Loki Cryptoeconomics

Alterations to the staking requirement and emission curve.

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July 16th 2018

Executive Summary

The current Loki emission curve does not suit a Sybil attack resistant Service Node network. We propose to alter it in order to naturally promote a reasonable percentage of the circulating supply being locked up in Service Nodes to retain the Sybil attack resistant properties of the network over the long term. We also discuss the staking requirement and propose a potential solution to this problem.

IMPORTANT NOTICE

This paper contains tables and charts which include examples of a price for the Loki cryptographic coin. Those prices are examples only and are not a prediction, forecast, or representation as to any actual likelihood of price movement of the Loki cryptographic coin. The payments shown in the examples below are general in nature and will only take effect if the planned hard fork occurs. Factors outside the control of Loki could impact what actual payments are made to service nodes, for example in the event of an attack on the Loki blockchain or there being bugs or errors in code.

Any references to the price of Loki in this paper are to the market price of the Loki cryptographic coin available on public cryptocurrency exchanges which choose to list the Loki token, noting that the Loki Foundation does not operate a cryptocurrency exchange.

Those parties not operating a service node should not rely on the examples when deciding whether or not to participate in the Loki project. This document should be read together with the Loki whitepaper published and other publications by Loki.

Acronyms

- LSR - Loki Staking Requirement, staking requirement expressed in units of Loki.
- $SR - Effective Dollar Staking Requirement, expressed in terms of fiat currency.
- $OE - Operating Expenses, Real dollar annual cost of running a server for a Service Node.
- LR - Lockup Ratio, proportion of 'staked' Loki in Service Nodes compared to circulating supply.
- LROI - Loki Return on Capital Input, return on Loki compared to Loki input.
- $ROI - Effective Dollar Return on Capital Input - LROI converted to fiat value, minus $OE.

1 Introduction

A paper was recently commissioned by the Loki team to assess the current viability of the Loki Project's cryptoeconomics. This paper[1], written by Dr Brendan Markey-Towler, an economist at the University of Queensland, laid out the complex optimisation problem of setting the staking requirement using strategic game theory. Using *Towler's* paper we have been able to create a model which allows us to assess the viability of various case studies.Through this modelling, we have formed the following views:

1. Setting an optimal staking requirement is largely dependant on the emission curve and the price of Loki.
2. The current emission curve presents some economic problems for all models.

In this report, we aim to demonstrate our vision of what a successful economic structure should look like for Loki. We discuss what is required to enable such economics, and make an assessment of the current scheme Loki uses. We then propose a new economic scheme based on our findings, with a new emission curve, reward split, and definition of the staking requirement.

2 Desirable Economic Properties of Loki

One of the most important features of the Loki network is its built-in market-based Sybil resistance. We define a successful Sybil attack as one where a single actor controls over 30% of the network's nodes. At this level of dominance, an actor could begin conducting effective network wide temporal analysis. Forcing nodes to have a stake in the network greatly increases the cost of performing this Sybil attack. *Towler* proved the effectiveness of this protection in his game theory model [1].

However, this protection is not guaranteed. Using game theory, we are able to model the behaviour of rational economic actors, and build a picture of what the net state of all Service Nodes at any given time should be, given a set of economic conditions. Using this, we can assess the potential difficulty and cost of executing a successful Sybil attack on the network under varying conditions.

In an economic scenario where only 5% of the circulating supply is locked up in Service Nodes, an attacker would only have to purchase 2.15% of the circulating supply in order to begin conducting effective temporal analysis on the network. Although this attack would be costly, the attacker would be unlikely to experience any compounding effect of the attack cost as a result of their attack.

True market based Sybil resistance only starts to materialise when a greater percentage of the circulating supply is locked up in Service Nodes. In a scenario where 90% of the circulating supply is locked, actors will struggle to purchase enough Loki to perform an effective temporal analysis. However, a 90% lockup is unlikely to occur as Loki aims to set its equilibrium Service Node lock up to 50% of the circulating supply. In this scenario, an attacker would have to purchase 21.5% of the circulating supply to begin performing serious network wide temporal analysis. However, purchasing 21.5% of the circulating supply to accomplish this will cause any available liquidity for Loki to rapidly decline, driving up the price of each additional Loki required to continue the attack. Thus, we see a compounding increase of the cost of such an attack.

