private payment channels. Alice and Bob can open a payment channel between themselves and should check their own full nodes to determine if their counterpart's funds are genuine. Alice and Bob can then send each other thousands of transactions without the knowledge of the rest of the network, primarily because Lightning Network transactions don't require an audit of the Bitcoin network. As long as the transaction is in accordance with the current state of the bilateral ledger between two parties, Alice and Bob can transact without the burden of broadcasting their transactions to the greater Bitcoin blockchain.

The importance of Lightning Network

Without a doubt, Lightning Network changes the value proposition for the Bitcoin network. Bitcoin is undoubtedly a revolution in networked money, or money depending only on free and open source software; its decentralized nature makes it the first globally accepted money not issued by a central authority since gold. Gold has endured centuries and millennia as a store of value because of its unique properties as a metal, such as durability and resistance to corrosion. But gold is not always easily verified as payment. Assaying gold, or the process of measuring gold's purity, can be costly which attracts fraud. Bitcoin is free to verify by running Bitcoin software, giving every peer in its global network the opportunity to defend itself against financial fraud.

Gold acts as a tremendous store of value across time and oceans, but doesn't hold up practically as a great medium of exchange. Gold coins and bars are heavy, not easily divisible, and, most importantly in today's age, not digitally transferable. Bitcoin quickly solves these three issues simply by being a software-based network protocol. But transfers of

bitcoin take time and can be costly because only a certain number of transactions are confirmed by the network per hour, a number with a high degree of variability.

The Lightning Network is a payment layer stacked on top of Bitcoin. The network is a web of financial contracts that, once confirmed to Bitcoin's blockchain, unlock speed-of-light value transfer between two peers. As the web of contracts spans, instant value transfer can occur seamlessly between unconnected peers due to Lightning's technological breakthrough: the hashed time-locked contract (HTLC)¹. These contracts are an innovation that has transformed Bitcoin from a commodity asset to a commodity with currency-like speed. The Lightning Network makes Bitcoin simultaneously a store-of-value and medium-of-exchange.

Our node is our business

OpenNode was founded to provide a suite of tools for businesses to accept Bitcoin. We identified Lightning as a way for Bitcoin to evolve and adapt new qualities like instant settlement and clearance. We started our Lightning node, signed HTLCs with other Lightning Network early adopters, and immediately processed transactions for developers building Lightning applications. These early contracts established OpenNode as a key player in the network, and careful management of our payment channels propelled our node to becoming one of the largest and well-connected in the Lightning Network. We had clients that were early Lightning pioneers, and our platform powered payments to grow our node's size and importance in the overall successful routing of payments in the network.

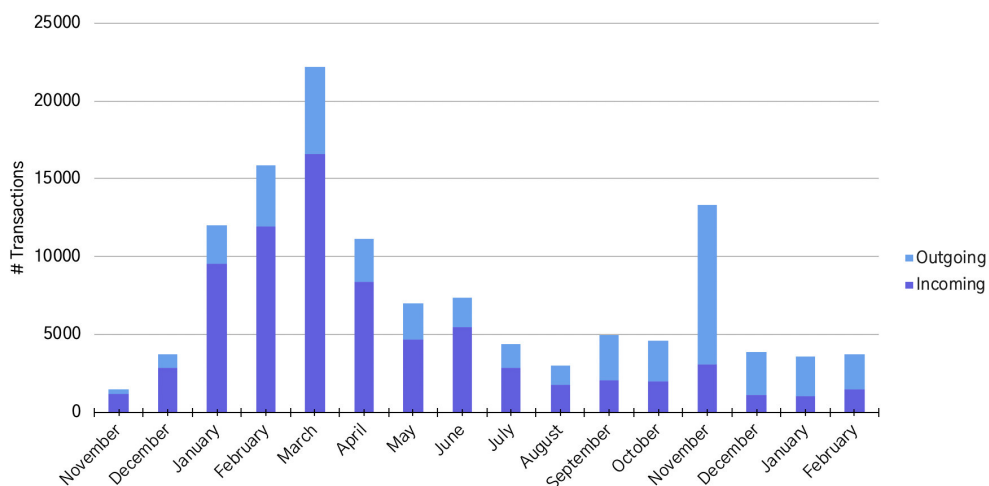
Today, OpenNode's public node is the second largest in the Lightning Network, giving us a tremendous amount of insight into Lightning Network activity. Lightning transaction and fee data isn't publicly available. Our only source is those involved in the transactions themselves. There is a small set of data that is publicly available, like the ranking of nodes by total capacity, but this data does not paint the full picture of the network. An estimated 41% of Lightning channels are private.² Our business model depends on our node being well connected, well funded, and carefully operated.

We're sharing information only visible to our node because we want to encourage the sharing of data from one node operator to the next. Together, we can better understand Lightning Network activity and collectively learn from insights across nodes.

