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State of the Lightning Network Report

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Research and Insights

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Executive Summary

- In September, **Twitter** announced the integration of Lightning-based BTC tipping in their iOS and Android apps, which will be processed by **Strike**, a third-party payment service.
- The Lightning Network experienced rapid growth throughout 2021, seeing a threefold increase in BTC capacity from **1059 BTC** in January to **3151 BTC** in November, according to Bitcoin Visuals.
- Multiple exchanges have moved to integrate Lightning, such as **OKEx**, **BitFinex**, **Paxful,** and **Bull Bitcoin**, showing that the high-fee environment during 2021 is forcing businesses to move to Layer 2 solutions.
- Communities such as **Plebnet** have begun to form to pool liquidity and share knowledge about Lightning, which has increased network capacity and the number of nodes.
- We are seeing early experimentation with the Lightning concept in the gaming world, with **Satoshi's Games** and **Zebedee** producing innovative play-to-earn concepts using Lightning.

1. Introduction

Recently, **Twitter announced that it would integrate the Lightning network into its mobile apps to allow users to tip others using Bitcoin**. This is the first adoption of Lightning by a major company since the network was proposed in 2015. As this may be the first mention of Lightning in some time for some of our readers, this may be a good time to provide an update on the state of the network and the shape of things to come.

1.1 Bitcoin Scaling Issues

A thorough early history of the network can be found at Bitcoin Magazine for those looking to learn about its origins in depth. While the Lightning Network was proposed in 2015, it did not pick up speed as a concept until the debate surrounding blocksize in 2017, which gave rise to the split in the Bitcoin community between Bitcoin Core and Bitcoin Cash, with the latter favouring larger blocksizes as a means of solving Bitcoin's scaling issues. **While Bitcoin Core (and smaller blocks) arguably won this civil war, the fact remained that a Layer 2 solution would be needed to help it scale and process transactions quickly**. For those interested in the history of this debate, we direct you to Jonathan Bier's fly-on-the-wall history *The Blocksize War*, which has been published for free online at BitMEX Research.

The debate around scaling is key to understanding why Lightning exists, and why it is necessary. A core criticism of Bitcoin since its inception has sometimes been called the 'cup of coffee problem'; this refers to a hypothetical scenario in which someone tries to buy coffee using Bitcoin; imagine this taking place at rush hour, with a queue of people buying takeaway coffee quickly on their way to work. Using Bitcoin in this scenario creates two issues:

Firstly, due to 10-minute block confirmation times, there is no way of buying the coffee quickly while ensuring that the transaction was successful and final. This means that each person must take between 10 and 60 minutes to pay for their coffee instead of a few seconds, depending on how many confirmations the coffee shop requires. The usual reply to this criticism is that transactions can simply be made with no confirmations, and that the risk of the transaction being reversed is similar to the current risk of the same thing with credit cards. However, given the difficulty in convincing brick-and-mortar businesses to use Bitcoin at all, the added risk of a transaction being reversed (no matter how unlikely) makes using Bitcoin for daily business an even less attractive gamble.

Secondly, to ensure that the transaction is processed quickly, the purchaser would need to include a fee for the miner to make it more attractive to include. **However, the fee could be close to the cost of the coffee itself**. This latter scenario in particular makes Bitcoin less than attractive for small transactions.

To get around these limitations, the Lightning Network was proposed. **In short, instead of writing every transaction to the blockchain (which is the source of the scaling issues), the network instead allows participants in a transaction to open a bidirectional payment channel using Bitcoin's native smart contract functionality**. Users can make updates to the payment channel to send bitcoin from one party to another, before it is closed and formally written to the blockchain, with only the final balance being broadcast to the network. An example of how a payment channel works is given below.