Of course, this accumulation can happen over time; depending on the patience of the attacker. Assuming they stake the Loki as they accumulate it, this will dilute the rewards that all Service Nodes receive, including the attacker's. Towler's game theoretic model shows that this should start to cause other Service Nodes to drop off the network, but it will also come at an enormous opportunity cost to the attacker. They will suffer a negative ROI in dollar terms for all of their nodes as long as the node count remains above the natural equilibrium point derived from a positive $ROI [1].

The cost of this Sybil attack is based on the market price and liquidity of Loki over the course of the attack, but assuming even low estimates of Loki's price, this attack could easily run into the tens or hundreds of millions of dollars. If an attacker can sustain these costs, they would eventually achieve dominance over the Service Node network and hold at least 30% of the nodes on the network. Other actors would be forced out, depending on their $ROI tolerance, and the attacker could potentially start to return a net positive $ROI from this attack. What happens next would then depend on the intentions of the attacker.

If the attacker chooses to use their dominance to passively perform analysis on the network, the users of Loki may not notice that this is occurring until follow-on effects of that analysis arise, at which point the value of the network is likely to decline, further hurting the attacker financially.

If the attacker starts using their dominance to undermine the network entirely by manipulating swarm tests, they could initiate the complete collapse of the Service Node network. This would have a catastrophic effect on the value of the Loki blockchain as Service Nodes would leave the network and operators would cease staking their coins. While the network will have been destroyed, the attacker will own a very large amount of worthless cryptocurrency - a cost that they may not be able to recover.

Through this analysis we can see that the level of Sybil resistance is derived from the attack cost, which is not only affected by the price of Loki, but also by the fact that a higher lockup ratio of the circulating supply has a compounding effect on the cost. Thus, we can surmise that having an economic condition where a large percentage of the circulating supply becomes locked is desirable for the Loki Network's Sybil resistance to remain effective. Although the lockup selection is somewhat arbitrary, for the purposes of modeling we place this percentage target at 50%.

3 Required Conditions for High Lockup Ratio (LR)

A high lockup ratio (LR), according to our modelling, is achieved when the dollar term return on capital input ($ROI) attracts enough Service Nodes to operate despite other forms of investment.

The LR is taken to be the midpoint in an equilibrium, where the number of nodes joining the network drives the rate of return down to the lowest tolerable $ROI compared to other forms of investment, and conversely, nodes leaving the network increase the $ROI for the remaining nodes up to the lowest tolerable $ROI.

$ROI is calculated by a combination of the following: the dollar value of the Loki required to purchase the staking requirement (LSR); the expected return on that in terms of Loki (LROI) (as the block reward grants the operator Loki, not dollars); the real world operating cost of running the Service Node (Operating Expenses, $OE); and, the dollar value of the LROI. From these variables we can derive the actual $ROI. The exact mathematics are discussed extensively in Towler's Paper: "Cryptoeconomics of The Loki Network" [1].

The LROI is directly proportional to the number of Service Nodes operating on the network, and the emission curve (the defined Loki inflation rate) embedded into the software. With the emission curve being the one variable we can hard-code, we should ensure that it suits economic conditions we consider desirable.

The introduction of the $OE presents a new problem, however. Because the cost of operation can only be reflected in dollar terms, the dollar return rate of a Service Node directly affects the viability of operating a Service Node. The $SR must be set high enough so that the $OE are acceptable compared to the $ROI. That being said, it is also important for the scalability of the network that as many Service Nodes as possible are incentivised to operate within this model, which means we need to set the LSR at an amount that balances $ROI and the node count (#N). It is also worth mentioning that there is a hard cap on #N. If the circulating supply is 50,000,000 and the staking requirement is 50,000, only 1000 nodes can possibly operate. In reality, #N will be the circulating supply divided by the LR, which if we assume our target of 50%, would mean 500 nodes should operate in the right economic conditions.

In order to design economic conditions to target a high LR, the $ROI needs to be consistently attractive to raise the LR to our target of 50% or higher. Considering opportunity cost, rational actors will only deploy a Service Node if the $ROI exceeds that of alternative rates of return. Using the long running average of stock market performance, we assume that an 8% per annum $ROI would be near to the lowest tolerable $ROI for rational actors. Of course, this is difficult to define accurately, as the price of Loki may experience great volatility, making any long term assessment of this profitability near impossible without speculating or assuming price.

However, something we can redefine is the emission curve, which directly influences LROI through time. LROI will be proportional to the LR, but as the same amount of Loki will be rewarded each block regardless of the LR, it is one variable we can analyse closely.