Payment processing

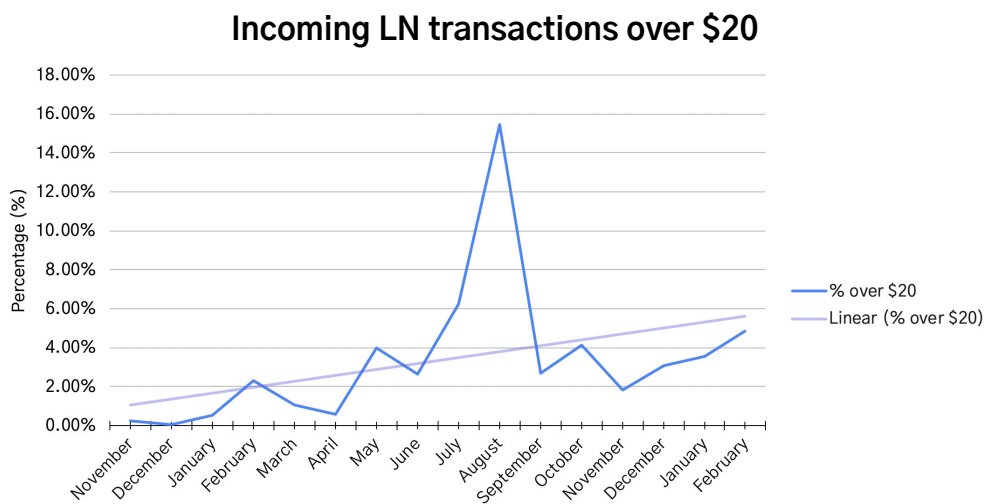
OpenNode has processed over 120,000 Lightning Network transactions since we launched our node in November 2018. The number of transactions is perhaps the least interesting of our findings. Instead, it's the sample set for our analysis. Before we look closely at our Lightning Network transaction data, it's important to note that over 99% of aggregate bitcoin processed by OpenNode occurs on-chain. Lightning Network is still an early technology and we don't yet observe it as a dominant payment method. However, we are experiencing steady growth in Lightning Network transactions processed and are disclosing some of our results to help strengthen understanding of Bitcoin's second layer.

Lightning Network Transaction Volume



Microtransactions and eCommerce

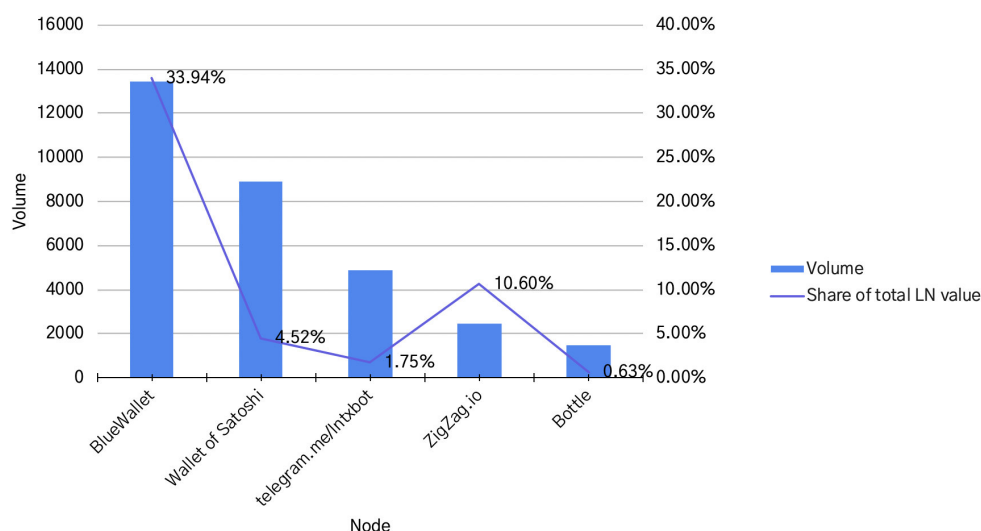
Bitcoin transactions under a certain amount, depending on network congestion, become both uneconomical and impossible. Lightning Network fixes this. Transactions with values less than a penny become possible because they are free from the burden of Bitcoin blockchain confirmation. Because of the novelty of microtransactions, a vast majority of early Lightning Network activity was simply enthusiasts sending a few cents back and forth to test software for the soundness of the network. This has notably changed over the past year. We observe a trend in which the percentage of Lightning Network transactions over \$20 is experiencing steady growth, now averaging over 5% of the transactions we process. Our eCommerce and Services clients are to thank for this growth.



Custodial wallets

When our clients withdraw Bitcoin from our platform via Lightning Network, where does the money go? We observed that the two most popular destinations for outgoing transactions from our platform are popular Lightning Network custodial wallets, BlueWallet and Wallet of Satoshi. Users are turning to custodial solutions likely for ease of use, although new non-custodial solutions such as ACINQ's Phoenix Wallet and Breez are gaining traction.

