LEDGER
ledgerjournal.org

Irrational Economic Action: Running a Bitcoin Lightning Node for Negative Profit

Edward Gotham[*]

Reviewers: Reviewer A, Reviewer B

Abstract. The final version of the paper "Irrational Economic Action: Running a Nitcoin Lightning Node for Negative Profit" can be found in Ledger Vol. 8 (2023) 58-75, DOI 10.5195/LEDGER.2023.289. There were two reviewers involved in the review process, neither of whom has requested to waive their anonymity at present, and are thus listed as Reviewers A and B. After initial review by Reviewers A and B, the submission was returned to the authors with feedback for revision (1A). The authors resubmitted their work and responded to reviewer comments (1B), after which the resubmission was deemed sufficient to address any prior concerns, thus ending the peer review process. Because of technical difficulties, author responses are limited to Reviewer A. Author responses in 1B have been bulleted for reader clarity.

1A. Review

Reviewer A

Does this paper represent a novel contribution to cryptocurrency or blockchain scholarship?

No

Is the research framed within its scholarly context and does the paper cite appropriate prior works?

Yes

Please assess the article's level of academic rigor.

Good (not excellent but a long way from poor)

Please assess the article's quality of presentation.

Good (not excellent but a long way from poor)

[*] E. Gotham (edgotham@pm.me) is corresponding author, Feng Chia University, Taichung, R.O.C.

How does the quality of this paper compare to other papers in this field?

Top 50%

Please provide your free-form review for the author in this section.

The article attempts to understand the irrational economic behavior of running lightning nodes even though the profits are negative. This is a nontechnical paper that acts as an economic guide for anyone who is looking to run an LN node. The article introduces the LN network at a high level and the reasoning behind running such an overlay network on Bitcoin. The article also acts as a guide for setting up LN nodes and configuring payment channels. It also covers the cost of setting up and running an LN node. Finally, the author assesses the LN market structure and concludes the paper by substantiating the reasons behind running an LN node with USD loss.

Strengths

- The language used in the article is easy to understand. The flow of content and the grammar is flawless.
- In the introduction section, the author does a fine job introducing the LN as a payment channel network and provides an overview of the growth of LN channels since 2018. He also briefly covers the irrational economical behavior of highly skilled people in running LN nodes.
- The literature review is good, and the author has cited relevant papers in the domain.
- In Section 3, The author provides a good overview of the LN network by covering topics like:
    - the need for the L2 layer for Bitcoin,
    - the cost comparison of running LN nodes as compared to Bitcoin nodes
    - setting up an LN node and connecting with other nodes via payment channels
    - LN connectivity that enables instant payments at meager fees
    - routing fees and managing channel balances
- In section 4, the article defines the LN market structure excellently. I agree with the author's assessment that the LN market structure is between perfect and monopolistic competition.
- In section 5, the article provides an excellent financial overview of operating an LN node by categorizing the cost into net initial cost, net running cost, and net exit costs.
- The conclusion covers most of the topics discussed in the paper and is reasonably well-written.

Weaknesses
- A more practical and thorough analysis is required for readers to understand the economics of running nodes and funding payment channels.
- More Empirical data is required to understand the irrational behavior of highly educated people running LN nodes with USD loss.
- The article could have provided a more in-depth and elaborate explanation of an LN node's actual setup and operation.
- The paper needs to provide an overview of the market for nodes in 2022 as per the details provided in the Literature review. However, the article does not cover this material.

- In section 3, more clarity on outbound and inbound liquidity would have been preferable i.e., to operate your own Lightning Node, you need liquidity; to send Lightning payments, you need outbound liquidity and to receive Lightning payments, you need inbound liquidity.

Other minor edits
- Section 3 and Section 4 have the same headline, i.e., "Functions and Limitations"
- In Section 4, Please fix the Error - "Error! Reference source not found."
- In Conclusion, Figure 5 is missing as referred in "Routing through the node shown in Figure 5".

Summary
Overall a good article and a commendable effort from the author to provide an overview of LN with such simplicity. However, the nature of the article could be more technical and given the paper's shortcomings mentioned above, the article could not be considered for publication in Ledger Journal.

Reviewer B:

With examples of 8 channel-system (with balance skewed toward the remote side (Peer 2)) and 5 channel-system (with balance skewed toward the remote side (Peer 0)), the paper describes the business operations of Bitcoin Lightning Network (LN), which is a locked-liquidity mesh network that uses thousands of nodes to decrease the work done by the main block-chain. Node operators charge a fee for use of their channel, and seek to maximize traffic through their node by minimizing fees, which is a multi-factorial problem, and is not easily resolved by a Lagrangian maximization. The analysis explains how routing income is derived from charging a base fee (mSats) and a scale-based fee (ppm). Overall, the paper is well-articulated, and asserts that the LN is still operating in beta, and novice operators may pose a threat to the system if their node is not managed effectively. As a recommended minor revision though, the Introduction should also briefly feature a rationale on the sustainable development (i.e., SDG) perspective of the paper's core objectives across a larger international perspective as well.