In summary, we believe the emissions curve should function so that at a target LR of 50%, the rate of return does not fall below 8% $ROI for as long as possible.

4 Current Economics Scheme

This is the original economics scheme that was implemented during the inception of the Loki project. In this model, we defined:

- The reward ratio as 45% Service Nodes, 50% Miners, and 5% to Governance.
- The Staking requirement at 10,000 Loki which decreases over time.
- A speculative guess at the potential price of Loki through time (to help calculate $ROI).
- A steep emission curve based on an emission speed factor of 20.
- A conservative $OE was taken at $600 USD/year accounting for a high bandwidth/storage VPS.

In the below chart, presented as an example only, the most important data to note is the "$ROI/ANNUM" column. The percentage of $ROI is calculated as if at that exact moment in time, the LR is exactly 50%, with the operating costs factored in. The resulting figure is therefore not an actual representation of the true $ROI, but the pressure that exists on the LR in either direction. A positive ROI above 8% suggests that the LR is likely to be above the 50% target. Anything below that makes it increasingly likely that the LR will fall below 50%.

Year	Block Height	Block Reward	Circulating supply	#N at 50% LR	LSR	Assumed price of Loki	Effective Inflation	$ROI/ANNUM
0	0	122.74	22500000	1125	10000	$0.25	125.33%	
0.5	129600	108.52	37466873	2177.16	8604.53	$0.49	66.55%	53.74%
1	259200	95.95	50699946	3413.94	7425.44	$0.85	43.48%	34.91%
2	518400	75.01	72744817	6509.77	5587.36	$1.58	23.69%	17.37%
3	777600	58.64	89978053	10523.53	4275.09	$2.00	14.97%	8.27%
4	1036800	45.84	103449869	15494.82	3338.21	$2.00	10.18%	1.40%
5	1296000	35.83	113981251	21350.13	2669.33	$2.00	7.22%	-3.87%
6	1555200	28.01	122213996	27879.83	2191.8	$2.00	5.27%	-8.31%
7	1814400	21.9	128649817	34753.87	1850.87	$2.00	3.91%	-12.22%
8	2073600	17.12	133680920	41581.2	1607.47	$2.00	2.94%	-15.66%
9	2332800	13.38	137613907	47992.77	1433.69	$2.00	2.23%	-18.64%
10	2592000	10.46	140688458	53713.03	1309.63	$2.00	1.71%	-21.16%

In the example shown above, an emissions curve that reduces over time (as currently designed) results in each node receiving a diminishing reward through time. If inflation always decreases, so too will the LROI, and depending on the price, a lower $ROI, thus causing a diminishing LR through time.

At the most extreme end of this example, if we assume the price of Loki is $2, and with each Block Reward (BR) at year 10 equalling 10 Loki, and assuming the average cost to run a Service Node for the year is USD$600, each node will lose $554 USD per annum. As this is obviously an untenable position, the LR is likely to drop well below 50%, undermining the Sybil resistance of the network. This current model gives the Loki Network less than 4 years of market based Sybil resistance.

5 Proposed Solutions

A tempting solution to this problem is to change the emission curve to continue to generate high block rewards through time. However, this would increase inflation and could undermine the $ROI of Service Nodes. Many 'Masternode' type coins have failed because of unsustainable inflation rates. Most worryingly, this sort of perpetual hyperinflation could result in a positive feedback loop that would force the Loki Foundation to manually increase the LSR to account for constant reductions in the price of Loki, consequently dropping the #N to levels which would degrade the privacy of Lokinet. Therefore, reducing the emission curve as soon as possible will allow rewards to be more evenly distributed through time, extending the lifetime of this economic model without drastically affecting the circulating supply over a 10 year period.

Once the emission curve has been refined, we must develop the LSR to avoid reaching the minimum $ROI threshold at a high LR. We must design the LSR to be high enough at any point in time to mitigate the effect the $OE has on the overall $ROI, but also small enough that the #N is as high as possible. Because the LSR is not expressed in dollar terms and the $OE is, we must account for a margin of variability in the Loki price when setting the LSR.