Top 5 LN outgoing transfer destinations

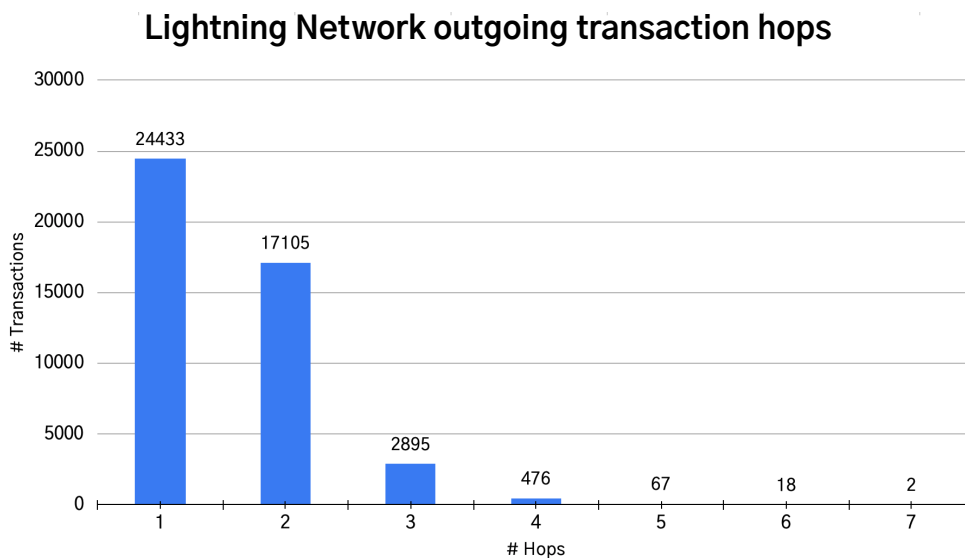


Balanced liquidity

One of the challenges to operating a high capacity Lightning Network node is the balance of incoming and outgoing liquidity. By processing payments, we receive inbound liquidity. By processing outgoing transfers to our clients, or payouts, we acquire outbound liquidity. This balance on both sides is a welcome advantage for our node's overall utilization in the network as one with strong routing capability. Our clients and their customers have confidence in our processing ability, creating a positive feedback loop of transactions routed through our node.

A Strong Peer

With OpenNode being a very well-connected node and custodial wallets the top recipients of our outgoing transactions, we've experienced 92% of our outgoing transactions processed in two hops or less. Lightning Network peers don't need to have a payment channel with each other, but a payment channel path must exist in order for them to transact. In rare cases, we've observed as many as seven hops, a fascinating indication that as the network spreads, distant peers should still be able to transact using Lightning Network.



Experimenting with different fee regimes

In addition to collecting our payment processing fees, OpenNode's Lightning Network node acts as a payment router for others in the network. We've routed over 30 BTC just through the Lightning Network since our node started. We're experimenting with different fee regimes in order to help the network, learn from activity, and gain empirical evidence on optimal pricing. We can confirm that lower fees can lead to increased routing, as well as shorter time locks on HTLCs.

Node Accrual Rate

The Node Accrual rate (NAR) is a formula for individual Lightning nodes that desire a standardized method for calculating their realized interest rates.

NAR Equation

$$NAR = \left(\frac{(p + f)^{52,560/n}}{p} \right) - 1$$

Let n = the measurement period, expressed in number of blocks, suggested minimum value of 100.

Let p = node's average balance held in channels over the measurement period, expressed in satoshis.

Let f = total routing fees earned by the node over the measurement period, expressed in satoshis

$52,560$ is the approximate number of blocks per year to normalize NAR as an annualized rate

Our node has earned an annualized rate ranging between 0.03% and 0.36% depending on fee regime. We realize this is quite an inconclusive NAR, but this is merely the result of experimentation. We are trying everything between altruistic and aggressive fee regimes, and documenting our results along the way. The network-wide participation in disclosure of NARs could benefit the evolution of Bitcoin's capital market, in which we're beginning to see an entire bitcoin-denominated investment product landscape, complete with interest rates and maturity term structure. A Lightning Network derived interest rate product with income achieved by routing Lightning payments might not be far away.

Conclusion

We hope this paper acts as an inspiration for other nodes in the Lightning Network to share statistics and strengthen our collective understanding of its architecture and capabilities. As one of the Lightning Network's highest capacity and well-connected nodes, we're proud to be a leader in its mindshare.

References

1. Nuzzi, Lucas. "A Look at Innovation in Bitcoin's Technology Stack." Medium, DigitalAssetResearch, 4 Dec. 2019, medium.com/digitalassetresearch/a-look-at-innovation-in-bitcoins-technology-stack-7edf877eab14.
2. "HTLC." OpenNode Blog, OpenNode, opennode.com/blog/glossary/HTLC