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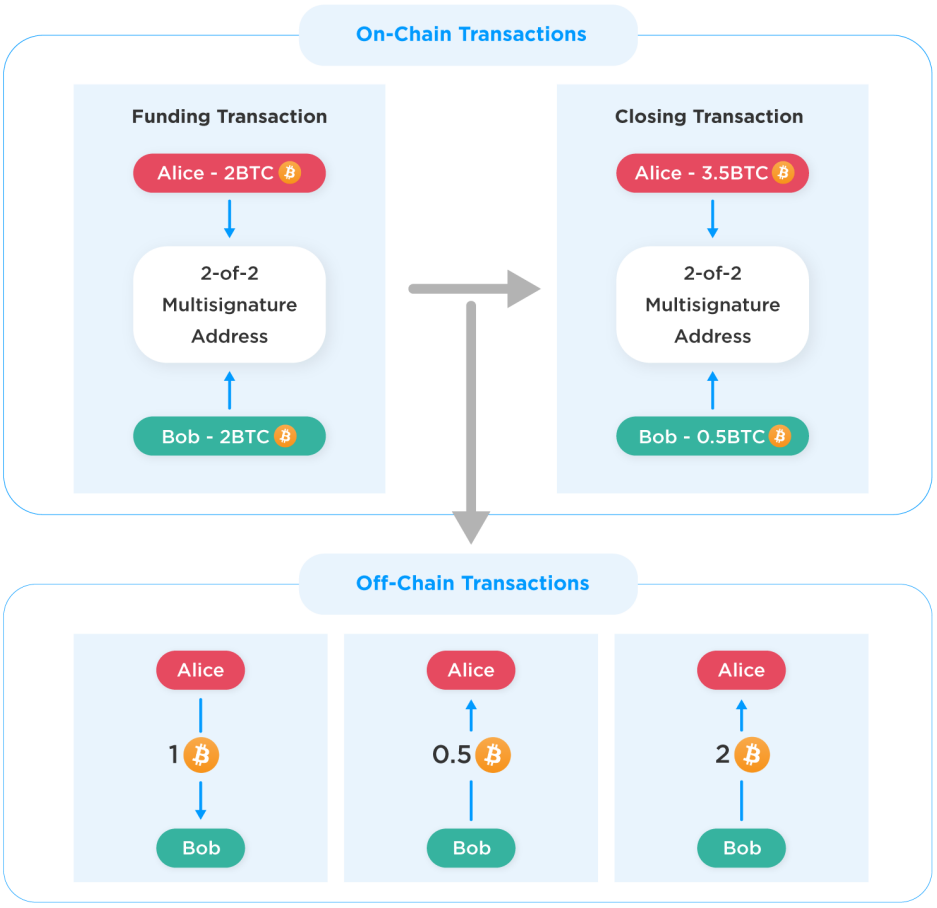
Example of Payments in a Lightning Network Channel

Off-chain transactions can take place while the channel is open



Source: Crypto.com Research

In other words, **Lightning allows users to bypass the blockchain when making small transactions such as sending money to a friend to pay one's share of a meal**. The logic is that not every transaction needs to be broadcast immediately to the whole network, but if one or more parties decides to close the channel, the final balance will be written to the blockchain. This allows users to transact freely without the time and fee cost of making an on-chain transaction for every purchase. For those interested in a more in-depth explanation of how Lightning works, we direct you to Bitcoin Magazine's series of articles on the subject.

2. State of Lightning Adoption

Lightning adoption among institutions and payment providers has been slow, as the Network is still in its infancy. **However, 2021 has seen some encouraging signs for both retail and institutional adoption of the network**.

While one of the more obvious use cases for Lightning is for deposits and withdrawals on exchanges, until recently most crypto exchanges have been reluctant to integrate the technology. This should not be surprising in a sense, as the golden rule for any Bitcoin exchange is 'don't lose the Bitcoin'; as Lightning is still experimental, it may be seen as carrying a risk of this occurring if not implemented with caution**.**

Nonetheless, several exchanges have begun to integrate the technology over the past year. In February, OKEx announced that they would integrate Lightning into their platform, so that users could deposit and withdraw Bitcoin via Lightning. Additionally, in September veteran Canadian exchange Bull Bitcoin announced that it would integrate Lightning for its non-custodial services, meaning that users could buy Bitcoin on the platform and receive it via Lightning. Paxful also announced that the platform would integrate Lightning, initially capped at $750 per transaction.

The fact that exchanges are beginning to step up Lightning adoption in 2021 is a big step forward for the network, and will hopefully serve as a good case study for its adoption among exchanges in future.

2.1 Lightning Tipping on Twitter

In September, Twitter announced that they would be integrating Bitcoin tipping using Lightning. The payments would be processed by Strike, a third-party payments platform. Twitter is by far the biggest company to adopt Lightning to date, so this announcement created some excitement in the Bitcoin community.

The fact that a corporation like Twitter would embrace this experimental technology may seem surprising, but Jack Dorsey has been a long-time supporter of both Bitcoin and Lightning, even participating in the so-called 'Lightning Torch' game in 2019, in which a transaction was sent from user to user, with each user adding a little extra to it, in order to raise awareness of the technology.

That Twitter can do this at all is a sign that the network is beginning to mature. The use of third-party processors for open source software might surprise some people; in reality, Twitter may simply not want to assign resources to set up and maintain Lightning nodes. Third-party hosting, where setup is already taken care of and maintenance and security of nodes is a core competency, is an important sector of the industry at this stage in its development in order to ease the on-ramp for business users to get involved, rather than being faced with the technical challenge of learning the internals of Bitcoin and Lightning.