So, with these two parameters in mind, we present a range of possible options and the resulting economic conditions. In each of these models, we defined:

- The reward ratio as 50% Service Nodes, 45% Miners, and 5% to Governance, giving a slight increase in rewards to Service Nodes to help address this problem.
- The LSR is derived from the block height, h, starts at 45,000 Loki when service nodes go live, decreases over time to 10000 Loki at year 4, then increases over the next 10 years at 500 Loki per year until it reaches 15000 Loki (See LSR Section).

$$LSR = \max\left(\left(10000 + \frac{35000}{2^{\left(\frac{h-129600}{129600}\right)}}\right), \left(\min\left(\left(\frac{5}{2592}h + 8000\right), 15000\right)\right)\right)$$

- An assumption of the price of Loki over time (which is not a forecast or representation of the Loki price but is used to calculate a hypothetical $ROI for Service Node operators).
- A steep, immediate drop-off in emission which reaches for a specific asymptote.
- A conservative $OE was also defined as $600 USD/year.

5.1 Option 1

$$Reward = 50 + \left(\frac{55}{2^{\left(\frac{h}{1555200}\right)}}\right)$$

Year	Block Reward	#N at 50% LR	Price of Loki	LSR	Proposed Inflation	$%ROI/ANNUM
0	122.74		$0.25		124.37%	
0.5	101.91	416.3	$0.49	45000	68.51%	66.55%
1	99	917.89	$0.85	27500	49.43%	47.10%
2	93.65	2623.95	$1.58	14375	31.34%	28.84%
3	88.89	4465.78	$2.00	11093.75	22.69%	20.08%
4	84.65	5916.45	$2.00	10273.44	17.64%	14.79%
5	80.87	6809.81	$2.00	10500	14.35%	11.54%
6	77.5	7432.82	$2.00	11000	12.04%	9.35%
7	74.5	7965.81	$2.00	11500	10.35%	7.77%
8	71.83	8423.79	$2.00	12000	7.07%	4.62%
9	67.13	8658.46	$2.00	12500	7.91%	5.53%
10	65.05	8984.09	$2.00	13000	7.11%	4.82%
11	63.22	9266.85	$2.00	13500	6.46%	4.26%
12	61.61	9513.53	$2.00	14000	5.93%	3.79%
13	60.2	9729.72	$2.00	14500	5.47%	3.41%
14	58.96	9920.07	$2.00	15000	5.09%	3.09%

Option 1 presents a $ROI above the threshold for the longest time of the three options, if all other assumptions are maintained. However, the inflation present in this model is high. As discussed, inflation may 'solve' the LROI problem, but it could have consequences for the rewards which Service Nodes receive measured in fiat currency, and thus reduce $ROI, driving the LR down.

5.2 Option 2

$$Reward = 28 + \left(\frac{100}{2^{\left(\frac{h}{64800}\right)}} \right)$$

Year	Block Reward	#N at 50% LR	Price of Loki	LSR	Proposed Inflation	$%ROI/ANNUM
0	122.74		$0.25		90.44%	
0.5	53	416.3	$0.49	45000	25.22%	28.49%
1	34.25	779.06	$0.85	27500	18.22%	16.38%
2	28.39	1761.88	$1.58	14375	14.40%	10.31%
3	28.02	2611.64	$2.00	11093.75	12.53%	7.28%
4	28	3173.5	$2.00	10273.44	11.13%	5.53%
5	28	3450.63	$2.00	10500	10.02%	4.60%
6	28	3623.68	$2.00	11000	9.10%	4.00%
7	28	3781.67	$2.00	11500	8.34%	3.52%
8	28	3926.5	$2.00	12000	7.70%	3.13%
9	28	4059.75	$2.00	12500	7.15%	2.82%
10	28	4182.74	$2.00	13000	6.67%	2.56%
11	28	4296.62	$2.00	13500	6.26%	2.34%
12	28	4402.37	$2.00	14000	5.89%	2.15%
13	28	4500.83	$2.00	14500	5.56%	2.00%
14	28	4592.72	$2.00	15000	5.27%	1.87%

Option 2 incorporates a dramatic cut or 'halvening' of the block reward to stem inflation, and then implements a softer curve down to an asymptote of 28 Loki per block reward. At the 10 year mark, the circulating supply is at 110 million Loki, as opposed the original scheme which produces 140 million Loki after 10 years. The $ROI decreases far less dramatically, and while still only 3 years of $ROI above the threshold of 8% is expected, the following years offer a $%ROI greater than 2%.