1B. Author Response

Reviewer A

This is a nontechnical paper that acts as an economic guide for anyone who is looking to run an LN node.

- This paper began as an investigation into the Lightning Network (LN) from the perspective of an outsider that is familiar with economics and finance. Unfortunately, the paper did not complete its primary purpose, but there were some discoveries made which were worth sharing with readers from a similar background to the author (i.e. non-technical). Changes have been made to the paper, based on the Reviewer's feedback, and these changes are highlighted in green in the revised manuscript.

- The secondary purpose of the paper, is to introduce the LN to non-technical readers. It is aimed at individuals with a background in finance or economics, and attempts to begin bridging the gap between the technical implementation (nuts and bolts) and economic market theory. If it appeared to be a guide for setting up a node, this is a fault of the author's poor writing. The author was using the experimental write up format to frame foundational economic information regarding the LN.

- Economics is the study of action under constraint (scarcity), and in that sense, it is only necessary to show the critical constraint points of the system, rather than fine detail. The author believes that some financial and economic theories can be usefully applied to the LN, but if there is no primary literature on the LN at an accessible level, the fields will remain segregated. One reader's comment was that the paper was simplistic (similar to Reviewer B), and another reviewer (not at the journal) requested a primer on the topic. The information gap on the LN is wide, and growing.

- As of March 2023, there are approximately 15 papers in the field of business and economics that can be said to cover the LN, but many of these are repurposed (or dual purpose) computer science literature. To reflect and emphasize this, a full table has been added to the literature review section.

- The author remains grateful to the Reviewer for their positive feedback, and has addressed the following specific points, where the data is available, and explained the reasons for missing data. Minor grammatical adjustments, or parts rephrased for clarity have not been highlighted.

A more practical and thorough analysis is required for readers to understand the economics of running nodes and funding payment channels.

- Thank you for raising this important issue. As described above, the difficulty that the author has is how much depth to go into before losing less technical readers.

- During the writing of this article, significant portions of such information were removed, in order to prevent an economics reader becoming disinterested.

- A short section regarding channel management has been added to the text, along with a note referring the reader to "Limitations and Further Research" in Section 5. It is this author's understanding that optimizations are not yet universal, and depend heavily on channel partners, node liquidity and a number of other issues that need specific treatment in another manuscript.

More Empirical data is required to understand the irrational behavior of highly educated people running LN nodes with USD loss.

- The author agrees with the Reviewer's comment. This is a significant shortcoming of the paper, and while it was the original objective of the paper, it was not sufficiently addressed. Changes have been made to the Abstract to reflect the absence of a finding

and emphasize the other merits of the paper. The need for a qualitative follow up study has been added to the Limitations and Restrictions Section.

- When conducting the initial survey, it was discovered that the distributed nature of the LN is mirrored in the distributed social networks: for example, there are two (maybe more) groups on Telegram, another on Twitter, another on Matrix, and some overlap between them.

- In attempting to survey node operators, the phrase that most frequently comes to mind is "attempting to herd cats". Aside from issues with declared and revealed preferences, there is a strong need for anonymity with most users. A follow up qualitative study with interviews is planned, as some users are very willing to get involved, whereas others "lurk" and provide intermittent responses to polls and surveys, but rarely complete a full set of questions. The latter category complicate matters, as the number of discarded responses for incomplete data after cleaning neared 80%.

- This has been written into the paper (using a more formal description), and the author is willing to change the title of the manuscript if the Reviewer or Editor thinks that, given the content, it is too misleading.

The article could have provided a more in-depth and elaborate explanation of an LN node's actual setup and operation.

- Thank you for this suggestion, some information has been added, but mainly with respect to channel partner selection. Because channel partner selection is a real can of worms, the key influential factors have been highlighted and discussed.

The paper needs to provide an overview of the market for nodes in 2022 as per the details provided in the Literature review. However, the article does not cover this material.

- Thank you for this observation. Section 4 – Market Structure on page 8 has been expanded and revised to show the pattern of distribution. Current data was used, as the structure has not changed significantly in the interim, and this noted in the text. In particular, the need for node-type differentiation when using data driven research was highlighted.

In section 3, more clarity on outbound and inbound liquidity would have been preferable i.e., to operate your own Lightning Node, you need liquidity; to send Lightning payments, you need outbound liquidity and to receive Lightning payments, you need inbound liquidity.

- Thank you for raising this important issue. As with some of the other points raised, the author was unsure of what level of information to try and present in one paper before the content becomes unmanageable.

- A section has been added on sending and receiving payments (p7), and also, another short section on the process of differentiating personal nodes, routing nodes, and

hybrid personal/routing nodes.

Other minor edits
- Section 3 and Section 4 have the same headline, i.e., "Functions and Limitations"

- Resolved.

- In Section 4, Please fix the Error - "Error! Reference source not found."

- Resolved.

- In Conclusion, Figure 5 is missing as referred in "Routing through the node shown in Figure 5".

- Resolved.