2.2 Lightning Development in 2021

Rather than a monolithic project conceived of and developed by a specific company or community, the Lightning Network began life as a theoretical concept. **Over the past number of years, different groups have tried to implement the concept as a software project**. At present, there are several different implementations of Lightning, the main projects are listed below.

The biggest project in the space in 2021 is still LND, which is developed by Lightning Labs. When people talk about the 'Lightning Network', this is usually the project they are referring to.

Eclair is another well-known implementation of the concept. This version is written in Scala, it was one of the earliest efforts to implement the Network.

Two of the other implementations focus on a specific programming language. C-Lightning is a separate implementation of the concept using the C programming language. Like LND, this project is still ongoing and is updated on a regular basis. Rust Lightning, similarly, is an implementation of the Network using the Rust language.

Sadly, the development of Ptarmigan was suspended in 2021. This project was designed to be used with embedded technology. It was also the first Lightning implementation to come out of Asia, the team being based in Japan.

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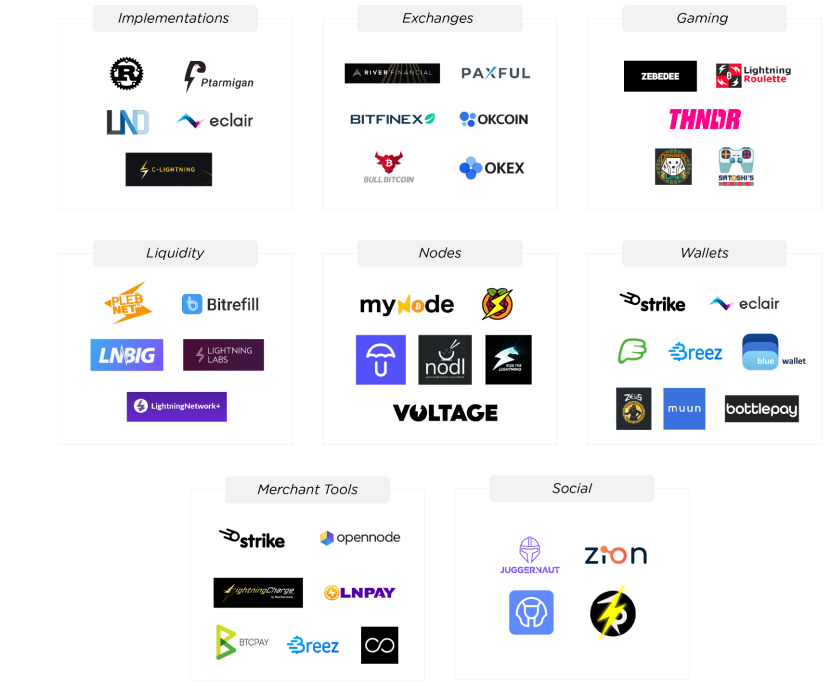
Lightning Network Ecosystem

The growth of Lightning has produced a wide range of projects and services using the technology



2.3 Network Statistics (Nov 2021)

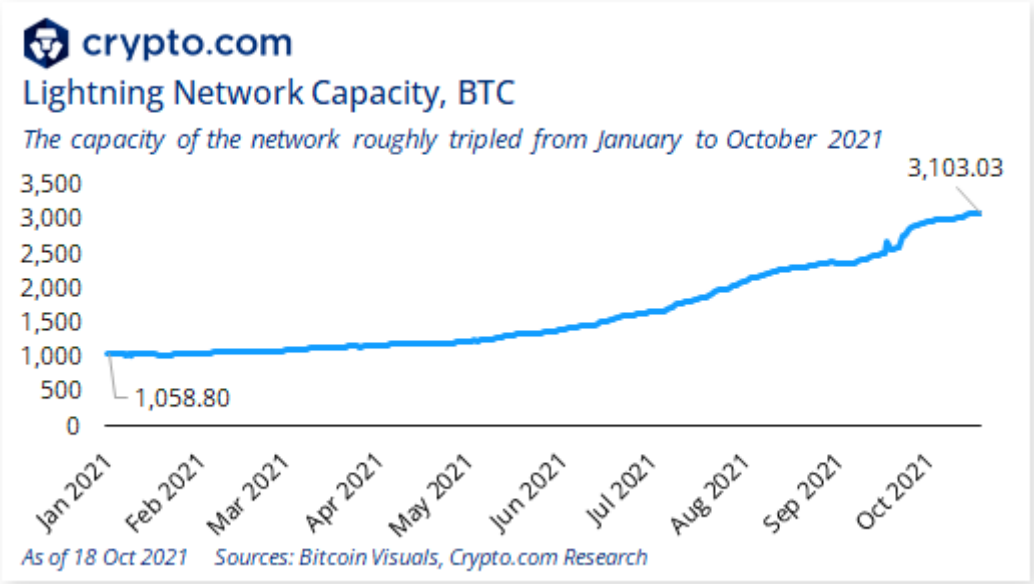
Statistic	Figure
Number of Nodes	30,275
Number of Channels	81,036
Nodes with Active Channels	18,073
Network Capacity (BTC)	3260.23 BTC
Network Capacity (USD)	$182.77m
Average Node Capacity (BTC)	0.18 BTC
Average Node Capacity (USD)	$10,112.95
Average Channels per Node	8.97