5.3 Option 3

$$Reward = 14 + \left(\frac{2^7}{2^{\left(\frac{h}{64800}\right)}} \right)$$

Year	Block Reward	#N at 50% LR	Price of Loki	LSR	Proposed Inflation	$%ROI/ANNUM
0	122.74		$0.25		84.56%	
0.5	46	416.3	$0.49	45000	17.17%	19.84%
1	22	755	$0.85	27500	10.43%	8.31%
2	14.5	1594.95	$1.58	14375	8.01%	5.39%
3	14.03	2232.23	$2.00	11093.75	7.33%	4.63%
4	14	2587.21	$2.00	10273.44	6.83%	3.91%
5	14	2704.19	$2.00	10500	6.39%	3.53%
6	14	2746.22	$2.00	11000	6.01%	3.28%
7	14	2784.59	$2.00	11500	5.67%	3.06%
8	14	2819.77	$2.00	12000	5.36%	2.86%
9	14	2852.13	$2.00	12500	5.09%	2.69%
10	14	2882	$2.00	13000	4.84%	2.54%
11	14	2909.66	$2.00	13500	4.62%	2.40%
12	14	2935.35	$2.00	14000	4.42%	2.27%
13	14	2959.26	$2.00	14500	4.23%	2.16%
14	14	2981.58	$2.00	15000	4.06%	2.06%

Option 3 follows a similar path, with even more restricted inflation, resulting in a static block reward of 14 after 4 years. While this does help spread the inflation out over a much greater period of time, it only guarantees 2 years of $ROI above the threshold, and would likely lead to an equilibrium of around 30% LR forming, which is potentially not strong enough to maintain a high level Sybil resistance.

5.4 Discussion of Options

These three options illustrate a range of possible solutions, with Option 1 representing the least difference from the current scheme, and Option 3 the furthest. The analysis we have performed here demonstrates that some midpoint between the two is most likely the best option. In light of this, we propose Option 2 as the most suitable solution.

It should also be noted that this emission model will not remain viable forever. This rewards scheme should remain partially effective in maintaining a higher LR for over a decade. Beyond that, one could increase the emission, but extended periods of high inflation will only lead to a continual devaluation and therefore a stagnant or declining #N. A medium term solution would be to eventually convert Loki to 100% proof-of-stake, where Service Nodes deterministically create blocks and risk losing their capital upon the creation of invalid blocks. In the long term, the only way we can foresee a high LR maintained is to work towards creating an internal economy within Loki, so that Service Nodes receive income from sources other than just the block reward - transaction fees accrued in proof-of-stake, for example.

Our assessment has also led us to believe it is in the best interests of the long term viability of this project to implement this change to the emission curve as soon as possible, ahead of the Service Node launch. Doing so will defer the emission of Loki into the lifetime of the Service Nodes, giving extended runway to the viability of this economic model.

6 Setting a Staking Requirement (LSR)

In our model, we assessed the viability of a staking requirement set at 45,000, non-linearly reducing to 10,000, and linearly increasing to 15,000 Loki. This was based on an approximation of our target #N whilst remaining considerate of the $ROI provided to each node.

As we have discussed, the optimal LSR needs to balance providing high $ROI (higher LSR) and a high #N (maximised by a low LSR).

The game theory that we analysed on this problem makes it clear that the optimal staking requirement is largely dependent on the price of Loki. The best possible way to limit the network to price exposure is to make the staking requirement directly correlate to Loki's price performance, as *Towler* suggests in his paper [1]. However, we believe that this exposes the network to new risks, that in our opinion outweigh the benefit of adding this functionality to the design. Namely, this would:

- Require the addition of a price oracle, which is difficult to implement while maintaining decentralisation.
- Be vulnerable to potential price manipulations that can be used to game this system in unforeseen ways.
- Overvalue the LR in favour of #N during periods of severe price declines.

Thus, we must make as best an approximation of a reasonable LSR as possible. In consideration of this, Loki becomes particularly vulnerable if the LSR is set too low and the dollar value of Loki fails to increase. In this scenario, the $OE of each node will quickly drive the $ROI down, causing nodes to drop off the network. The drop-off of nodes could cause a precipitating price crash that exacerbates this problem.

Based on our modelling, we propose to set the LSR at the initial Service Node launch to 45,000. At this rate, with the Option 2 emission curve in place, the circulating supply will be ˜37,400,000 when Service Nodes are live (this includes locked coins from the premine). This will allow for a #N of 830 at a LR of 100%. However, this is very unlikely to happen, so we can more reasonably predict that the LR will be closer to a 60% target due to the very high initial LROI and $ROI. At a LR of 60%, we should expect to see a #N of 490.