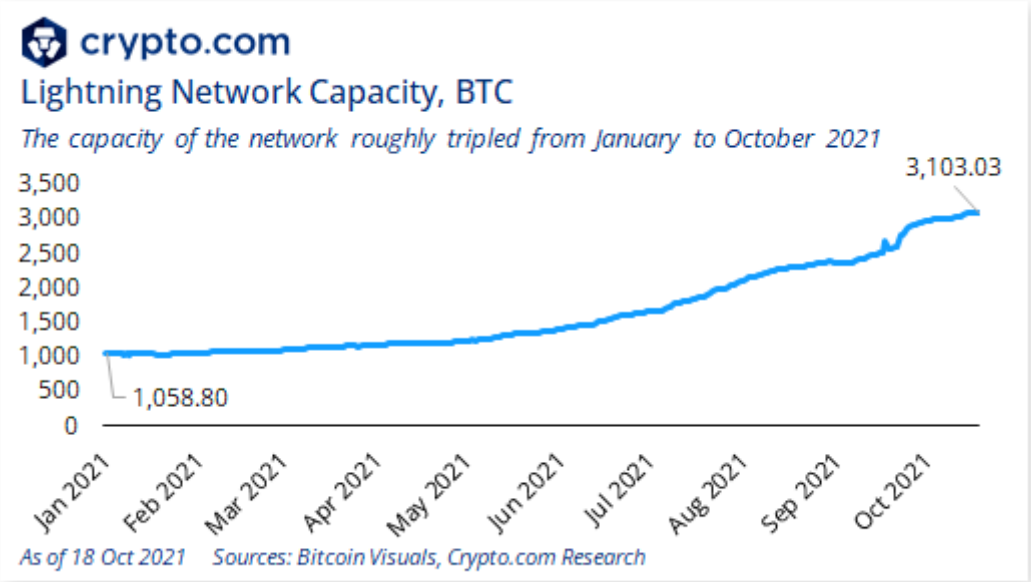
As of 19 Nov 2021 Sources: 1ml.com, Crypto.com Research

2.4 Growth of the Network in 2021

It was a poorly-kept secret in the Bitcoin world at one point that the majority of Lightning liquidity and activity came from a specific user (or group of users) called LNBig; in an interview with The Block in 2019, the person behind LNBig claimed to hold roughly 40% of the total capacity of the network. This meant that the great dream of decentralised payments had ended up somewhat centralised.

In 2021, this seems to have changed, with a growing number of users being onboarded, and channel capacity exploding over the past number of months, with a particular increase beginning around May.





It has been suggested that the real driver of Lightning growth going forward, rather than the convenience of quick transactions, will in fact be fees. Lightning's main value offering is that it allows Bitcoin users to make transactions irrespective of the fee environment. Consider the following chart:

At one point in April this year, the average fee per transaction was $60.55. Suffice to say, no one is buying coffee in this fee environment if they must make an on-chain transaction. This uncertainty disappears when Layer 2 solutions such as Lightning and Liquid are used.

The growth of Network capacity is an extremely strong signal for the health of the project, and may be a sign that the concept is beginning to catch on.

2.5 The Rise of Communities

The aforementioned increase in capacity may be attributed to a number of factors, one of which being the rise of communities dedicated to using and educating others about the Lightning Network, in addition to the added benefit of having easy access to liquidity.

As Lightning depends on networks of nodes to route transactions, having communities of users running their own nodes with liquidity is essential for growing the network at this early stage of its development. Fortunately, 2021 seems to be the year that this has started in earnest.

One concept that has emerged in Lightning communities is the Ring of Fire. This is a means of creating a closed circle of nodes that can share capacity in such a way that high-capacity nodes share with low-capacity nodes. Helpful resources such as LightningNetworkPlus have been set up to allow users to set up Ring of Fire communities more easily, which is in turn increasing not only the amount of node operators, but also the total capacity of the Network.

Plebnet is a good example of this kind of community. Plebnet is a large group that has sprung up over the past number of months, organized entirely over Telegram. In a recent interview on Matt Odell's Citadel Dispatch podcast, several prominent members of the group described its recent growth, claiming that its members control roughly a third of the current Lightning capacity.

The group was mentioned in Bitcoin Magazine by Erin Malone, who used it as a learning resource for Lightning. Her article gives a good overview of how running a Lightning node can be profitable. While profitability may not be likely for the average user at present (the low return on investment for locking up Bitcoin in a channel was highlighted early on as an issue with Lightning), it is possible that as the network grows, the opportunity for making profit while running a node may grow with it.

Plebnet has pointed out that the cumulative bitcoin capacity across all channels increased drastically after the group was founded. There may be some truth to this connection, given that the group has a focus on onboarding new Lightning users, and at the time of writing has 5296 users in their Telegram group. The rise of this kind of group may be a sign of things to

come for Lightning.

2.6 Lightning Projects and Services

Because Lightning still requires a reasonable amount of technical knowledge to set up and use, a cottage industry of different companies providing services in the space has sprung up. A comprehensive list of projects and third-party providers in the Lightning space is maintained by Jameson Lopp. A number of interesting projects are listed below.

One wallet provider that has done well recently is Muun, which has made a name for itself as an easy-to-use way of sending and receiving payments through Lightning. Zeus is a long-standing open source wallet for both iOS and Android. Blue Wallet also provides a custodial Lightning wallet for those who prefer a hosted service rather than their own hardware.

Strike, mentioned above in connection with Twitter's plan for Bitcoin tipping over Lightning, is a payments processor for Bitcoin that also supports Lightning payments. It allows users to send dollar amounts to an address, which can be used to pay someone with Bitcoin via the Lightning network.

Because setting up Bitcoin and Lightning nodes on servers still requires a reasonable degree of technical knowledge, companies providing pre-built nodes emerged, a good example being Nodl, which provides various types of physical Bitcoin and Lightning nodes that are already set up. Lightning In a Box is another example of this product, more focused on Lightning.

One lesser-known use case for Lightning is that it can be used as a chat protocol. This idea was raised some time ago as a theoretical concept, eventually producing projects such as Sphinx Chat and Juggernaut. While still a very new concept, it is a great example of how the Bitcoin and Lightning community can think outside the box of simple payments.

2.7 Gaming

Because Lightning opens the door for Bitcoin to be used for quick micropayments, it was inevitable that eventually it would find its way into gaming. With the explosion in play-to-earn games during 2021, the use of Lightning in gaming has started to gain traction.

A development studio named Satoshi's Games has emerged on the back of the recent blockchain gaming wave. This studio focuses solely on developing games that integrate Bitcoin. They use the Lightning network by default for

microtransactions. Their current titles are Lightnite, a *Fortnite* clone based around a play-to-earn mechanic using Lightning; also Satvival, a survival game also based around a Bitcoin play-to-earn concept, with rewards paid out through Lightning. While games fully integrating Bitcoin micropayments are in their infancy, they will hopefully be a good proof-of-concept for future developments.

Zebedee took a different approach to a Bitcoin-based play-to-earn model using Lightning. Instead of building games structured around Lightning, they simply added Lightning play-to-earn to existing games like *CS:GO*. Their *Infuse* product allows users to play *CS:GO* for a Bitcoin prize pot, paid out through Lightning. They also provide tools for game developers to integrate this play-to-earn mechanic into their own games. This approach may make Lightning integration into gaming much smoother, as it allows the game developers to focus on game development rather than the technical aspects of integrating Bitcoin.

3. Conclusion

The growth of the Lightning Network during 2021 is a testament to the spirit of the Bitcoin community. It goes without saying that Twitter's adoption of the technology is a very important step in its development, and Jack Dorsey should be commended for embracing an experimental technology. However, despite the excitement of breaking into the mainstream, it is important to bear in mind that it is the community that has got Lightning to where it is today, and which is responsible for setting up the different building blocks (such as third-party hosting services, payment platforms and wallets) that allow big business to enter the space in the first place.

While the Lightning Network still has some growing to do, 2021 has been a huge step forward in terms of development and adoption. We are at the early stages of seeing the concept transform from experimental technology to something that a major corporation can integrate safely. If the current momentum behind Lightning keeps up, the coming months should prove very interesting for those watching the space.

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