This #N is of course very low. The Tor network, for example, runs at least 2000 'high' performance nodes on its network (out of a rough total of 6500, although the performance quickly drops off in the latter two thirds of nodes). Such a #N is required of the Loki network to match and exceed this performance without increasing minimum standards of node performance and therefore $OE. However, this initial LSR is required to account for the $OE, given the price of Loki. We could lower the LSR to maximise #N, but doing so exposes the network's LR to price stagnation. If the price does not rise as it does in our model, a higher LSR provides the LR with a greater tolerance to the $OE.

We can address the low #N by lowering the LSR over time. We propose that the initial implementation of the LSR should progressively decrease to 10,000 Loki by year four of the

Loki network's operation, and then slowly increase the LSR towards 15,000 by year fourteen, after which it will remain fixed. This will improve the long term price risk tolerance, without negatively impacting positive #N growth over time.

Year	BR	Circulating supply	#N at 50% LR	LSR	$ROI/ANNUM
0	122.74	22500000			
0.5	53	37466873.21	416.3	45000	28.49%
1	34.25	42848557.06	779.06	27500	16.38%
2	28.39	50653933.27	1761.88	14375	10.31%
3	28.02	57945769.28	2611.64	11093.75	7.28%
4	28	65205509.03	3173.5	10273.44	5.53%
5	28	72463242.76	3450.63	10500	4.60%
6	28	79720851.12	3623.68	11000	4.00%
7	28	86978451.64	3781.67	11500	3.52%
8	28	94236051.68	3926.5	12000	3.13%
9	28	101493651.7	4059.75	12500	2.82%
10	28	108751251.7	4182.74	13000	2.56%
11	28	116008851.7	4296.62	13500	2.34%
12	28	123266451.7	4402.37	14000	2.15%
13	28	135191685.3	4661.78	14500	2.00%
14	28	142449285.3	4748.31	15000	1.87%

We believe that after many attempts to model a potential staking requirement, this approach presents a reasonably low risk tolerance towards price volatility, whilst still accommodating a gradual increase in #N. The #N is sufficiently high after a few months, due to the circulating supply increasing and the staking requirement decreasing, without impacting LR to run a sufficiently large network for a brand new mixnet. As adoption picks up, so too does the #N over the course of time in this model.

Although there are many members of the community that have been quite vocal about their desire to keep the $SR low, our assessment leads us to believe that this is the lowest it should be within our desired risk tolerance.

Furthermore, we propose that the Loki community should be open to annually reviewing this staking requirement. If the price performance is proven to be consistently much lower or higher than our model has predicted, it may make sense to alter the staking requirement. Such changes can be conducted through gradual soft forks if required.

6.1 Proposal Summary

We propose to initiate a hardfork at block height 64324, approximately the 30th of July, 2018. This hardfork will only change one parameter in the current Loki implementation, which is the emission curve.

After block height 64324, the Loki block reward will go from being calculated in terms of the circulating supply with an emission speed factor of 20, to be derived from the block height. Defining the base block reward based on height will mean that the typical block size penalty will simply under-emit if miners attempt to create abnormally large blocks. However, this should not negatively impact Service Nodes as we intend to apply this penalty on the miner's reward output only.

The formula used to calculate the block reward ($Reward$) where h is the block height:

$$Reward = 28 + \left(\frac{100}{2^{\left(\frac{h}{64800} \right)}} \right)$$

The remaining changes concern Service Nodes, which are due to come at a seperate hardfork event. During this event, we propose that the network should assign 50% of the block reward to Service Nodes, 45% to miners, and 5% to the two governance initiatives.

And finally, the staking requirement should begin at 45,000 during Service Node launch, descend non-linearly to 10,000 by year 4 (block height 1036800), and increase linearly to 15,000 by year 14 (block height 3628800), according to the equation:

$$LSR = \max\left(\left(10000 + \frac{35000}{2^{\left(\frac{h - 129600}{129600} \right)}} \right), \left(\min\left(\left(\frac{5}{2592} h + 8000 \right), 15000 \right) \right) \right)$$

We believe that these changes will amount to a more sustainable, more resistant, and greater capacity network over the next decade, and propose to implement them as soon as is practical.

References

[1] Brendan Markey-Towler, *Cryptoeconomics of the Loki network* (2018), https://loki.network/wp-content/uploads/2018/07/CryptoeconomicsOfTheLokiNetworkV1.pdf.